



This work is licensed under the Creative Commons Attribution-Noncommercial-Share Alike 3.0 United States License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc-sa/3.0/us/> or send a letter to Creative Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA.

THE PREDACEOUS WATER BEETLES (COLEOPTERA: DYTISCIDAE) OF  
ALBERTA: SYSTEMATICS, NATURAL HISTORY AND DISTRIBUTION

DAVID J. LARSON\*  
Department of Biology  
University of Calgary  
Calgary, Alberta

*Quaestiones Entomologicae*  
11: 245 - 498 1975

*One hundred and forty five species belonging to 17 genera of the family Dytiscidae are recorded from Alberta. Adults of each species are described and keys for identification are presented. Six species are described as new: Hydroporus criniticoxis, Hydroporus carri, Hydroporus hockingi, Hydroporus rubyi, Agabus margareti and Acilius athabasca. The species Hygrotytus picatus (Kirby) is recognized as valid, and the name Dytiscus alaskanus J. Balfour-Browne is revalidated. The following new synonymy is proposed: Hydroporus coloradensis Fall = H. griseostriatus (DeGeer); Hydroporus hortense Hatch = H. laevis Kirby; Hydroporus productotruncatus Hatch = H. alaskanus Fall; Rhantus aequalis Hatch = R. binotatus (Harris); Dytiscus ooligbukii Kirby = D. circumcinctus Ahrens; and Dytiscus vexatus Sharp = D. dauricus Gebler.*

*For each species, the following information is presented: synonymy, selected literature references, description, taxonomic notes, natural history notes, and distribution, which includes a brief outline of the species range and a map showing Alberta collection localities. Illustrations of taxonomically important characters are presented.*

*The post-glacial distribution of the Alberta species is discussed and related to post-glacial vegetational movements and climatic change. The sources of most elements of the Alberta dytiscid fauna cannot be determined definitely but it is shown that the fauna is of diverse origin. A Prairie, Boreal and Cordilleran fauna comprise the Alberta fauna. Each component is of complex origin and is defined on the basis of similarities in range ends of its constituent species rather than actual associations of species forming discrete faunal units. The areas of the province with richest faunas are those of a transitional nature.*

*Les coléoptères dytiscides en Alberta comprennent cent-quarante-cinq espèces distribuées en 17 genres. Chaque espèce est décrite et nous présentons une clef pour leur identification. Nous avons décrit six espèces nouvelles: Hydroporus criniticoxis, Hydroporus carri, Hydroporus hockingi, Hydroporus rubyi, Agabus margareti et Acilius athabasca. L'espèce Hygrotytus picatus (Kirby) est valide, et le nom Dytiscus alaskanus J. Balfour-Brown est de nouveau valide. Nous avons proposé la nouvelle synonymie suivante: Hydroporus coloradensis Fall = H. griseostriatus (DeGeer); Hydroporus hortense Hatch = H. laevis Kirby; Hydroporus productopunctatus Hatch = H. alaskanus Fall; Rhantus aequalis Hatch = R. binotatus (Harris); Dytiscus ooligbukii Kirby = D. circumcinctus Ahrens; et Dytiscus vexatus Sharp = D. dauricus Gebler.*

*Nous avons l'information suivante pour chaque espèce: la synonymie, les références choisies, la description, les notes taxonomiques, les notes sur l'histoire naturelle et la distribution qui inclue en court sommaire de la distribution de l'espèce et une carte montrant les localités de collection en Alberta. Nous avons illustré les caractères taxonomiques importants.*

*Nous avons discuté la distribution post-glacière des espèces albertaines en relation aux mouvements post-glacière de la végétation et du changement climatique. L'origine de la plupart des dytiscides albertains ne peut pas être déterminée définitivement, mais nous avons démontré leur origine diverse. La faune se compose d'éléments des prairies, des régions boréales et des rocheuses. Chaque groupe est d'origine complexe et nous les avons définis en fonction de similarités dans la terminaison de la distribution de leurs espèces constituantes plutôt que par*

\* Present address: Saskatchewan Fisheries Laboratory, 30 Campus Drive, Saskatoon, Sask. S7N 0X1.

*l'actuelle association des espèces formants des unités faunales discrètes. Les régions de la province les plus riches se rencontrent dans les régions de transition.*

#### TABLE OF CONTENTS

Introduction	246
Study Area	246
A Brief History of Systematic Study of North American Dytiscidae	247
Material	248
Methods	249
Systematics	254
Key to Adults of Genera of Alberta Dytiscidae	257
Subfamily Laccophilinae	258
Subfamily Hydroporinae	261
Subfamily Colymbetinae	327
Subfamily Dytiscinae	394

#### INTRODUCTION

This survey of the dytiscid beetle fauna of the province of Alberta deals with systematics, distribution and very briefly, habitat preferences of the species.

In spite of statements in the literature such as Arnett's (1963) that "As a group, the species (of the family Dytiscidae) are well known", many taxonomic problems require study. The higher taxa in the family are well defined, but within the larger genera such as *Hydroporus* and *Agabus*, the arrangement of species in supraspecific categories is unsettled. Many genera and species groups require revision. Certain species are well known and well defined. However, many instances of inter- and intrapopulation variation, sexual di- or polymorphisms, and occurrence of groups of morphologically very similar species, have been observed. I point out such areas of taxonomic complexity.

The Alberta distribution of each species is described as fully as possible. Certain areas of the province have been collected extensively. However, large and zoogeographically important areas such as much of the northern portion of the province, the parkland belt of east-central Alberta, and the northern Rocky Mountains in and adjacent to Jasper National Park, have been collected only superficially. Extensive collecting in these areas may lead to the discovery of new provincial records, and will at least modify certain of the distribution patterns outlined in this study. Attempts have been made to explain the post-glacial distribution of the present fauna by consideration of present-day distribution patterns.

Natural history data consist of brief descriptions of the habitat in which adult specimens of each species are most frequently found. The time of year at which teneral adults are found is listed for each species, as this gives some idea of the seasonal timing of the life history. Immature stages have not been considered in this study. Much work remains to be done in terms of relating larvae to adults, description of life histories, and detailed ecological studies of species. In addition to their inherent biological interest, studies of these insects could appraise their role as predators on economically important insects such as mosquitos, and as indicators of environmental conditions.

#### THE STUDY AREA

The limits of the study area are the political boundaries of Alberta. This large area includes

a varied range of geological, climatic and vegetational zones. Physical and biotic features of the province are described in Hardy (1967) and R. D. Bird (1961), Moss (1947, 1953, 1955) and Rowe (1959) describe major vegetational features.

Probably, no species of dytiscid beetle is restricted to Alberta. Most species occurring in Alberta range extensively in central, western or northern Canada. By including all species known from neighbouring Canadian areas in at least the keys, it is hoped that this work will be useful for identification of dytiscids of southeastern British Columbia, the Prairie Provinces and the southern reaches of the Northwest Territories.

#### A BRIEF HISTORY OF SYSTEMATIC STUDY OF NORTH AMERICAN DYTISCIDAE

The early history of taxonomic work on the North American dytiscid fauna closely parallels that on the North American carabid fauna as outlined by Lindroth (1969). Many temperate and arctic species of Dytiscidae are Holarctic and hence a number were described by early European workers. North American populations of many of these Holarctic species were described as separate species and even to this date, the relationships between certain morphologically similar forms in the Palaearctic and Nearctic regions have not been determined.

W. Kirby (1837) and C. Aubé (1838) were the first Europeans to describe large numbers of North American species. Kirby's types of North American Dytiscidae, housed in the British Museum of Natural History, London, were examined in the course of this study. Most of Aubé's types, located in the Royal Museum of Natural Sciences, Brussels, Belgium, were not revised by North American workers. T. Say, in papers between 1823 and 1834, was the first North American to describe many water beetles. Say's types are considered to be lost, but recent authors have generally accepted interpretations as indicated by specimens in the LeConte collection in the Museum of Comparative Zoology, Harvard University. T. W. Harris (1828, 1829) described several species of Dytiscidae from the eastern United States. Harris' types are also located in the Museum of Comparative Zoology.

During the mid 1800's, J. L. LeConte, in a series of papers (1845 - 1878), described a very large number of dytiscid beetle species, presented catalogue listings, and revised several of the larger genera. G. R. Crotch (1873) revised the North American members of the family and described a number of new species, but the descriptions are generally too brief to allow reliable identifications.

The most ambitious work in the history of dytiscid classification is D. Sharp's (1882) world revision of the family. He provided a detailed classification of the family, definition of supra-specific groups, and description of numerous new species from all parts of the world, including North America. His work was unfortunately hampered by a dearth of material from North America, but Sharp's classification is still largely accepted. I examined a few of his types in the British Museum of Natural History.

G. H. Horn (1871, 1883) described a few species of Dytiscidae, but generally his work was very conservative. He proposed considerable new synonymy, but some of these synonyms have been subsequently revalidated.

H. Wickham (1895a, b, c) published mainly literature compilations on the Dytiscidae of Canada and covered only a small proportion of the eastern Canadian species.

Since 1900, most research on Nearctic dytiscids has been carried out by North American workers. Nevertheless, several Europeans including A. Zimmermann (1919-1935), F. Guignot (1931-1946), F. Balfour-Browne (1934-1950), J. Balfour-Browne (1943-1948) and F. Zaitsev (1953) made contributions in the areas of nomenclature and classification as well as providing much information on natural history and distribution patterns of many elements of the Holarctic fauna.



H. C. Fall revised the following genera: *Coelambus* (= *Hygrotus*) (1919); *Agabus* (1922); *Hydroporus* and *Agaporus* (= *Laccornis*) (1923); and *Ilybius* (1927b). Fall recognized 221 species in the above genera. New species have been described subsequently in each of these genera but with the exceptions of Wallis' revision of *Ilybius* (1939c) and Leech's revision of *Laccornis* (1940), these genera have not been reworked. Fall's revisions of *Hygrotus*, *Agabus* and *Hydroporus* remain the basic works for each of these genera.

Since 1900, many new species of Dytiscidae were described by a number of authors including Blatchley (Blatchley's types were revised by Young, 1953d); W. J. Brown; F. S. Carr; H. C. Fall; M. H. Hatch; H. B. Leech; J. B. Wallis; and F. N. Young. The most important revisions or reviews of genera are: *Laccophilus* (J. Zimmerman, 1970); *Desmopachria* (Young, 1951); *Bidessini* (Hatch, 1928; Young, 1967, 1969); *Hygrotus* (Anderson, 1971); *Hydroporus* (Hatch, 1933a; R. Gordon, in prep.); *Laccornis* (Leech, 1940); *Matus* (Young, 1953c); *Hydrovatus* (Young, 1956, 1963b); *Copelatus* (Young, 1963a); *Agabus* (Leech, 1942b, and other papers); *Ilybius* (Wallis, 1939c); *Rhantus* (Hatch, 1928; Zimmerman and Smith, in press); *Colymbetes* (Hatch, 1928); *Dytiscus* (Roberts, 1905; Hatch, 1928); *Graphoderus* (Hatch, 1928; Wallis, 1939b); *Hydaticus* (Wallis, 1939a); and *Acilius* (Young, 1954).

Faunal works cover the following areas of North America: Florida (Leng and Mutchler, 1918; Young, 1954); Maine (Malcolm, 1971); Indiana (Blatchley, 1910); North Dakota (Gordon and Post, 1965); Manitoba (Wallis, 1973); Baja California (Leech, 1948b); California (Leech and Chandler, 1956); Nevada (LaRivers, 1951); Utah (Anderson, 1962); and the Pacific Northwest (Hatch, 1953).

H. Bertrand and K. Galewski described the immature stages of many European species of Dytiscidae. Chief among the few studies of Nearctic immature dytiscids are those of Needham and Williamson (1907), Wilson (1923), Chandler (in Leech and Chandler, 1956), James (1970) and Watts (1970).

The only previous faunal work on Alberta Dytiscidae is in F. S. Carr's (1920) list of Coleoptera of Northern Alberta. Although the results of their work were not published, a number of people have made valuable contributions in the exploration of the water beetle fauna of the province. Based upon records that I have seen, the most important of these collectors are as follows: F. S. Carr, collected a very large number of water beetles between 1914 and 1932 in the Edmonton and Medicine Hat areas, as well as southwestern Alberta and Banff; O. Bryant, collected in various areas of southern and central Alberta between 1925 and 1928; S. H. Pepper collected in the Lethbridge and Waterton areas in 1929 and 1930; W. J. Brown made two collecting trips to Alberta – McMurray (1953) and Banff (1955); A. R. Brooks collected many specimens on trips into Alberta – Cypress Hills (1952) and Central Alberta (1957, 1961); Mr. and Mrs. J. L. Carr, from 1953 to the present, have taken specimens of almost all species of Dytiscidae known from the province.

## MATERIAL

Material for this study consisted of more than 27,000 adult specimens of dytiscid beetles collected primarily from Alberta, mostly during the summers of 1970, 1971 and 1972. Additional specimens were obtained on loan from the private collection of Mr. and Mrs. J. L. Carr, Calgary, Alberta; the Canadian National Collection, Ottawa; and the Strickland Museum, Department of Entomology, University of Alberta, Edmonton.

Localities from which I examined specimens of each species are indicated on maps (Figures 326-469). However, except for a few infrequently collected species and the new species described in this work, a detailed list of collecting localities is not presented. Copies of a complete list of localities are in the Department of Biology, University of Calgary, and the Department of

Entomology, University of Alberta. Reference to a locality from which a specimen was collected is followed by the name of the collector (if known) and/or the museum in which the specimen is housed. If no collector or collection is indicated, the specimen was collected by Donald N. Larson, Margaret A. Larson or myself. Specimens collected by B. J. and J. L. Carr and housed in their collections are indicated by CARR. The names of all other collectors are written in full, followed by an abbreviation for the museum in which the specimens currently reside. Abbreviations for museums are:

BMNH	British Museum of Natural History, London
CARR	Collection of Mr. and Mrs. J. L. Carr, Calgary, Alberta
CAS	California Academy of Sciences, San Francisco, California
CNC	Canadian National Collection, Ottawa, Ontario
MCZ	Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts
UASM	Strickland Museum, Department of Entomology, University of Alberta, Edmonton, Alberta
UC	Department of Biology, University of Calgary, Calgary, Alberta
USNM	United States National Museum of Natural History, Washington, D. C.

Small representative collections of Alberta Dytiscidae are retained by the Department of Biology, University of Calgary and by myself. Also, representative collections were deposited in CAS and with J. Zimmerman, New Mexico State University. Representative collections of *Hygrotus* and *Hydroporus sensu stricto* were sent to R. Anderson (Southern Utah State College, Cedar City, Utah) and to R. Gordon (USNM), respectively. The remainder of the material collected during the study is in the CNC and UASM, with the majority of specimens in the latter collection. Holotypes and allotypes are in the CNC. The disposition of paratypes is listed under the description of each new species.

## METHODS

### Collection and preservation of specimens

A common method to collect water beetles is to wait by the side of a body of water, and to capture beetles swimming by with a sieve or light weight net. A modification is to sweep the net through aquatic vegetation and capture insects resting there. Both methods on occasion yield good results, but for the most part only larger strong swimming species are taken in this way.

In almost every body of water, most dytiscids are in the zone of emergent vegetation, but in melt water ponds or recently flooded areas, the beetles are in dense flooded mats of terrestrial vegetation near the shore line. When cover is extremely dense, beetles are difficult to collect, and one must use a very stout net and considerable effort.

The best collecting procedure is to select an area of dense vegetation or detritus, and attack it by sweeping vigorously through a restricted area and treading in the area to roil up the bottom and vegetation. A given area should be swept and churned a number of times before moving on, as some specimens, especially those of the larger strong swimming species, often take refuge in dense mats of detritus or on the bottom where they are difficult to capture in a net. Discretion should be used in collecting, for this technique damages vegetation and if carried out extensively severely modifies a small body of water. Collecting should not be restricted to definite ponds or streams, for small bodies of water no more than a few square feet in extent and several inches deep, often possess characteristic faunas, especially when fed by small springs or seepage areas or located in a moss carpet. *Sphagnum* mats possess an interesting and poorly known fauna. These are best collected by sweeping a net through small *Carex*-filled pools or by treading the moss down so that water appears and then sweeping this shallow layer of water.

Flowing water contains many characteristic species. Beetles are found by turning over rocks and logs just at or below water line, by sweeping emergent or trailing vegetation along the banks, or by swirling a net over the bottom in pools and eddies, to disturb sediments and beetles resting on them, and to raise the beetles into open water where they can be captured by the net. In streams with coarse gravel or large rocks, beetles are observed swimming over rocks and clinging to them. They are captured by picking them off the rocks by hand or with a small household strainer or dip net.

Beetles inhabiting shallow gravel shore lines of mountain lakes and clay-bottomed saline prairie lakes are collected by disturbing the bottom with a net or foot and then sweeping the net through the disturbed area to capture any specimens dislodged from the bottom.

Specimens of certain species, especially those of *Colymbetes* and *Dytiscus*, are collected readily during their dispersal periods. In late summer and early fall, these insects come to light in numbers, especially in rural areas. At this time, there are often large flights of beetles leaving ponds just at sunset, and under certain conditions the beetles can be collected as they pull themselves out of the water in preparation for flight, or with an aerial net just after they have taken flight. Many species showing spring dispersal are diurnal. These can be captured in flight or they may often be found landing on shiny dark surfaces such as cars.

Larvae are usually in the same situations as the adults, but may be found in more open areas, particularly the larvae of the larger active forms such as *Dytiscus* or the almost pelagic larvae of *Graphoderus* and *Acilius*.

Adults and larvae are captured in traps which are basically modifications of the funnel design of minnow traps (James and Redner, 1965; F. Goulet, pers. comm. 1971). If specimens are to remain alive in a trap, an air space or access to the water's surface must be provided to allow the insects to respire.

The beetles are preserved most easily by placing them directly into 90-95% alcohol. After the collection is completed, the alcohol is renewed and again, after a day, it is replaced with 70% alcohol if extended storage is required. Because of the rigid structure of the body, the beetles undergo little or no distortion in alcohol. However, prolonged storage makes them brittle and makes extraction of the genitalia difficult. Specimens of certain species change color with preservation. Pale individuals tend to bleach with prolonged storage in alcohol and certain specimens of *Laccophilus*, greenish in life, fade to testaceous or yellow. Permanent storage is best effected by pinning the specimen, or if it is smaller than 7 or 8 mm in length, by glueing it onto a paper point on a pin. Specimens are best studied dry to observe fine microsculpture and punctuation. Prior to pinning, specimens should be washed thoroughly in soapy water to remove particles of dirt and grease.

### Illustrations

Line drawings, prepared with the aid of a camera lucida, illustrate taxonomic characters and augment descriptions. Illustrations of homologous structures in related species are to the same scale and from the same aspect.

Scanning electron micropictographs are presented to clarify descriptions of microsculpture. These illustrations are clearer and at a higher magnification than structures seen through an ordinary binocular microscope. For this reason they do not agree precisely with the descriptions in the text which are based on visual examination of specimens. For example, in the genus *Agabus*, some forms of elytral sculpture are described as isodiametric and rounded. Examination of the appropriate illustration shows that mesh size and shape vary slightly.

### Measurements

Measurements were taken routinely from a sample of specimens for each included species.

If sufficient specimens were available, at least 20 from the same population sample were measured, but lacking sufficient material from one locality, specimens from several localities within as limited a geographical area as possible, were pooled. For species exhibiting geographical variation in mensural characters, data were obtained for two or more population samples, in order to describe pattern and magnitude of variation. Measurements and their abbreviations are:

Total length (TL) – a single measurement from the anterior margin of the clypeus to the apex of the elytron.

Maximum width (MW) – width of body at its widest point.

Width of metasternum (WS) – minimum width of sternum between marginal rim of mesocoxa and anterior border of metacoxal plate (Fig. 133).

Width of metacoxa (WC) – width of metacoxa along the extension of the same line along which measurement WS is taken (Fig. 133).

The ratio TL/MW is given for all species as this is a good index of shape of the insect. Values for WC/WS are given for species in genera in which this ratio provides a useful taxonomic character. For each measurement or ratio, range, mean and standard deviation are presented.

Most measurements were made with a micrometer 10X eye piece in a Wild M5 stereomicroscope. At 50 magnifications, one division on the micrometer scale equalled 0.02 mm. Measurements of specimens of *Dytiscus*, too large to measure conveniently under a microscope, were made with a pair of calipers on which one division equalled 0.05 mm.

#### Cluster analysis

A cluster analysis was used to compare the faunas of various areas of the province in order to define the major patterns of faunal distribution. The analysis was performed on a CDC 6400 computer using the University of Calgary Computer Services library program UCCS-72-CLUSTAN-1, a modification of D. Wishart's CLUSTAN-1 program (Wishart, 1968).

The basic procedures of cluster analysis were well explained by Sokal and Sneath (1963), Cairns and Kaesler (1969), Cairns et al. (1970), and Roback et al. (1969).

The method of analysis was as follows. The province was divided into twenty zones (Fig. 3) and a list of dytiscid species found in each zone was compiled. The faunal composition of each zone was compared with that of every other zone by means of a Jaccard Coefficient of similarity which is:

$$S_j = \frac{a}{a + b + c}$$

where a, b and c are standard notation for binary data in a 2 by 2 contingency table (Simpson, Roe and Lewontin, 1960; Cairns et al., 1970), indicating the presence or absence of species in a given zone. The Jaccard coefficient was used because it omits negative matches from the calculation of the coefficient of similarity, hence mutual absence of a species from two zones being compared does not contribute to their level of similarity. Calculation of the Jaccard coefficient of similarity between all pairs of zones produced a matrix of similarity indices. These data were ordered into a hierarchy based on similarities by means of a group average method of cluster analysis (Wishart, 1968). Results are presented in the form of a dendrogram.

#### Criteria for recognition of species-group and genus-group taxa

Whitehead (1972) gives a lucid account of his criteria for the recognition of species-group and genus-group taxa. For the most part, I agree with his criteria with only minor modifications to conform to the geographically more limited nature of this study. Mayr (1963, 1969) defines a species as a population or group of populations between which gene flow actually or potentially exists and which are reproductively isolated from other similar populations. As so defined,

this is the only taxonomic category that has an objective basis. Nevertheless, conclusions regarding the application of the definition to a population must be based on data other than direct observation of reproductive isolation in most systematic studies. Morphological characteristics, distributional and ecological data are used in ranking population samples. Discontinuity in morphological features is the major criterion for postulating reproductive isolation between populations and hence is the major criterion for defining species limits. For sympatric forms, this practice presents few problems. On the other hand, geographically separated populations are not so easily treated, especially if they differ in only a few minor features, or if the differences are inconsistent. If geographically intermediate populations possess intermediate characteristics, I interpret this as evidence of gene flow and treat the populations so connected as members of the same species.

In some groups, intraspecific differences between the sexes is greater than interspecific differences between members of the same sex. Thus the conspecific sexes are determined by association, or rarely, by finding specimens in copulation.

Erwin (1970) and others criticize the use of subspecific names on the basis that "criteria other than morphological characters of museum specimens (are) necessary for the recognition of limits of taxa below the species level". This criticism is appreciated especially in light of the tendency of taxonomists working on some groups to apply trinomials to every recognizable form or population. Nevertheless, a nihilistic approach to the problem is not any more illuminating. A major portion of taxonomic work involves recognition and description of variation and diversity. A formal system of nomenclature codifies and allows this information to be exchanged without using long descriptive phrases. Erwin correctly advocates description of this variation, analysis of the pattern and investigation of environmental and historical correlations. The subspecific trinomial is a shorthand notation for these patterns just as other taxonomic names are for other patterns. A special case is continuous variation where segregation into taxa involves arbitrary decisions about limits unless the zone of intergradation is relatively narrow. Even an otherwise rather trivial character may have zoogeographical significance, especially if it acts as a marker for a group of populations of common origin. In cases such as this, trinomials serve a useful purpose and have been thus used in several instances in this study.

I agree with Lindroth (1969) about the inadvisability of dividing genera, as long as this does not result in an artificial grouping of unrelated taxa. Thus I define broadly the genera and higher taxa of Dytiscidae. This creates a classification that can be mastered relatively easily by the non-specialist. I am not convinced that some genera or subgenera created at the expense of certain of the larger genera, are clearly monophyletic or comparable in status. These less inclusive groups lose most of their usefulness if they fail to meet these criteria.

#### **Taxonomic characters and terms**

The principal taxonomic characters and terminology used, are explained below. For additional details, see Torre Bueno (1962). Characters used in only one or two genera, are discussed following the appropriate generic description.

*Color.* — Color is described at some length for most species. Differences in color are frequently correlated with differences in structural features, and because of ease of observation color characters are used extensively in keys and descriptions. Color of the ventral surface of the body is described very generally, as color in this area varies considerably intraspecifically.

The principal terms used to describe colors are: yellow, red, brown and black. Generally, however, the insects do not show pure colors. Terms used to designate intermediate colors are testaceous (yellow with a brownish or blackish tinge), rufous (reddish), and piceous (pitchy). Some species possess a metallic sheen which is usually green (aeneous) or coppery (cupreous).

*Sculpture.* — Sculpture takes on many forms such as pits, ridges, grooves or lines, and is often very important for species recognition. Microsculpture, in simplest form, consists of finely engraved lines which intersect at more or less regular intervals to form numerous rounded or polygonal smooth areas referred to as meshes of the sculpture. Many specimens possess two or more patterns of sculpture: a series of fine lines and small meshes which is broken up by coarse lines forming coarse large meshes. In the following descriptions, the most coarsely impressed network of lines is referred to as the primary sculpture while the more finely impressed network is called the secondary sculpture. The terms “primary” and “secondary” are used in a strictly descriptive sense. F. Balfour-Browne (1940) considers the basic sculpture of dytiscids to consist of reticulation and punctation or modification of these. What is treated here as primary sculpture, is derived, according to Balfour-Browne, by modification of the basic fine reticulation and hence is of secondary origin. Recently, Young (1963c) and Zimmerman (1970) used the terms “single” and “double” to describe presence of a network of fine meshes or a tendency toward development of coarse large meshes, respectively. I have not used this terminology because many specimens that possess “double” sculpture have secondarily lost the fine basic sculpture, and while in such cases this terminology is unambiguous phylogenetically, it may be confusing in a descriptive sense. The term “dual punctation” means that punctures of two distinct size classes are present.

*Sexual Characters.* — Primary and secondary sexual characters often provide the best specific characters for species recognition. These characters are either described or illustrated with line drawings.

The majority of these characters occur on the male and consist chiefly of features of the pro- and mesotarsal articles, the protarsal claws, abdominal sternum 6, and the genitalia which include aedeagus (penis or intromittent organ) and parameres. Terminology is complex for parts of the tarsus. Authors have used “palette” interchangeably for adhesive suckers on the ventral surfaces of the pro- and mesotarsal articles, or for the plate formed by expansion of articles 1 to 3 of the protarsus. Here, the term refers to the latter case, and I refer to vestiture of the tarsal articles as adhesive hairs, scales or discs, depending upon size of the structure.

#### Organization of species accounts

For each species the following groupings of information are presented: synonymy and literature references; species diagnosis; description; taxonomic notes; natural history notes; and distribution.

The synonymy and literature references section consists of a listing of names proposed for each species, a literature citation for each original description, and a listing of the type locality. Under each species name, a selected list of literature references is presented, including taxonomic studies, faunal works, biological studies and catalogue listings. The history of changes in a name's status or generic placement is not presented. I have accepted most of the synonymy from previous publications, usually without comment or explanation, but the sources are presented. New synonymy or changes in the status of names that have been introduced here, are discussed under Taxonomic notes.

The diagnosis is a brief statement of the principal characters that distinguish the species from related forms.

The description includes a list of measurements of selected specimens and a brief description indicating general appearance and color, with emphasis on a comparative description of characters of importance in species recognition and classification.

The taxonomic notes include a discussion of such topics as nomenclatural problems, description of observed variation, and observations on relationships and classification.

The natural history notes are summaries of my impressions of the prevalent conditions under

which specimens of a given species are collected. Time of year at which general specimens were collected provides information on seasonal timing of the life cycle. Observations on flight are given when available.

In the distribution section, the continental range of the species is outlined in very general terms, mainly based on published distributional data. Sources of this information are not cited in this section but are included in the list of references. In those cases where I have seen specimens from outside of Alberta that present new data regarding the range of the species, the localities from which the specimens were collected as well as the museum in which they are housed, are listed. An autopsy sign (!) or abbreviation for a museum or collection following a locality listing, indicates that I examined specimens from that locality. The Alberta distribution is outlined in general terms and locality records for each species are plotted on a map. Locality records are on file in the Department of Biology, University of Calgary, and the Department of Entomology, University of Alberta, Edmonton.

## SYSTEMATICS

### Family Dytiscidae Leach, 1817

Dytiscidae Leach, 1817: 68. (emendation of Dyticidae Leach (Opinion 619, Bull. Zool. Nom. 18 (1961))).

All members of this family are aquatic and show adaptations for aquatic life. These beetles vary little in body form, being generally fusiform or oval in outline with flattened hind legs and enlarged metacoxae. The medially divided first visible abdominal sternum (belonging to segment 2) separates members of this family from the aquatic Polyphaga – especially the superficially similar members of the family Hydrophilidae. A filiform antenna of 11 articles, one pair of compound eyes, lack of large coxal plates covering the metatrochanters and presence of long natatorial setae on the hind legs separates these insects from other Alberta families of aquatic Adephaga which are Amphizoidae, Haliplidae and Gyrinidae.

*Description.* – Adults of Alberta species range in TL from 2 to 40 mm; body oval in outline, dorsoventrally flattened in members of some species; pronotum of most specimens as broad basally as clytra across humeral angles; color various, usually dark but also pale with dorsal surface variously maculate; body glabrous or setose.

Head narrower than pronotum, prominent, prognathous or hypognathous; antenna with 11 articles, inserted under frontal ridge between eye and base of mandible; mandible stout, blunt or bifid at apex; maxillary palpus with 4 articles, labial palpus with three articles; mentum with median emargination truncate or toothed medially; eyes large; fronto-clypeal suture evident or obsolete.

Pronotum of most specimens with maximum width at or near base, sides usually evenly rounded laterally and forming a continuous curve with clytron; less commonly narrower than clytron across base; rarely sinuate before postero-lateral angle. Scutellum visible or hidden by postero-medial lobe of pronotum. Elytra streamlined, maximum width of most specimens at or slightly before middle: typically smooth with 3 or 4 longitudinal series of setiferous punctures (serial punctures) on disc; longitudinally grooved or sulcate on some specimens; variously sculptured. Prosternum prolonged between procoxae, in many specimens apex received into groove on anteriomedial margin of metasternum between mesocoxae: procoxal cavities open behind. Metepisternum reaching mesocoxal cavities (except Laccophilinae in Alberta fauna). Metacoxa very large, laterally reaching epipleuron of elytron. Front and middle legs slender, hind legs usually distinctly flattened and edged with natatorial hairs. Tarsi 5-5-5 or actually or apparently 4-4-5: articles 1 to 3 of pro- and mesotarsi of many males variously dilated and clothed beneath with adhesive hairs or scales; protarsal claws of males often modified.

Abdomen with 6 visible sterna, sternum 1 divided medially by metacoxae: sterna 1 to 3 connate. Male genitalia with median aedeagus and paired lateral lobes or parameres: parameres usually symmetrical and setose apically. Female genitalia various.

Larvae campodeiform, cylindrical or slightly flattened: distinctly segmented. Dorsal surface completely sclerotized, less so ventrally. Color white or yellow to black, most specimens yellow with distinct gray or brown maculations. Head prominent and exserted, flattened, prognathous: labrum and clypeus fused, often greatly prolonged anteriorly and covering mandibles: mandibles elongate and slender, acute apically and grooved or hollowed internally for sucking; antenna elongate and prominent, with four articles, but in some specimens articles secondarily divided: maxillary palpus with three or four articles, labial palpus with three articles: ligula of labium present or absent. Head with six pairs of ocelli or ocelli absent (exotic forms).

Prothorax often longer than other two thoracic segments combined. Legs of five articles; coxa, trochanter, femur, tibia, tarsus: each tarsus with two claws. Abdomen with eight segments, segment 9 reduced and not visible dorsally; segment 8 often elongate: cerci present, nonsegmented. Most specimens without lateral gills (present only on *Coptotomus*), six or seven pairs of spiracles.

*Natural history.* — For good general summaries see Needham and Williamson (1907), Balduf (1935), F. Balfour-Browne (1940), Leech and Chandler (1956), and Galewski (1971).

Active stages are aquatic. Nevertheless, the insects depend largely upon atmospheric oxygen for respiration, and both adults and larvae of most species must come to the surface of the water at intervals to renew their air supply. Adults carry air in their tracheal system as well as in a subelytral chamber into which the abdominal spiracles open. Air is renewed while a beetle hangs head downward from the surface film of the water with apices of the elytra and the last abdominal tergum exposed. Larvae carry their air supply in the tracheal system. This supply is renewed through the terminal pair of abdominal spiracles which are thrust through the surface film when the larva comes to the surface. Larvae of certain small species as well as very small larvae of larger species may respire cutaneously and thus do not need to surface (Galewski, 1971). The larva of a species of *Coptotomus* possesses gills (Wilson, 1923), and is the only dytiscid larvae known to possess gills.

Dependence upon atmospheric oxygen is probably a prime factor restricting dytiscids to very shallow water. Adults and larvae are generally inhabitants of small, shallow bodies of water or the margins of larger lakes and rivers. They occupy the zone of emergent vegetation or mats of plant debris or flooded terrestrial vegetation along the shoreline. Seldom are beetles or their larvae common in water more than two or three feet deep. Most are lotic but certain ones are restricted to flowing water, ranging in size from small seepage areas to springs, creeks and the margins of large fast-flowing rivers. Other habitats of dytiscids include the rocky shoreline of high elevation oligotrophic lakes, *Sphagnum* bogs and highly saline prairie ponds. A large proportion of the Alberta fauna is either restricted to, or at least occurs in part in, temporary ponds which fill with water in spring during snow melt then slowly dry up during the summer. My observations on the habitats of dytiscids are in accord with those of Galewski (1971) who concludes that the "ecological distribution of species is mostly determined by a permanence degree of their habitat, and the depth and often size of a water body, that is, structural features seem to play . . . a far greater role than chemical features such as pH, salinity, degree of aeration, etc. Furthermore, the presence or absence of vegetation and its composition . . . together with the presence or absence of sediments. . . seem to have a great significance in the occurrence of the particular species."

Most, if not all, temperate species of Dytiscidae are univoltine. Most species overwinter as adults which apparently lay eggs in the spring. Larval development occurs during the spring and early summer with adults emerging in late summer or fall and hibernating. The larvae pass through three instars, the first two of which are of short duration while the third instar is protracted and may last as long as a month in certain large species (e.g., *Dytiscus* sp., James, 1970). When fully grown, the third instar larva leaves the water for pupation on land. The pupa is generally formed in a cell in moist earth, in leaf litter, or under cover. The pupal stage is generally of short duration, but after emergence, the adult remains in the pupal cell for some time while the cuticle hardens.

This basic pattern of life cycle shows a great deal of interspecific variation which, to a large extent, is related to the seasonal history of the habitat in which the species is found. Species characteristic of temporary melt ponds or runoff creeks complete their larval development early in spring. Adults of these species are often found in copulation at the appearance of the first open water in the spring, and small larvae are collected frequently from ponds still partly frozen over and fed by melting snowbanks. Species living in permanent habitats apparently breed later in the season as a rule, and the larvae of species of *Dytiscus*, *Graphoderus* and *Acilius* are found as late into the season as August. The larvae of species that live in creeks and rivers are usually found in mid-summer, after the heavy spring runoff has passed. Larvae of a few species overwinter, and apparently complete early development in the fall, overwinter, then resume develop-



ment the following spring. Larvae of species that live in springs that do not freeze are active all winter (e.g., *Agabus austinii*). Unidentified larvae hibernating in the soil in basins of dried out ponds presumably would have become active the following spring when the pond refilled. Adults of *Agabus erichsoni*, a species characteristic of small temporary ponds, lay eggs in the early spring which undergo a limited amount of embryonic development then enter a state of diapause broken by exposure to an extended period of cold. Thus, these eggs do not hatch until the next spring (James, 1970).

Overwintering is achieved in several ways. Adults of a few species remain active under the ice of lakes or in streams which do not freeze. However, most beetles probably burrow into soil in dry basins of temporary ponds or leave the water and hibernate in litter or soil near the water (Galewski, 1964a). This latter tactic is suggested by the fact that beetles often are found in the shallow layer of melt water forming over and along the ice of still frozen lakes in early spring. At this time, beetles that remained in the lake still would be locked under the ice. Popham (1952) and James (1970) suggested that dytiscids leave drying ponds for permanent water in the summer and fall, returning again in the spring when the pools are refilled. Certain species, such as those of *Colymbetes* and *Dytiscus*, have strong flying adults which undertake extensive summer and fall flights, probably use this strategy in part. However, adults of the majority of species, especially those largely restricted to temporary ponds, are collected during the winter from vegetation and soil from the pond margin or basin. Some larvae also can be collected during the winter from soil at the bottom of dry ponds. Hence, it appears that hibernation is in or near a site of typical habitat for the species. Adults of species that occupy temporary habitats generally disperse in the spring when such habitats are present, while adults whose species principally occupy permanent water disperse in later summer and fall, as well as in the spring. Although members of all Alberta species of dytiscids except of *Agabus bifarius* apparently possess fully developed wings, the beetles may not all be capable of flight. Jackson (1952, 1956) found that flight muscles may be only poorly developed in specimens with otherwise full wings. Development of the flight muscles may be individually varying, or in an individual, may function for a while, and then atrophy.

A variety of methods of oviposition have been observed, ranging from a simple scattering of eggs over the bottom of a pond, arrangement of eggs on the surface of plants, in crevices or in mud along the shoreline, to placement of eggs in plant stems either by the female biting a hole into the stem and laying her egg there or by means of a modified ovipositor which pierces, slices or saws an opening into the stem in which the egg is laid (Wesenberg-Lund, 1912; Böving, 1913; Jackson, 1958, 1960). Generally, eggs are thin-walled and delicate and the egg stage lasts only a short time. Jackson (1958) found that eggs of *Agabus bipustulatus* (L.) are capable of surviving for some time out of water if surrounded by plant material. Eggs of *Agabus erichsoni* G. & H. are resistant to both cold and drying (James, 1970).

Although these insects are known as "predaceous" water beetles, many observations indicate that adults may be, at least partly, scavengers, feeding upon dead or injured animals (Leech, 1945a; Johnson and Jakinovich, 1970; Smith, 1973). On the other hand, most observations indicate that larvae are voracious predators, and certain species may be of considerable economic importance by eating mosquito larvae (James, 1961, 1966) or upon fish (Wilson, 1923). Adults possess generalized biting mouthparts and ingest particulate material which is stored in a crop or distended portion of the foregut prior to being crushed or further macerated by the often complexly organized teeth and filter apparatus of the gizzard (F. Balfour-Browne, 1934a, 1935). The larvae of most species possess grooved or hollow mandibles and suck fluids from their prey. The larva of *Copelatus* ingests large particulate food crushing it in the specially modified gizzard (Williams, 1936).

Schildknecht (1970) found that two different portions of the body are employed in production

of defensive secretions: prothoracic glands, situated in the prothorax and discharging between the head and the pronotum; and pygidial glands, discharging from the apex of the abdomen. The prothoracic glands produce steroids which affect the autonomic nervous system of vertebrates and hence have been interpreted as acting as a defense against vertebrate predators. However, as these compounds are similar to the wetting agents of soaps, they may serve this latter function for beetles whose smooth cuticle might otherwise be hydrophobic. The pygidial glands produce benzoic acid and phenols which are antiseptic. Schildknecht believes that the beetles spread these materials over their bodies to prevent attachment of microorganisms.

*Distribution.* — This family is cosmopolitan. Many groups reach their greatest diversity in temperate and boreal regions although others are primarily tropical. The majority of the temperate genera are Holarctic in distribution, as are many species. Most temperate species have very wide ranges.

#### Key to Adults of Genera of Alberta Dytiscidae<sup>1</sup>

1. Scutellum of mesothorax not visible, concealed by posterior margin of pronotum ..... 2
- 1' Scutellum of mesothorax visible ..... 7
- 2 (1) Protarsus and mesotarsus of five distinct articles, article 4 approximately as long as 3; metepisternum separated from mesocoxal cavity by mesepimeron; middle of prosternum and its process in same plane (Laccophilinae) ..... *Laccophilus* Leach, p. 259
- 2' Protarsus and mesotarsus apparently or actually of four articles, true article 4 absent or concealed between lobes of article 3; metepisternum attaining mesocoxal cavity; middle of prosternum not in same plane as its process (Hydroporinae). . . 3
- 3 (2) Metacoxal process flat, more or less adpressed to level of abdominal sternum 1, side not diverging laterally as lateral lobe; base of metatrochanter entirely or mainly free; size very small, TL less than 2.4 mm ..... 4
- 3' Metacoxal process raised<sup>2</sup> above level of abdominal sternum 1, its side diverging posteriorly as lateral lobe covering base of metatrochanter; size various, most specimens with TL greater than 2.5 mm ..... 5
- 4 (3) Metatibia straight, of almost equal width from near base to apex; metatarsal claws unequal; body short and broad, almost globose (Fig. 267); basal margin of pronotum and elytron each lacking a deeply impressed longitudinal stria. .... *Desmopachria* Babington, p. 261
- 4' Metatibia slightly arcuate, narrow at base and gradually broadened toward apex; metatarsal claws equal; body elongate and oval in outline; basal margin of pronotum and elytron each with a sharply impressed longitudinal stria ..... *Liodessus* Guignot, p. 262
- 5 (3) Elytron with epipleuron crossed by diagonal carina at shoulder (Fig. 110) ..... *Hygrotus* Stephens, p. 264
- 5' Epipleuron without carina at shoulder ..... 6
- 6 (5) Metafemur not attaining outer margin of lobe of metacoxal process, separated by basal portion of metatrochanter ..... *Hydroporus* Clairville, p. 279
- 6' Metafemur with base attaining level of outer margin of lobe of metacoxal process ..... *Laccornis* Des Gozis, p. 325

1. Modified from Leech and Chandler, 1956

2. Specimen lying on its back.

- 7 (1) Eye with anterior margin above base of antenna, emarginate: male with articles 1 to 3 of protarsus widened but not forming an oval or circular palette (*Colymbetinae*) . . . . . 8
- 7' Eye with anterior margin not emarginate: male with articles 1 to 3 of protarsus greatly broadened, together forming an oval or nearly round palette (*Dytiscinae*) . . . . . 14
- 8 (7) Metafemur ventral surface with linear group of setae near the posterior apical angle, OR if setae not linearly arranged, metatarsal claws of equal length . . . . . 9
- 8' Metafemur without such a group of setae: metatarsus with claws obviously unequal . . . . . 12
- 9 (8) Terminal article of each palpus emarginate at apex. . . . . *Coptotomus* Say, p. 377
- 9' Terminal article of each palpus entire, not emarginate apically . . . . . 10
- 10 (9) Labial palpus with penultimate article enlarged, triangular in cross section, faces concave and unequal: postmentum longitudinally ridged. . . . . *Carrhydrus* Fall, p. 369
- 10' Labial palpus with penultimate article linear, not enlarged and triangular: postmentum not ridged . . . . . 11
- 11(10) Metatarsus with claws of equal length, or if slightly unequal then both very short and only 1/3 length of metatarsal article 5 . . . . . *Agabus* Leach, p. 327
- 11' Metatarsus with claws obviously unequal, outer claw 2/3 or less length of inner . . . . . *Ilybius* Erichson, p. 370
- 12 (8) Elytron with sculpture of numerous, parallel, transverse grooves. . . . . *Colymbetes* Clairville, p. 386
- 12' Elytron variously reticulate, without deeply impressed transverse grooves . . . . . 13
- 13(12) Pronotum without lateral bead: elytron coarsely reticulate: large, black, TL greater than 13 mm . . . . . *Neoscutopterus* Balfour-Browne, p. 384
- 13' Pronotum with a lateral bead continuous or not throughout length of side: elytron not coarsely reticulate: color various: size smaller, TL less than 12 mm . . . . . *Rhantus* Dejean, p. 378
- 14 (7) Metatarsus with dorsoapical margins of articles 1 to 4 glabrous: size very large, TL greater than 20.0 mm . . . . . *Dytiscus* Linnaeus, p. 394
- 14' Metatarsus with dorsoapical margins of articles 1 to 4 each bearing fringe of short, flat, golden setae: size smaller, TL less than 20 mm . . . . . 15
- 15(14) Metatibial spur with apex acute: metasternum with outer margin of lateral wing, straight. . . . . *Hydaticus* Leach, p. 405
- 15' Outer (shorter) metatibial spur with apex emarginate: metasternum with outer margin of lateral wing strongly arcuate . . . . . 16
- 16(15) Elytron with punctation fine; female with elytron not longitudinally fluted or hairy: male palette of protarsus with numerous round adhesive discs on ventral surface . . . . . *Graphoderus* Dejean, p. 406
- 16' Elytron with punctation coarse and dense; many females with elytron longitudinally fluted, impressions with suberect setae: male palette of protarsus with three large adhesive discs and two groups of numerous adhesive hairs on ventral surface . . . . . *Acilius* Leach, p. 409

#### Subfamily Laccophilinae

This subfamily is represented in all major zoogeographical regions of the world. The genus *Neptosternus* Sharp is restricted to the Old World, and *Laccodytes* Reg. is found in the New

World tropics and subtropics. The third genus in the subfamily, *Laccophilus* Leach, is cosmopolitan.

In this subfamily, the metepisternum does not reach the middle coxal cavities. Sharp (1882) termed this group the “Dytisci Fragmentati” while all other subfamilies of Dytiscidae were assigned to the “Dytisci Complicati”. Lindroth (1969) has criticized the use of such coxal characteristics in defining major groups in the family Carabidae: however, in the case of the Laccophilinae, the group is well separated from the remainder of the Dytiscidae on the basis of other characters, the most important of which are given in the following generic description. The treatment of *Laccophilus* is drawn primarily from Zimmerman’s (1970) careful revision of the North American species.

#### Genus *Laccophilus* Leach, 1817

*Laccophilus* Leach, 1817: 69. (Type species – *Dytiscus minutus* Linnaeus, designated by Westwood, 1838).

**Diagnosis.** — In addition to the characters given in the key to genera, members of this genus may be recognized on the basis of pale color of the dorsal surface of the body, small size, (less than 6.5 mm), and strongly lobed metatarsal articles.

**Description.** — The following description applies primarily to the two Alberta species. Size small (3.9 to 6.4 mm); body broadly oval, flattened ventrally and only lowly convex dorsally. Dorsal surface glabrous except for two irregular rows of setae on disc of each elytron and row of conspicuous golden setae near apical lateral margin of elytron. Sculpture of small polygonal meshes: abdominal sterna with several oblique grooves.

Head deflected downward, more or less hypognathous: eye with anterior margin slightly emarginate at middle; mentum without medial tooth. Pronotum without lateral bead; posterior margin produced and covering scutellum. Prosternum and prosternal process on same plane when viewed from side; prosternal process carinate medially, apex acute. Metasternal wings narrow laterally, arcuate. Metacoxal processes with margins parallel anteriorly, divergent posteriorly as lobes over bases of metatrochanters. Metatibia with posterior margin glabrous in both sexes, without natatorial setae; metatibial spurs emarginate apically. Tarsi of all legs clearly composed of five articles, article 4 subequal to article 3; metatarsi very broad, each article with postero-apical angle strongly lobed; metatarsus with claws unequal or with only single claw.

Male with articles 1 to 3 of pro- and mesotarsi dilated, but not together in form of broad oval plate, with stalked oval scales beneath. Genitalia: parameres asymmetrical, right smaller and more strongly sclerotized than left; aedeagus at least twice as long as either paramere, asymmetrical.

Ovipositor strongly sclerotized, toothed ventrally

Larvae of both Alberta species were described (Wilson, 1923; Watts, 1970).

#### Key to Adults of Alberta species of *Laccophilus*

- |    |  |                                    |
|----|--|------------------------------------|
| 1  | Elytron irrorate (freckled with small brown spots), with distinct pattern of dark and pale areas: TL greater than 5.0 mm . . . . . | <i>L. maculosus</i> Say, p. 259    |
| 1' | Elytron not irrorate, uniformly colored or at most with poorly defined lateral and basal pale areas: TL less than 5.0 mm . . . . . | <i>L. biguttatus</i> Kirby, p. 260 |

#### *Laccophilus maculosus* Say, 1823

*Laccophilus maculosus* Say, 1823a: 100 (from LeConte, 1859b). (Neotype – male in MCZ, 5 mi n Bloomington, Monroe Co., Indiana (selected by Zimmerman, 1970).

*Laccophilus decipiens* LeConte, 1852: 205. (Type – male in MCZ. Type locality restricted by Zimmerman (1970) to 2.8 mi e La Grange, Vizard Cr., Stanislaus Co., California.)

Complete synonymy is given by Zimmerman (1970).

**Diagnosis.** — In addition to characters given in the key, males possess a “stridulatory” file on each metacoxal plate.

**Description.** — (after Zimmerman, 1970). TL – 5.1 to 6.4 mm. Color testaceous to pale brown: elytra testaceous, irrorate with brown spots, coalescent around lateral and sutural pale areas. Antennal articles slender, apical article sharply pointed. Hind legs broad. Aedeagus and female genitalia figured by Zimmerman (1970).

**Taxonomic notes.** — Western North American populations of this species have previously

been treated by most authors as *L. decipiens* LeConte. However, Zimmerman (1970) showed that this form hybridizes with the eastern species *L. maculosus* in southern Manitoba and the Dakotas and therefore he treats both as subspecies of one species. Alberta specimens belong to the subspecies *L. m. decipiens* LeConte.

*Natural history notes.* — Specimens of *maculosus* were collected on the prairies from shallow ponds, margins of lakes and occasionally from slow-flowing weedy creeks, mostly from amid emergent *Typha* or *Juncus*, some from among *Carex* in cool water of willow-ringed foothills beaver ponds. The insects are more frequently encountered in permanent than in temporary bodies of water. Teneral specimens were collected August 15 and 24, 1971.

*Distribution.* — This species is transcontinental. However, the subspecies *L. m. decipiens* is restricted to the western half of the continent, ranging from Baja California to Alaska and eastward to at least Alberta and Colorado. In Alberta, this species has been taken as far north as Edmonton (Zimmerman, 1970) but the majority of specimens have been collected south of the Red Deer River. I examined 130 specimens from Alberta localities (map, Fig. 326).

#### *Laccophilus biguttatus* Kirby, 1837

*Laccophilus biguttatus* Kirby, 1837: 69. (Type locality — “Boreal America”, type in BMNH).

*Laccophilus inconspicuus* Fall, 1917: 169. (Type locality — Winnipeg, Manitoba).

Complete synonymy given by Zimmerman (1970).

*Diagnosis.* — See key.

*Description.* — Zimmerman (1970) gives the following measurements: TL — 3.9 to 4.8 mm; MW — 2.3 to 2.6 mm. Color varied, dorsal surface testaceous to pale brown, elytra darker than disc of pronotum, brown to piceous; antennae and palpi with apical articles infuscate; ventral surface of meso- and metathorax and abdomen varied in color, ranging from testaceous to piceous or black. (The above description refers to preserved specimens, live specimens are usually somewhat darker in color and appear distinctly greenish, especially ventrally.) Microsculpture fine, on elytra of small regular or slightly irregular meshes.

Antennae with articles shorter and stouter than in *maculosus*. Hind legs relatively slender. Metacoxa of male without file. Male genitalia figured by Zimmerman (1970).

*Taxonomic notes.* — This species is very similar to the Palaearctic species *L. minutus* L. and the two forms may be conspecific. Alberta populations vary in color of ventral sclerites of the body: entirely pale; or with abdominal sterna infuscate; or with both abdominal sterna and metacoxae infuscate. Within a given population sample, color of most specimens tends to be rather uniform. Specimens from the prairies tend to be paler than those from forested areas, but specimens collected from open warm ponds, even in the forested regions, tend to be paler in color than specimens from neighbouring populations in colder *Carex* marshes.

Fall (1917) described *L. inconspicuus* from Winnipeg, Manitoba, and recorded the species from Edmonton. F. S. Carr (1920) recorded this species from northern Alberta under the name *L. inconspicuus*.

*Natural history notes.* — Specimens of *L. biguttatus* are found in a variety of aquatic habitats, ranging from shallow, warm prairie ponds of south eastern Alberta, to cold *Carex* marshes in northern and western parts of the province, mainly in areas of emergent or rooted aquatic vegetation, seldom in open water. This species is seldom common in temporary ponds.

I collected pupae and prepupal larvae on August 3, 1964, in leaf litter along banks of sheltered bays on Great Slave Lake. In Alberta, teneral adults were collected from July 31 to August 29. Specimens were observed in flight during the last half of May, and on May 30, 1972, many specimens landed on the roof of a black car.

*Distribution.* — This is primarily a boreal species, ranging from Quebec to British Columbia and from California and Colorado to the North West Territories and Alaska (Zimmerman, 1970). I examined more than 600 specimens from Alberta localities (map, Fig. 327).

## Subfamily Hydroporinae

Except for a few species of *Agabus* with very small members and the two species of *Laccophilus*, all water beetles in the province less than 6 mm in total length belong to this subfamily of which only one species, *Hydroporus columbianus* Fall, exceeds 6 mm in length, but not 6.4 mm. These beetles share the hidden scutellum with the genus *Laccophilus*, but they can be separated from the latter by: 1) shape of the prosternum and its process; 2) metepisternum, which contacts the mesocoxal cavities; 3) tarsal formula of 4-4-5 (sometimes 5-5-5); and 4) by the slender non-lobed metatarsal articles.

*Description.* – (Alberta forms only). Small beetles less than 6.5 mm in total length. Shape of body various. Color various. Mentum with distinct, usually acutely pointed, medial tooth. Prosternum and its process not in same plane when viewed from side. Scutellum concealed by posteromedial lobe of pronotum. Legs relatively little flattened, slender; metatibia with setae along posterior margin of both sexes; tarsi actually or apparently 4-4-5, true article 4 of pro- and mesotarsus absent or small and hidden between lobes of article 3; metatarsal articles slender, hind margin not lobed. Bifid setae and spines lacking. Male with articles 1 to 3 of pro- and mesotarsi dilated or not; if dilated, articles not together forming oval palette. Male genitalia with parameres equal, setose apically or internally in most specimens, not broadly united dorsally by membrane, extended to apex of aedeagus but attached to it only at basal piece. Ovipositor not adapted for piercing.

The larva is very distinctive because of the anterior prolongation of the clypeus which forms a projection covering the dorsal surface of the mandibles and hiding them in dorsal view. In addition, the maxillary palpus is of three articles and the body lacks lateral fringes of swimming hairs.

Genus *Desmopachria* Babington, 1841

*Desmopachria* Babington, 1841: 16. (Type species. – *Desmopachria nitida* Babington, 1841).

*Description.* – (Modified after Young, 1954). Body short, broadly oval, somewhat depressed therefore not distinctly globose. Clypeus with raised anterior margin or rim. Elytron with diagonal carina across epipleuron at humeral angle. Prosternal process short, almost as broad as long, rhomboidal with apex acute. Anterior portion of metasternum between mesocoxae broad (equal in width to about one half width of mesocoxa), broadly and shallowly impressed anteriorly; bead remote from anterior margin. Metacoxa without lobes, base of metatrochanter free. Metatibia more or less of uniform width from base to apex or slightly and evenly widening distally. Metatarsal claws unequal, outer claw much shorter and narrower than inner.

Young (1951) gives a key to the described North American species of *Desmopachria*. He records 7 species from America north of Mexico, stating that some of the species require revision and that there are some undescribed species in the southern portion of the United States. A single species reaches Alberta.

*Desmopachria convexa* (Aubé, 1838)

*Hydroporus convexus* Aubé, 1838: 479. (Type locality – North America). Melsheimer 1853: 33. – LeConte 1855: 294. – LeConte, 1863a: 16. – Gemminger and Harold 1868: 431. – Crotch 1873: 388. – Sharp 1882: 237. – Wickham 1895a: 73. – Blatchley 1910: 212. – Zimmermann 1919: 130. – Leng 1920: 77. – Young 1951: 112. – Hatch 1953: 197. – Gordon and Post 1965: 12. – Malcolm 1971: 19. – Wallis 1973: 101.

*Description.* – (Fig. 267). Measurements of 20 specimens from Tp. 37 Rge. 5 W. 5 (nr. Stauffer), Alberta, are: TL – 1.70 to 1.85 mm ( $\bar{X} = 1.78 \pm 0.04$  mm); MW – 1.14 to 1.27 mm ( $\bar{X} = 1.21 \pm 0.04$  mm); TL/MW – 1.44 to 1.51 ( $\bar{X} = 1.47 \pm 0.02$ ).

Color reddish to reddish brown, head and pronotum slightly paler than disc of elytron; elytra without distinct maculations. Dorsal surface smooth and shiny with scattered small shallow punctures: metacoxa distinctly punctate internally, punctures obsolete towards lateral margin; metasternal wing and abdominal sterna 1 to 3 laterally very finely punctate. Antenna with articles 1 and 2 broad; article 3 narrow, elongate and conical; articles 4 to 11 broader, almost transverse with anterior apical angle somewhat produced. Pronotum without basal plicae. Elytra without sutural striae.

*Natural history notes.* – Many specimens of *D. convexa* were collected from quaking bogs in the vicinity of Stauffer, Alberta, a considerable distance from firm shoreline, in an area where the vegetation consisted of a moss mat with a few sparse sedges and dwarf birch. The moss mat (*Drepanocladus* sp.) was not continuous but was broken by areas of dead and flooded

mosses. The beetles were collected by forcing the living moss down into the water, then sweeping the flooded area with a net. They were very sluggish and slow to move, and remained motionless until the detritus in the net began to dry.

*Distribution.* — This species is transcontinental, or almost so, in North America. It has been recorded from Maine, New York and Indiana to British Columbia. The southern and northern limits are unknown. I examined more than 120 specimens from Alberta localities (map, Fig. 328).

### Genus *Liodessus* Guignot, 1939

*Liodessus* Guignot, 1939: 55. (Type species — *Hydroporus affinis* Say, 1823 (original designation)).

This is a group of species with small members, whose total range includes much of North and South America. Characters common to the two Alberta members of the genus are:

Hydroporinae of small size, TL — 1.78 to 2.28 mm. Head with dorsal cervical stria between hind margins of eyes; clypeal margin not thickened or modified. Basolateral portion of pronotum and base of elytron each with sharply impressed longitudinal stria; elytron without sutural stria. Metacoxal process flat, more or less adpressed to level of abdominal sternum 1, side not divergent laterally as rounded lobe hence most of base of metatrochanter visible. Metatibia slightly arcuate, narrow basally and gradually expanded towards apex and hence appearing club-like: metatarsal claws equal. Parameres simple, slender, jointed: aedeagus simple.

This description of *Liodessus* is based on Young's (1967) definition in his revision of the American genera of the tribe Bidessini. Young's revision has done much to clarify relationships within this very diverse group of insects. However, his concept of the genus is narrower than the concept used throughout the rest of this study, and for this reason I would prefer to treat *Liodessus* as a subgenus of the Old World genus *Bidessus*. However, I have followed Young's ranking because of his extensive experience with this group.

#### Key to Alberta species of *Liodessus* Guignot

- 1 Pronotum and elytra distinctly maculate or patterned on most specimens: dorsal surface of body with short but conspicuous setae . . . . . *L. affinis* (Say), p. 262
- 1' Body reddish brown in color, not distinctly maculate: dorsal surface with setae very short and inconspicuous, more or less glabrous. *L. cantralli* (Young), p. 263

### *Liodessus affinis* (Say, 1823)

*Hydroporus affinis* Say, 1823b: 104 (from LeConte, 1859b). (Type locality — not stated by author, type considered lost).

Not Aubé 1836: 232. Melsheimer 1853: 33. — LeConte 1855: 290. — LeConte 1863a: 16. — Gemminger and Harold 1868: 430. — Crotch 1873: 391. — Sharp 1882: 318. — Wickham 1895a: 73. — Blatchley 1910: 213. — Zimmermann 1919: 141. — Carr 1920: 3. — Leng 1920: 77. — Hatch 1928: 219. — J. Balfour-Browne 1948: 159. — LaRivers 1951: 398. — Hatch 1953: 198. — Young 1954: 70. — Leech and Chandler 1956: 315. — Anderson 1962: 58. — Gordon and Post 1965: 13. — Young 1969: 3. — Malcolm 1971: 21. — Wallis 1973: 101.

Synonymy given by Young 1969: 3.

*Diagnosis.* — Adults are moderate to relatively large members of genus *Liodessus*, characterized by elongate body, patterned or maculate pronotum and elytra, and short although conspicuous setae of the dorsal surface of the body.

*Description.* — Measurements of 40 specimens from the vicinity of Lethbridge and Magrath, Alberta, are: TL — 1.88 to 2.28 mm ( $\bar{X}$  — 2.13 ± 0.08 mm); MW — 0.96 to 1.16 mm ( $\bar{X}$  = 1.07 ± 0.04 mm). TL/MW — 1.92 to 2.02 ( $\bar{X}$  = 1.97 ± 0.02).

Head brown to piceous with clypeus and anterior margin of frons, testaceous; antenna with articles 1 to 4 testaceous, outer articles piceous; palpi testaceous with terminal article of each palpus piceous. Pronotum testaceous except disc medially, pale brown to piceous (anterior and posterior margins translucent and colored by underlying head and elytron respectively). Elytron testaceous except sutural margin, four longitudinal vittae and mediolateral spot, brown to piceous (vittae variously fused — separate and traceable to apex of elytron, or vittae expanded and confluent and disc more or less uniformly dark). Ventral surface variously colored: metasternum and metasternal wings piceous to black, remainder of body rufous to piceous. Legs testaceous to rufous, except apex of tibia and tarsi infuscate.

Head finely reticulate: frons punctate with punctures coarse and dense medially between eyes, and in frontal impressions. Pronotum and elytra strongly punctate, each puncture bearing a decumbent or semierect seta; setae short but conspicuous. Male with interspaces between punctures smooth and shiny, with at least rudiments of sculpture toward apex of elytron; female sculpture similar, apical half of elytron with microsculpture, or some females with entire disc of pronotum and elytron dull from dense fine sculpture. Ventral surface of body with at least isolated patches of microsculpture on metacoxal plates and abdominal sterna.

Head with anterior margin of clypeus slightly thickened, especially laterally, but not margined or produced; cervical stria present. Pronotum with lateral margins evenly arcuate, maximum width at hind angles; plica strong, about two thirds length of maximum length of pronotum, straight basally and slightly converging anteriorly. Elytron with plica present and well developed. Sexes similar, male with basal articles of protarsus slightly broader than on female.

*Taxonomic notes.* – This widely distributed species varies extensively in color and sculpture. Several subspecies or species may be included in this complex but the variation has not been carefully analyzed.

*Natural history notes.* – Specimens of *L. affinis* were found in a wide variety of habitats, ranging from rocky shore lines of subalpine lakes and margins of quiet pools and backwaters in foothill rivers, to shallow warm prairie ponds, springs, *Carex* marshes and even occasionally in *Sphagnum* bogs. They are often in mats of filamentous algae. Teneral specimens were collected from July 6 to August 22. Specimens were observed in flight from April 5 to May 30 (Calgary).

*Distribution.* – In aggregate, the various forms of this species have a range which includes most of North America and extends from Alaska to Argentina. The species probably occurs throughout Alberta but there are no Alberta records north of Fort McMurray. The species was collected at several localities around Great Slave Lake (UC!). I examined more than 300 specimens from Alberta localities (Map, Fig. 329).

#### *Liodesus cantralli* (Young, 1953)

*Bidessus cantralli* Young, 1953a: 111. (Type locality – Hidden Lake, E. S. George Reserve nr. Pinckney, Michigan). Young 1969: 3.

*Diagnosis.* – Adults are small and elongate characterized by reddish brown color, almost glabrous highly polished dorsal surface and relatively slender shape.

*Description.* – (Modified from Young, 1953a) – Measurements and ratios for 20 specimens from Tp. 37 Rge. 5 W 5 (nr. Stauffer), Alberta, are: TL – 1.78 to 1.96 mm ( $\bar{X}$  = 1.88 ± 0.05 mm); MW – 0.90 to 1.04 mm ( $\bar{X}$  = 0.99 ± 0.03 mm); TL/MW – 1.86 to 1.98 ( $\bar{X}$  = 1.90 ± 0.03).

Body chestnut brown except anterior and posterior margins of pronotum and sutural margin of elytron slightly darker; elytra uniformly colored, nonvittate; outer antennal articles, terminal article of each palpus, apex of tibia, and tarsi, infusate.

Head finely reticulate: meshes anterior to cervical stria more or less isodiametric, behind stria slightly transverse; frons with sparse irregularly spaced punctures. Pronotum with disc shiny but rudiments of effaced sculpture on some specimens; disc with small sparse punctures in addition to coarse apical and basal series of punctures. Elytron smooth and shiny: disc with large more or less evenly spaced setiferous punctures and a longitudinal series of coarser more or less confluent punctures forming a stria parallel to clytral suture; setae small and more or less inconspicuous. Ventral surface of body irregularly sculptured, punctation sparse.

Pronotum with maximum width at or near hind angles: lateral margin evenly arcuate and narrowing toward front; lateral pronotal plica about two thirds maximum length of pronotum. Elytron with basal plica slightly shorter than that of pronotum, deeply impressed.

*Taxonomic notes.* – Members of *L. fuscatus* resemble those of *L. cantralli* in general size and color but differ in larger size, body more robust, usually with maximum width of the pronotum anterior to the hind angles on many specimens, more coarsely punctate, and with conspicuous microsculpture on the dorsal surface of the body. Although *L. fuscatus* has not been collected in Alberta, it may occur in acidic *Sphagnum* bogs.

*Natural history notes.* – Long series of this species were found in quaking bogs surrounding small lakes near Stauffer, Alberta. These bogs consist of a moss mat comprised chiefly of *Drepanocladus* sp. with sparse *Carex*, *Eriophorum*, *Menyanthes trifoliata*, and the occasional small birch. Around some of the birches, especially toward shore line, small mounds of *Sphagnum*



are present. Most specimens of *L. cantralli* were collected from shallow water-filled depressions in the moss mat, especially those in close proximity to shrubs and the higher mounds of moss associated with them. However, specimens were found throughout much of the bog, frequently along the edges of saturated growing mosses, and in pools covering areas of dead moss. The occasional specimen was found in *Sphagnum* bogs in the province, but no series has been taken in this habitat. These observations substantiate Young's (1953a) conclusion that *L. cantralli* is a species of non- or weakly-acid water and not of acid *Sphagnum* bogs.

*Distribution.* – This species is known from only the type locality in Michigan and the Alberta localities indicated in Figure 328. I examined 80 Alberta specimens and a male paratype.

#### Genus *Hygrotus* Stephens, 1828

*Hygrotus* Stephens, 1828: 46. (Type species – *Dytiscus inaequalis* Fabricius, 1777, designated by Curtis, 1835a.)

*Coelambus* Thomson, 1860: 13. (Type species – *Dytiscus impressopunctatus* Schaller, 1783, designated by Brinck, 1942 (Guignot, 1946)).

This large genus has a Holarctic distribution. Within the Alberta fauna, the combination of rounded metacoxal processes which cover the bases of the metatrochanters, and the oblique humeral carina on the elytral epipleuron (Fig. 110), sufficiently define this hydroporine genus. The following description applies to Alberta species.

Body various, short and broad, more or less globose, to elongate but convex. Color various, many specimens with elytra distinctly patterned. Dorsal surface glabrous or with very short, sparse, inconspicuous setae. Sculpture various, specimens evidently punctate. Elytron with carina on epipleuron at humeral angle and internal subapical projection or ligula on posterior portion of submarginal ridge. Metacoxal process with prominent lateral lobes; not adpressed medially to abdominal sternum 2.

Larvae are not distinguishable from those of certain species of *Hydroporus*. Larvae of the following Alberta species have been described sketchily by Watts (1970): *H. punctatus* Say (= *sayi* Balfour-Browne), *H. punctilineatus* Fall, *H. tumidiventris* Fall, *H. impressopunctatus* Schaller, *H. canadensis* Fall, *H. patruelis* LeConte, and *H. sellatus* LeConte.

Identification of male specimens of *Hygrotus* is often relatively easy, for those of many species show unique secondary sexual characteristics in the pro- and mesotarsi. Degree of dilation of the tarsal articles and shape of the protarsal claws, which may be very peculiarly or even grotesquely modified, differ between some species. Identification of females is much more difficult, for along with a general similarity in body form among certain species, females of certain species vary greatly in sculpture, punctation and color. Certain species include two forms of females, with some resembling the male in sculpture while others having the entire body covered with fine dense microsculpture.

Anderson (1971) published the first part of a revision of the North American species of this genus.

Within the study area, this genus attains its greatest diversity on the prairies although some species are found throughout the province or only in the forested areas. Many species occur in temporary or strongly saline bodies of water.

#### Key to Alberta species of *Hygrotus* Stephens

- 1 Body short and broad, more or less globose (TL/MW – 1.50 to 1.70); ventral surface rufous to rufopiceous, not mainly black . . . . . 2
- 1' Body more elongate, not globose (TL/MW > 1.75); ventral surface mainly black . . . . . 4
- 2 (1) Size larger, TL – 2.8 to 3.2 mm: male resembling female, i.e., protarsal articles not dilated; sternum 6 not medially excavate . . . . . *H. sayi* Balfour-Browne, p. 267
- 2' Size smaller, TL – 2.1 to 2.3 mm: male with protarsal articles slightly broadened;

- sternum 6 medially excavate with pair of medial posteriorly-directed spines . . . 3
- 3 (2) Clypeus with anterior marginal rim; elytron with submarginal discal ridge, punctation simple, epipleuron with punctures discrete . . . . . *H. acaroides* (LeConte)<sup>3</sup>
- 3' Clypeus without anterior marginal rim; elytron without submarginal discal ridge or carina on basal half, punctation dual, at least basally; epipleuron very densely and confluent punctate . . . . . *H. farctus* (LeConte), p. 268
- 4 (1) Anterior border of clypeus with raised margin or rim . . . . . 5
- 4' Anterior border of clypeus without raised rim . . . . . 6
- 5 (4) Male protarsal claws (Fig. 37) very long, dorsoventrally flattened and expanded laterally; frons with posteriomedial piceous spot; lateral margin of elytron strongly ascending at humeral angle . . . . . *H. masculinus* (Crotch), p. 278
- 5' Male protarsal claws short, arcuate and not laterally dilated; frons without posteriomedial piceous spot on most specimens; lateral margin of elytron less strongly ascending to humeral angle . . . . . *H. salinarius* (Wallis), p. 278
- 6 (4) Abdominal sternum 6 with basolateral impression and distinct tumid or elevated area on each side; elytron testaceous with piceous vittate markings . . . . . *H. tumidiventris* (Fall), p. 274
- 6' Abdominal sternum 6 without basolateral impressions and swellings; elytron vittate or not . . . . . 7
- 7 (6) Anterior protarsal claw modified, different from posterior protarsal claw (males of most species) . . . . . 8
- 7' Anterior protarsal claw not modified, similar in size and shape to posterior protarsal claw (females and some males) . . . . . 17
- 8 (7) Anterior and posterior protarsal claws highly modified, neither similar in shape to mesotarsal claws . . . . . 9
- 8' Only anterior protarsal claw modified, posterior claw evenly arcuate and tapered towards apex, similar in shape and size to mesotarsal claws or slightly longer and broader . . . . . 10
- 9 (8) Anterior protarsal claw much longer than posterior . . . . . *H. punctilineatus* (Fall) in part, p. 275
- 9' Anterior protarsal claw shorter than posterior claw . . . . . *H. unguicularis* (Crotch) in part, p. 273
- 10 (9) Protarsus with at least article 2 broadly dilated . . . . . 12
- 10' Protarsus narrowly dilated, article 2 little broader than article 4 . . . . . 11
- 11(10) Larger, TL – 3.5 to 4.0 mm; elytral maculations nebulous or rarely clearly defined . . . . . *H. canadensis* (Fall) in part, p. 270
- 11' Smaller, TL – 3.0 to 3.4 mm; elytral maculations well defined anteriolateral spot and broad posterior blotch . . . . . *H. sellatus* (LeConte) in part, p. 272
- 12(10) Serial punctures of elytron more or less confluent on basal half of disc, in form of three or four evident impressed striae (Fig. 276, 277); elytra with very large coarse punctures and numerous interspersed small punctures: size large, TL – 4.4 to 5.3 mm . . . . . 13
- 12' Serial punctures of elytron not confluent and not forming striae; punctation various; size various . . . . . 14
- 13(12) Abdominal sternum 3 smooth and shiny, without trace of microsculpture; elytron with at least suggestion of longitudinal maculation; pronotum with basal dark marks

3. not known from Alberta.

- not extended to side margins . . . *H. impressopunctatus* (Schaller) in part, p. 276
- 13' Abdominal sternum 3 with finely impressed microsculpture along posteriomedial margin; elytron non vittate; pronotum unicolorous, piceous, or with broad basal mark extended to side margins. . . . . *H. picatus* (Kirby) in part, p. 277
- 14(12) Anterior protarsal claw with ventral basal tooth: metacoxal plate smooth and shiny, without microsculpture or rarely with lightly impressed open sculpture . . . . . *H. dentiger* (Fall) in part, p. 273
- 14' Anterior protarsal claw without ventral tooth: metacoxal plate smooth or microsculptured . . . . . 15
- 15(14) Elytron longitudinally vittate: pronotum with lateral margins almost straight, little arcuate, narrower at base than elytron across humeral angles on some specimens: metacoxal plate microsculptured . . . . . *H. semivittatus* (Fall) in part, p. 275
- 15' Elytron not vittate: lateral margin of pronotum arcuate: pronotum as wide at base as elytra across humeral angles: metacoxal plates shiny on most specimens . . . . 16
- 16(15) Article 2 of protarsus much broader than article 1 (Fig. 28): elytral punctation dual basomedially (Fig. 270) . . . . . *H. compar* (Fall) in part, p. 269
- 16' Article 1 of protarsus dilated, only slightly narrower than article 2 (Fig. 30); elytral punctures of more or less uniform diameter or with few irregularly situated large punctures near base (Fig. 273) . . . . . *H. patruelis* (LeConte) in part, p. 271
- 17 (7) Metacoxal plate and elytron smooth and shiny, without microsculpture . . . . . 18
- 17' Metacoxal plate and also elytron of most specimens with evident microsculpture. . . . . 22
- 18(17) Abdominal sterna with fine, usually somewhat stretched microsculpture . . . . 19
- 18' Abdominal sternites smooth and shiny, without microsculpture . . . . . 20
- 19(18) Basomedial portion of elytron with distinct dual punctation (Fig. 270); disc of pronotum and elytron reddish to reddish brown, darker pattern if present nebulous and poorly defined . . . . . *H. compar* (Fall) in part, p. 269
- 19' Elytral punctation of more or less uniform size basomedially: disc of pronotum and elytron testaceous with distinct dark brown or piceous pattern . . . . . *H. sellatus* (LeConte) in part, p. 272
- 20(18) Elytron basomedially with punctation dual (Fig. 269); elytron reddish brown without distinct pattern of maculation, or disc diffusely darker medially and apically: size small, TL 2.7 to 3.1 mm . . . . . *H. turbidus* (LeConte), p. 269
- 20' Without above combination of characters: size larger or elytron with well defined dark marks . . . . . 21
- 21(20) Head dark with isolated pale spot between eyes; pronotum mainly dark brown to piceous with lateral portions and a subapical transverse area somewhat paler; elytral punctation relatively fine, punctures equal (except for serial punctures) (Fig. 272); size larger, TL – 3.5 to 4.0 mm . . . . . *H. canadensis* (Fall), p. 270
- 21' Color paler, head with clypeus and frons medially, rufous; pronotum testaceous to rufous with posterior margin and medial discal spot, piceous; elytron more coarsely punctate, with few scattered coarse punctures and more numerous fine punctures: size smaller, TL – 2.95 to 3.4 mm . . . . . *H. suturalis* (LeConte), p. 272
- 22(17) Basal third to half of elytron without microsculpture, smooth and shiny between punctures . . . . . 23
- 22' Elytron with microsculpture on basal third . . . . . 24
- 23(22) Disc of elytron very coarsely punctate, interspaces with fine secondary punctation: serial punctures of elytron longitudinally confluent in form of three or four striae on basal portion of disc (Fig. 276) . . . . . 28

- 23' Disc of elytron with moderate sized uniform punctures; serial punctures not confluent and not in form of longitudinal striae on disc. . . . . *H. dentiger* (Fall) in part, p. 273
- 24(22) Head and disc of pronotum immaculate; lateral margin of pronotum more or less straight throughout length; articles 1 to 3 of pro- and mesotarsi very narrow and elongate; elytron with reduced pattern of vittate maculations . . . . . *H. semivittatus* (Fall) in part, p. 275
- 24' Head and disc of pronotum variously maculate; lateral margin of pronotum arcuate; pro- and mesotarsi with articles broader . . . . . 25
- 25(24) Elytron with distinct longitudinal vittae, or size greater than 4.4 mm . . . . . 26
- 25' Elytral markings nonvittate, usually in form of one or two irregular blotches on each elytron, or elytron more or less uniformly colored . . . . . 29
- 26(25) Elytron testaceous or pale brown with clearly limited dark brown or black vittae; pronotal disc testaceous with small piceous spot situated on medial fovea . . . . . 27
- 26' Elytron dark rufous to brown, with or without vittae; if present, vittae somewhat irregular and little contrasted with ground color of disc; pronotal disc with expanded basal maculation or entire disc dark rufous or brown . . . . . 28
- 27(26) Elytral punctation dual (Fig. 275); size small, TL — 3.7 to 4.1 mm; frons with anterior projection of black basal margin along inner margin of each eye . . . . . *H. punctilineatus* (Fall) in part, p. 275
- 27' Elytral punctures more or less uniform in size; size larger, TL — 4.9 to 5.6 mm; frons pale inside eyes or with isolated brown spot . . . . . *H. unguicularis* (Crotch) in part, p. 273
- 28(23, 26) Stylus of ovipositor short (Fig. 26); elytron with at least suggestion of longitudinal pale areas on disc: pronotum with posteriomedial maculation not extended to lateral margin . . . . . *H. impressopunctatus* (Schaller) in part, p. 276
- 28' Stylus with apex elongate (Fig. 27); elytron dark brown to piceous, immaculate; disc of pronotum piceous or basal piceous maculation extended to lateral margin . . . . . *H. picatus* (Kirby) in part, p. 277
- 29(25) Pronotum uniformly dark rufous or brown, or with apical and basal margins piceous; elytral punctation dual (Fig. 269); elytron more or less unicolorous, rufous or chestnut, at most with ill defined discal maculation. . . . . *H. compar* (Fall) in part, p. 269
- 29' Pronotum distinctly patterned, testaceous or pale rufous with a basomedial piceous spot; elytral punctation of more or less uniform size (Fig. 274); elytron testaceous or pale brown with more or less well defined medial and posterior discal cloud . . . . . *H. patruelis* (LeConte) in part, p. 271

*Hygrotus sayi* J. Balfour-Browne, 1944

- Hygrotus sayi* J. Balfour-Browne, 1944: 347. (new name for *Hygrotus punctatus* (Say, 1824)). LaRivers 1951: 399. — Hatch 1953: 202. — Leech and Chandler 1956: 316. — Anderson 1962: 59. — Gordon and Post 1965: 14. — Anderson 1967: 365. — Anderson 1971: 509. — Malcolm 1971: 23. — Wallis 1973: 102.
- Laccophilus punctatus* Say, 1824: 271. (Plesiotype — male, 5 mi NE Pembine, Wisconsin, USNM (selected by Anderson, 1971)). Not Marsham, 1802. Aubé 1838: 471. — LeConte 1850: 214. — Melsheimer 1853: 33. — LeConte 1855: 290. — LeConte 1859a: 35. — Gemminger and Harold 1868: 439. — Sharp 1882: 395. — Fall 1919: 6. — Hatch 1933b: 10. — F. Balfour-Browne 1940: 204.
- Hydroporus inaequalis* Crotch, 1873: 387. Not Fabricius, 1777. F. S. Carr 1920: 3.

*Diagnosis.* — The globose shape, size, raised margin of the clypeus, the rufous ventral surface of the body, and males without secondary sexual modifications separate this species from all other species of *Hygrotus* known from Alberta.

*Description.* – Body short and broad, convex both dorsally and ventrally. Measurements of 20 Alberta specimens are: TL – 2.84 to 3.20 mm ( $\bar{X} = 3.05 \pm 0.09$  mm); MW – 1.68 to 1.96 mm ( $\bar{X} = 1.85 \pm 0.07$  mm); TL/MW – 1.58 to 1.70 ( $\bar{X} = 1.65 \pm 0.03$ ).

Head rufous except frons lightly infuscate laterally on many specimens; antennae testaceous except articles 5 to 11 infuscate; palpi testaceous. Pronotum rufous except anterior and posterior margins piceous. Elytra various, uniformly rufous to dark brown, many specimens with variously developed paler maculations. Ventral surface rufous to rufopiceous, not black. Legs pale rufous.

Elytron with punctures evident, somewhat varying in size but of approximately similar coarseness and depth (Fig. 268); interspaces smooth and shiny in both sexes; epipleuron with distinctly separated punctures. Ventral surface of body coarsely punctate, punctures for most part separate.

Clypeus margined anteriorly. Prosternal process contacting metasternum between mesocoxae. Elytron without anterior sublateral ridge. Abdominal sterna not modified. Male with protarsus and protarsal claws unmodified, similar to that of female. Aedeagus as in Figure 10.

*Taxonomic notes.* – F. S. Carr (1920) recorded this species from Alberta under the name *H. inaequalis* Fabr. Although *H. sayi* closely resembles the Old World species *H. inaequalis*, R. Anderson (1971; pers. comm., 1973) considers the two to be distinct.

*Natural history notes.* – This species is common in warm weedy ponds and in backwaters of slow weedy creeks. Specimens are seldom found in temporary ponds. Teneral specimens were collected at the end of July and during August. A specimen was captured in flight on May 30, 1972 (Calgary).

*Distribution.* – *H. sayi* occurs throughout much of North America with the apparent exception of southeastern United States (Anderson, 1971). I examined more than 300 Alberta specimens (map, Fig. 330).

#### *Hygrotus farctus* (LeConte, 1855)

*Hydroporus farctus* LeConte, 1855: 294. (Type locality – Massachusetts). Gemminger and Harold 1868: 433. – Crotch 1873: 388. – Sharp 1882: 396. – Fall 1919: 5. – Anderson 1971: 508. – Wallis 1973: 102.

*Diagnosis.* – Members of this species are small, oval or globose with clypeus unmargined, the elytra nonpatterned and lacking raised basal sublateral carinae on disc, prosternum with a large conical projection. Male have sternum 6 deeply and broadly excavate medially, the anterior margin of the excavation with a pair of slender posteriorly projecting parallel spines.

*Description.* – Body broadly rounded, convex and almost globose. Measurements of four specimens from Tp. 37 Rge. 5 W. 5 (NW of Stauffer, Alta.), are: TL – 2.12 to 2.24 mm ( $\bar{X} = 2.18$  mm); MW – 1.36 to 1.46 mm ( $\bar{X} = 1.41$  mm). TL/MW – 1.53 to 1.57 ( $\bar{X} = 1.55$ ).

Head rufous; antennae rufous basally (some specimens with article 2 infuscate apically), outer articles, beginning at article 5, infuscate; palpi pale, terminal article of each palpus piceous. Pronotum rufous except basal and, to a lesser extent, apical margins, rufopiceous to piceous. Elytra rufopiceous to piceous medially, gradually paler laterally, without distinct pattern. Ventral surface rufous except metacoxal plates and basal abdominal sterna darker. Legs rufous except tarsi infuscate.

Elytron densely punctate; basally on disc, punctures dual with large shallow punctures separated by more numerous small punctures; apically, large punctures less numerous and smaller hence punctation near apex more or less uniform; remnants of microsculpture visible behind shoulder and near apex; epipleuron very densely and confluent punctate. Metasternal wings laterally and metacoxal plates coarsely punctate, punctures irregular and largely confluent laterally. Abdominal sterna with small confluent punctures, with more or less granular appearance.

Clypeus without anterior marginal bead. Prosternum with prominence large and forming a strong conical projection between anterior portion of procoxae. Elytron lacking anterior submarginal carina or ridge.

Male with sternum 6 deeply and broadly excavate: anterior margin of excavation with pair of slender posteriorly directed spines; floor with pair of posteriorly diverging carinae and lateral margins without projections or teeth. Protarsus slightly dilated, claws not modified.

*Taxonomic notes.* – Three North American species of *Hygrotus* possess the peculiar modification of male sternum 6 (Anderson, 1971). These are largely allopatric, with *H. marginipennis* (Blatchley) restricted to Florida, *H. acaroides* (LeConte) widely distributed throughout the Mississippi River basin and north to Winnipeg, Manitoba, and *H. farctus* (LeConte) in north-eastern United States and southern Canada. Although specimens of *H. acaroides* were not collected in Alberta, it is not unlikely that they will be discovered here. Members of *H. acaroides*

resemble those of *H. farctus* in shape and size but differ in having the elytra patterned, elytral punctation simple and general punctation of the body sparser, clypeus margined, and the elytra with a low anterior sublateral ridge or carinae.

*Natural history notes.* — Specimens of this species were collected from only one Alberta locality, near the outer margin (lakeward side) of a quaking bog, along the edges of pools situated in the floating *Drepanocladus* moss mat. These pools contained dead moss, *Menyanthes trifoliata* and other rooted aquatic vegetation and hence resemble small ponds more than pools such as are usually found in quaking bogs.

*Distribution.* — Anderson (1971) records this species from northeastern United States and southern Canada, from Massachusetts to Manitoba. Five Alberta specimens were examined (map, Fig. 330).

#### *Hygrotus turbidus* (LeConte, 1855)

*Hydroporus turbidus* LeConte, 1855: 298. (Type locality — Massachusetts.) LeConte 1863a: 16. — Gemminger and Harold 1868: 441. — Crotch 1873: 389. — Sharp 1882: 399. — Wickham 1895a: 73. — Blatchley 1910: 215. — Fall 1919: 7. — Carr 1920: 3. — Leng 1920: 77. — Brown 1931: 88. — Hatch 1953: 199. — Gordon and Post 1965: 14. — Wallis 1973: 102.

*Diagnosis.* — Members are small, reddish brown, with dual elytral punctation, elytra and ventral surface of body without microsculpture and clypeus unmargined. Male protarsi are not modified.

*Description.* — Measurements of 20 Alberta specimens are: TL — 2.72 to 3.08 mm ( $\bar{X} = 2.90 \pm 0.09$  mm); MW — 1.52 to 1.72 mm ( $\bar{X} = 1.62 \pm 0.05$  mm); TL/MW — 1.74 to 1.85 mm ( $\bar{X} = 1.79 \pm 0.03$ ).

Dorsal surface rufous to brown; head with posterior margin and frons inside each eye somewhat darkened; antennae with articles 5 to 11 infusate, at least apically; palpi testaceous except terminal article of each maxillary palpus slightly darkened. Pronotum with diffuse spot centered on medial fovea; elytron with sutural margin narrowly piceous, disc rufous to brown, paler laterally. Ventral surface of body black. Legs rufous to pale brown.

Punctation of basal portion of elytral disc dual, with large punctures and scattered smaller punctures of less than one half diameter of larger (Fig. 269); punctures subequal in size towards apex. Metacoxal plate with separated coarse punctures. Head with isodiametric microsculpture, otherwise body smooth and shiny between punctures and devoid of sculpture.

Clypeus unmargined. Prosternal process elongate and sharply carinate medially, apex extended to metasternum. Male protarsus with article 2 very slightly broadened, otherwise not modified. Aedeagus as in Figure 11.

*Natural history notes.* — *H. turbidus* is a freshwater species, the members usually found in the vegetation-rich shallows of permanent ponds or at least ponds that last throughout a considerable portion of the summer. Teneral specimens were collected in August. Specimens were taken in flight during the last week in May.

*Distribution.* — The species ranges from the Atlantic coast of British Columbia and south to at least South Dakota (UASM!) and Wyoming (CARR!). Northern limits are unknown. The species occurs throughout Alberta east of the Rocky Mountains. I examined 128 specimens from Alberta localities (map, Fig. 331).

#### *Hygrotus compar* (Fall, 1919)

*Coelambus compar* Fall, 1919: 8. (Type locality — Tyngsboro, Massachusetts.) Leng and Mutchler 1927: 17. — Brown 1930b: 234. — Gordon and Post 1965: 14. — Wallis 1973: 102.

*Diagnosis.* — Members are medium sized and are recognized on the basis of the following characters: dorsal surface of body dark rufous to brown, elytra not distinctly patterned; elytral punctation dual; clypeus not margined. Males have protarsal article 2 much broader than article 1.

*Description.* — Measurements of 20 Alberta specimens are: TL — 3.52 to 4.08 mm ( $\bar{X} = 3.78 \pm 0.13$  mm); MW — 1.76 to 2.12 mm ( $\bar{X} = 1.99 \pm 0.08$  mm); TL/MW — 1.84 to 1.93 ( $\bar{X} = 1.89 \pm 0.03$ ).

Head dark rufous to brown except clypeus and frons medially and anteriorly, paler rufous; antenna testaceous basally,

articles 5 to 11 piceous apically; palpi testaceous except apex of terminal article of each palpus infusate. Pronotum rufous to reddish brown except anterior and basal margins piceous. Elytron with sutural margin narrowly piceous, otherwise disc uniformly rufous to brown, without distinct marks, some specimens with disc slightly darker medially and posteriorly but limits of darkened area obscure. Ventral surface mainly piceous to black, some specimens with metasternum medially, rufous. Legs rufous, some specimens with bases of femora and tarsi infusate.

Elytral punctation dual, punctures of two distinct size classes (Fig. 270, 271). Males with elytra, metacoxal plates and abdominal sterna smooth and shiny without microsculpture. Females of two types: male-like, with elytra and metacoxal plates smooth, abdominal sterna with microsculpture; or female form with elytra, metacoxae and abdominal sterna dull with dense microsculpture.

Clypeus without anterior bead. Posternal process acutely raised medially, apex extended to anterior margin of metasternum. Abdominal sterna not modified. Male protarsus (Fig. 28) with article 2 much broader than article 1; anterior protarsal claw strongly arcuate basally. Aedeagus as in Figure 12.

*Taxonomic notes.* — Members of *Hygrotus obscureplagiatus* (Fall, 1919) are very similar to those of *H. compar* in most features. However, as Fall pointed out, all members of the former species have the elytral punctures more uniform in size, and the body is generally more coarsely punctate. The male anterior protarsal claw is more strongly arcuate basally. Members of *H. columbianus* (Brown, 1930b) differ from those of *H. obscureplagiatus* only in color and for this reason Hatch (1953) is correct in regarding the name *H. columbianus* as a junior synonym of the name *H. obscureplagiatus*. Although *H. obscureplagiatus* occurs in southeastern British Columbia, I have not seen specimens from Alberta nor is there any evidence of this species hybridizing with *H. compar*. These species appear allopatric, constituting a pair of east-west vicars.

*Natural history notes.* — Specimens of *compar* are often abundant among flooded grasses and rushes in temporary prairie ponds. Although usually found in fresh water, specimens were collected from distinctly saline sloughs. Teneral specimens were collected on August 22, 1971 (Travers, Alta.). No records of flight are available.

*Distribution.* — This species ranges from New England to Alberta. The southern limits are unknown. In Alberta specimens have been found on the prairies south of the North Saskatchewan River. I examined 275 Alberta specimens (map, Fig. 332).

#### *Hygrotus canadensis* (Fall, 1919)

*Coelambus canadensis* Fall, 1919: 11. (Type locality — Winnipeg, Manitoba.) Leng and Mutchler 1927: 17. — Gordon and Post 1965: 15. — Wallis 1973: 102.

*Diagnosis.* — Size, color, lack of microsculpture on elytra and ventral surface of the body, the slightly dilated protarsi of the male and the shape of the male protarsal claws define this species.

*Description.* — Body elongate oval, slightly broader and more depressed than in *H. patruelis* specimens. Measurements of 20 Alberta specimens are: TL — 3.48 to 3.96 mm ( $\bar{X} = 3.68 \pm 0.12$  mm); MW — 1.72 to 2.08 mm ( $\bar{X} = 1.93 \pm 0.09$  mm); TL/MW — 1.84 to 2.00 ( $\bar{X} = 1.89 \pm 0.04$ ).

Color various. Head dark rufous to piceous with paler medial spot on frons between eyes; antenna with articles 1 to 4 testaceous or pale brown outer articles infusate; palpi testaceous except terminal article of each palpus infusate. Pronotum with anterior and posterior margins piceous, disc dark brown with lateral and anterior submarginal areas rufous. Elytron pale brown with disc medially and posteriorly darker, almost piceous in some specimens with disc more or less distinctly patterned but for majority of specimens limits of dark areas vague. Ventral surface mainly black. Legs brown or piceous.

Elytral punctation (Fig. 272) relatively fine, punctures between discal series smaller than serial punctures, more or less equal in size and relatively sparse, larger and denser posteriorly. Metacoxa deeply punctate. Elytra and ventral surface without microsculpture.

Clypeus without anterior bead. Abdominal sterna not modified. Male with articles 1 to 3 of protarsus (Fig. 29) narrowly but evidently dilated, articles 1 and 2 of about equal width, slightly wider than article 3. Anterior protarsal claw slightly broader and shorter than posterior claw, more strongly arcuate basally. Aedeagus strongly arcuate (Fig. 13).

*Taxonomic notes.* — Fall (1919), in his original description of this species, stated that two females in the type series were opaque (i.e., strongly microsculptured) and indistinguishable from opaque females of *patruelis*, and may in fact belong to that species. Microsculptured

females assignable to the species *canadensis* were not seen from Alberta whereas all females of *H. patruelis* from the province were microsculptured. This is the best character for separating females of the two species. Hence, it appears likely that Fall's series was actually mixed, as he suggested.

*Natural history notes.* — Specimens of *H. canadensis* occur in a variety of lotic habitats, in emergent vegetation or in flooded plant debris along margins of open temporary or permanent ponds; occasionally in slightly saline water, or in cold *Carex* marshes.

*Distribution.* — The species is known from Manitoba and North Dakota to Alberta. In Alberta, specimens have been taken as far north as Manning. I examined more than 380 specimens from Alberta (map, Fig. 333).

*Hygrotus patruelis* (LeConte, 1855)

*Hydroporus patruelis* LeConte, 1855: 298. (Type locality — Fort Laramie, "Nebraska" (Wyoming)). LeConte 1859a: 35. — LeConte 1863a: 16. — Gemminger and Harold 1868: 438. — Crotch 1873: 389. — Sharp 1882: 400. — Wickham 1895a: 74. F. Carr 1920: 3. — Leng 1920: 77. — Anderson 1962: 59. — Gordon and Post 1965: 15. — Wallis 1973: 102.

*Diagnosis.* — Characteristics of this species are similar to those of *H. canadensis* Fall but differ in the male protarsus being widely dilated, the female densely microsculptured, and the elytral color pattern more distinct.

*Description.* — Measurements of 20 Alberta specimens are: TL — 3.36 to 4.16 mm ( $\bar{X} = 3.82 \pm 0.21$  mm); MW — 1.76 to 2.16 mm ( $\bar{X} = 1.98 \pm 0.11$  mm); TL/MW — 1.88 to 2.00 ( $\bar{X} = 1.93 \pm 0.03$ ).

Head rufous except frons inside each eye and along posterior margin, piceous; antennal articles 1 to 4 or 5 testaceous, outer articles piceous; palpi testaceous except terminal article of each palpus infusate. Pronotum bicolored, testaceous to rufotestaceous and following areas piceous: disc, basally in all specimens, dark mark extended to anterior margin in some specimens; basal margin, narrowly so laterally, more broadly so medially, continuous with discal mark; and anterior margin narrowly so, along emargination. Elytral color various: sutural margin narrowly piceous: most specimens with at least epipleuron, humeral angle, lateral margin in basal half to two thirds, and subapical spot, testaceous; remainder of disc brown or rarely piceous (some specimens with brown discal cloud of elytron reduced to form small elongate subhumeral spot and larger discal cloud on apical half, rarely entire disc pale brown, without distinct darker areas). Ventral surface mainly black. Legs pale brown to rufous with terminal tarsal articles infusate dorsally on some specimens.

Elytral punctation dense; discal punctures deep and of slightly differing diameters, not of two distinct size classes (Fig. 273, 274). Male with elytra, metacoxa and abdominal sterna without microsculpture, or rarely male with metacoxal plates and abdominal sterna with evident microsculpture. Female densely microsculptured, luster dull.

Clypeus unmarginated. Prosternal process normal. Abdomen not modified in either sex. Male with articles 1 to 3 of protarsus (Fig. 30) broadly dilated, article 2 broader than 1 but disparity between two less than in males of *H. compar* Fall; anterior protarsal claw short and broad, strongly bent near base. Aedeagus more or less straight in apical half, more arcuate basally (Fig. 14).

*Taxonomic notes.* — Three males from the Ft. McKay and Lake Athabasca areas differ from other Alberta specimens in that the metacoxal plates are microsculptured, and the abdominal sterna of one specimen are sculptured. However, they agree with other Alberta specimens in all other structural characters. The names *H. borealis* (Fall, 1926: 138) and *H. quebecensis* (Brown, 1930b: 234) appear to apply to this sculptured form. However, I have not examined the type material and have seen too few specimens of this microsculptured form to form an opinion on its status. The sculptured form appears to be more northern in distribution than is the normal form of the species.

*Natural history notes.* — This species occurs in much the same sort of habitats as described for *H. canadensis* (Fall). Teneral specimens were collected from July 1 to October 21; however the majority of immature specimens were taken from the end of July through August. Several specimens were observed landing on a black car in Calgary on May 30, 1972.

*Distribution.* — This species was recorded from Nebraska, Wyoming, North Dakota, Manitoba and Utah. I examined more than 370 specimens from Alberta localities (map, Fig. 334).



*Hygrotus sellatus* (LeConte, 1866)

*Hygrotus sellatus* LeConte, 1866: 365. (Type locality – "Dakota"). Gemminger and Harold 1868: 440. – Crotch 1873: 389. – Sharp 1882: 809. – Fall 1919: 11. – Leng 1920: 77. – Hatch 1953: 199. – Gordon and Post 1965: 15. – Wallis 1973: 102.

**Diagnosis.** – Members of this and the following species, *H. suturalis* LeConte, are separated from the rest of the Alberta species of *Hygrotus* on the basis of their characteristically colored elytra: testaceous, each with a well defined small longitudinal subhumeral spot and a larger, more or less sharply defined (less on some specimens of *suturalis*), apical blotch. Males of *sellatus* have the anterior protarsal claw modified while the females bear fine microsculpture on the abdominal sterna. Members of *suturalis* lack these features.

**Description.** – Measurements of 20 Alberta specimens are: TL – 3.00 to 3.36 mm ( $\bar{X}$  = 3.17 ± 0.10 mm); MW – 1.60 to 1.80 mm ( $\bar{X}$  = 1.71 ± 0.07 mm); TL/MW – 1.78 to 1.93 ( $\bar{X}$  = 1.86 ± 0.04).

Head dark brown or piceous with frons medially rufotestaceous to pale rufous (on some specimens pale area includes most of clypeus); antennae testaceous basally, outer articles piceous at least apically; palpi pale, except terminal article of each palpus infusate apically. Pronotum mainly brown to piceous except anterolateral pale area on disc, on some specimens more or less expanded and extended anteriorly submarginally to anterior border. Elytron bicolored, pale testaceous, sutural margin piceous: basal one third immaculate except for subhumeral elongate brown or piceous spot; apical two thirds of disc with large brown or piceous spot continuous with sutural margin internally but separated from other margins by distinct pale area; these maculations distinctly limited. Ventral surface mainly black. Legs testaceous to brown, most specimens with femora basally and tarsi infusate; some specimens with tibiae infusate apically.

Punctures of elytron, except for serial punctures and the fine punctation of sutural margin, more or less equal in size. Male with elytra, metacoxae, and abdominal sterna shiny and devoid of microsculpture; female similar except abdominal sterna with lightly impressed transversely stretched microsculpture best developed medially on each segment.

Clypeus without raised anterior bead. Prosternal process elongate and extended to metasternum. Male with protarsal articles only very slightly dilated (Fig. 31), anterior protarsal claw broadened and strongly arcuate basally. Aedeagus slender and more or less evenly arcuate throughout length (Fig. 15).

**Natural history notes.** – These insects frequent fresh to moderately saline prairie ponds, often in shallow water among dense aquatic vegetation, but also among sparse emergent rushes in ponds with bare clay bottoms. Teneral specimens were collected on July 11. Specimens were captured in flight on May 30, 1972.

**Distribution.** – This species ranges from Manitoba and North Dakota to British Columbia. In Alberta it is found on prairies and adjacent parklands and may be isolated in the Peace River area. I examined 156 specimens from Alberta localities (map, Fig. 335).

*Hygrotus suturalis* (LeConte, 1850)

*Hygrotus suturalis* LeConte, 1850: 216. (Type locality – Lake Superior.) Melsheimer 1853: 32. – LeConte 1863a: 16. – Gemminger and Harold 1868: 441. – Crotch 1873: 389. Sharp 1882: 400. – Fall 1919: 10. – Leng 1920: 77. – Hatch 1953: 200. – Gordon and Post 1965: 14. – Wallis 1973: 102.

**Diagnosis.** – The principal characters for the recognition of this species are presented under *H. sellatus*.

**Description.** – Measurements of 20 Alberta specimens are: TL – 2.96 to 3.40 mm ( $\bar{X}$  = 3.24 ± 0.10 mm); MW – 1.56 to 1.84 mm ( $\bar{X}$  = 1.76 ± 0.07 mm); TL/MW – 1.80 to 1.90 ( $\bar{X}$  = 1.84 ± 0.03).

Color similar to that of *H. sellatus*, differing as follows: ground color of elytron dark testaceous or rufous, apical elytral spot larger and on many specimens extended onto basal third of elytral disc as one or two longitudinal projections, on some specimens, continuous with subhumeral spot; limits of maculations well defined or obscure.

Punctures on basomedial portion of elytron irregular in size, with few large punctures, scattered among smaller ones; punctures denser and more uniform in size toward apex. Both sexes with elytra, metacoxal plates and abdominal sterna devoid of microsculpture.

Male with protarsal article 2 very slightly dilated, subequal in width to article 1; protarsal claws not modified. Aedeagus (Fig. 16) arcuate basally, more or less straight toward apex.

**Natural history notes.** – This species is most frequently found in warm weedy fresh water ponds, usually in the parkland or mixed forest zones of the province. However, specimens were also collected on the prairies and in the boreal forest.

*Distribution.* — The known range of this species is from Lake Superior and North Dakota to Alberta and British Columbia. I have seen specimens from as far north as Aklavik, N.W.T. (Bryant, UASM) and Mayo, Yukon (CARR) and examined more than 150 specimens from Alberta localities (map, Fig. 336).

*Hygrotus dentiger* (Fall, 1927)

*Coelambus dentiger* Fall, 1927a: 136. (Type locality — Medicine Hat, Alta.) Leng and Mutchler 1933: 15. — Hatch 1953: 201. — Anderson 1967: 360. — Wallis 1973: 103.

*Diagnosis.* — The large size, vittate pattern of the elytra, toothed anterior protarsal claw of male, and the basally shiny elytra of the female characterize this species.

*Description.* — Measurements of 20 Alberta specimens are: TL — 5.04 to 5.68 mm ( $\bar{X} = 5.32 \pm 0.17$  mm); MW — 2.60 to 2.88 mm ( $\bar{X} = 2.69 \pm 0.08$  mm); TL/MW — 1.90 to 2.02 ( $\bar{X} = 1.95 \pm 0.03$ ).

Head rufous except frons with posterior margin and spot internal to each eye, piceous; antennae pale, except outer articles infusate apically; palpi pale except terminal article of each palpus infusate apically. Pronotum rufotestaceous except anterior and basal margins piceous medially, disc with medial brown or piceous spot. Elytron testaceous, except sutural margin black; disc with four or five longitudinal brown or piceous vittae, latter varied in development, usually distinct on basal half of disc, broader and more or less continuous posteriorly (some specimens with vittae broadly expanded and entire disc of elytron dark brown with only lateral, basal and narrow subsutural pale areas). Ventral surface piceous to black. Legs pale brown with terminal articles of pro- and mesotarsus infusate on many specimens.

Disc of elytron basally, between serial punctures, with few sparse large punctures, subequal in size to serial punctures, more numerous small punctures interspersed. Male with elytra, metacoxae and abdominal sterna smooth and shiny, without microsculpture or some non-Alberta specimens with lightly impressed lines and open meshes; female with basal third to half of elytron smooth, microsculpture on apical two thirds or half; metacoxae and abdominal sterna sculptured.

Clypeus without anterior marginal bead. Prosternal process elongate and slender, extended to anterior margin of metasternum. Pronotum with sides evenly and smoothly arcuate throughout length; maximum width at hind angles; latter narrowly rounded and slightly obtuse. Male protarsus broadly dilated, articles 1 and 2 subequal in width, article 3 narrower; anterior protarsal claw slightly shorter than posterior, stouter and bearing a right angled ventral tooth near base; posterior claw not modified. Aedeagus (Fig. 18) very long, more or less straight in apical two thirds.

*Taxonomic notes.* — I saw a single female specimen (Tp. 8 Rge. 2 W 4, Alta., UC) with the entire elytral surface microsculptured. The meshes are large basally, hence the base is still somewhat shiny and not more or less opaque as are the elytra of *H. unguicularis* (Crotch) females, with which it could otherwise be confused. Also, I examined a male from Colorado (Blue Mesa Res., CARR) which has lightly impressed sculpture on the metacoxal plates and abdominal sterna.

*Natural history notes.* — This species is found in both fresh and slightly saline prairie ponds, often commonly in temporary ponds. Teneral specimens were collected from July 28 to September 25.

*Distribution.* — I have seen specimens from North and South Dakota (UASM), Montana (CARR) and Saskatchewan (CARR). Hatch (1953) records it from southeastern British Columbia, and Anderson (1967) indicates collection records for the Northwest Territories, and southern Yukon and New Mexico. I examined more than 200 specimens from Alberta localities (map, Fig. 337).

*Hygrotus unguicularis* (Crotch, 1874)

*Hydroporus unguicularis* Crotch, 1874, 73. (Type locality — British Columbia.) Sharp 1882: 813. — Fall 1919: 19. — Leng 1920: 76. — Hatch 1953: 201. — Anderson 1962: 60. — Gordon and Post 1965: 16.

*Diagnosis.* — The male of this large vittate species is easily identified on the basis of the structure of the protarsus. However, the female possesses no single diagnostic character and is best identified on the basis of the characters presented in the key to species.

*Description.* — Size large for genus. Measurements of 20 Alberta specimens are: TL — 4.92 to 5.56 mm ( $\bar{X} = 5.29 \pm 0.19$  mm); MW — 2.56 to 2.80 mm ( $\bar{X} = 2.67 \pm 0.07$  mm); TL/MW — 1.88 to 2.11 ( $\bar{X} = 1.98 \pm 0.06$ ).

Color similar to that of *H. dentiger* individuals. Head pale except posterior margin and on some specimens frons inside each eye, brown to piceous; antenna pale except terminal articles infusate; palpi pale, except terminal article of each palpus infusate. Pronotum testaceous except anterior and posterior margins medially, narrowly brown or piceous; disc with small medial piceous spot. Elytron bicolored; testaceous, sutural margin narrowly black; disc with three more or less complete brown vittae, vitta 4 broken medially and vitta 5 represented only on apical half; most specimens with vittae separate and distinct on basal half, but variously widened and fused toward apex.

Elytron covered with small more or less equal sized punctures; punctuation of metacoxae and abdominal sterna finer than that characteristic of *H. dentiger*. Male with elytra smooth and shiny between punctures, without microsculpture; female with entire elytron densely sculptured; both sexes with metacoxae and abdominal sterna sculptured.

Clypeus without anterior marginal bead. Pronotum with sides arcuate, greatest width slightly anterior to obtuse narrowly rounded hind angles; prosternal process elongate and extended to metasternum. Metatarsal article 1 with longitudinal row of seven to 12 setae on ventral face. Male with protarsal articles 1 to 3 broadly dilated (Fig. 32); protarsal claws broadened; anterior claw shorter than posterior, with obtuse ventral tooth; posterior claw twisted anteriorly in dorsal view. Aedeagus (Fig. 19) large, more or less straight in apical two thirds.

*Natural history notes.* — Specimens of this species inhabit warm, weedy ponds throughout the province. They occur primarily in fresh water although occasional specimens were taken from slightly saline waters. Scudder (1969) calls this a fresh or low salinity species, and records it from lakes on the Fraser Plateau of British Columbia, which range in conductivity from 400 to 29,000 micromhos/cm. Specimens occur in both temporary and permanent ponds. Teneral specimens were collected from July 30 to September 3.

*Distribution.* — This species ranges from North Dakota and Manitoba to Utah and British Columbia, and as far north as the Mackenzie Delta (Aklavik, Tununuk; O. Bryant; UASM). I examined more than 250 specimens from Alberta localities (map, Fig. 338).

#### *Hygrotus tumidiventris* (Fall, 1919)

*Coelambus tumidiventris* Fall, 1919: 16. (Type locality — Stony Mountain, Manitoba.) Carr 1920: 3. — Leng and Mutchler 1927: 17. — Hatch 1953: 200. — Leech and Chandler 1956: 316. — Anderson 1962: 60. — Gordon and Post 1965: 15. — Wallis 1973: 103.

*Diagnosis.* — The following characteristics define this species: large size; vittate elytral pattern of many specimens; dual punctuation on elytra; and abdominal sternum 6 with basal lateral impression followed by an inflated or tumid area.

*Description.* — Measurements of 20 Alberta specimens are: TL — 4.08 to 4.88 mm ( $\bar{X}$  = 4.58 ± 0.20 mm); MW — 2.04 to 2.64 mm ( $\bar{X}$  2.38 ± 0.13 mm); TL/MW — 1.85 to 2.00 ( $\bar{X}$  = 1.92 ± 0.04).

Head rufotestaceous except frons with posterior margin medially and spot medial to each eye, continuous on most specimens with posteromedial spot, dark brown or piceous; antennae pale, except outer articles infusate apically; palpi pale, terminal article of each palpus lightly infusate or not. Pronotum rufotestaceous with anterior and posterior borders pale or narrowly darker near middle; disc with small brown medial spot. Elytron testaceous to rufotestaceous except sutural margin narrowly piceous, disc of most specimens with distinct vittate maculations, variously fused on apical half of disc, vittae 1 and 2 more or less complete and narrow, vitta 3 often broken in one or two places, vitta 4 broken at middle and vitta 5 absent or represented as small spot on apical half.

Elytron with punctuation of disc dual: disc basally with sparse scattered punctures subequal in size to serial punctures, separated by more numerous smaller punctures. Male without microsculpture on disc of elytra and metacoxal plates. Female with fine microsculpture on elytra and metacoxal plates or rarely, female without microsculpture and resembling male; both sexes with abdominal sterna microsculptured.

Clypeus without anterior bead. Prosternal process elongate, normal. Abdominal sternum 6 with basolateral impression on each side and pronounced swelling or tumidity (more pronounced on male than on female). Metatibia slightly arcuate in lateral view, dorsal margin slightly concave. Male with articles 1 to 3 of protarsus dilated (Fig. 33), articles 1 and 3 subequal in width, article 2 broader than 1 and 3; protarsal claws narrow; anterior claw slightly shorter than posterior and abruptly bent near base, dorsoventrally broadened medially, but without tooth and not twisted in dorsal aspect. Aedeagus and parameres as in Fig. 17.

*Natural history notes.* — Although this species is most frequently encountered in warm prairie ponds, it also occurs sporadically in the northern forested portion of the province, in both fresh and saline waters and in permanent and temporary ponds. Teneral specimens were collected from August 22 to September 8.

*Distribution.* — The known range of this species is from Manitoba and North Dakota to

British Columbia and California. I examined 20 specimens from Salt Plain, N.W.T. (Wallis, UASM), and more than 200 Alberta specimens (map, Fig. 339).

*Hygrotus semivittatus* (Fall, 1919)

*Coelambus semivittatus* Fall, 1919: 18. (Type locality -- Seligman, Arizona). Leng and Mutchler 1927: 17. -- LaRivers 1951: 399. -- Hatch 1953: 202.

*Diagnosis.* -- The unmarginated clypeus, pale color, reduced vittate elytral maculations, and narrow pronotum, serve to characterize this species.

*Description.* -- Measurements of 20 Alberta specimens are: TL -- 4.44 to 4.92 mm ( $\bar{X}$  = 4.67  $\pm$  0.14 mm); MW -- 2.24 to 2.52 mm ( $\bar{X}$  = 2.36  $\pm$  0.08 mm); TL/MW -- 1.92 to 2.08 ( $\bar{X}$  = 1.98  $\pm$  0.05).

Head and pronotum uniformly rufotestaceous; antennae with only outermost articles lightly infuscate; apical article of each palpus lightly infuscate; pronotum with basal margin narrowly brown or piceous. Elytron testaceous except sutural margin piceous: disc with four narrow vittae; vitta 2 best developed and extending medial two thirds length of elytron, vitta 1 slightly shorter, with origin more apically, vitta 3 origin about middle; vitta 4 various, usually one spot on apical half, but on some specimens continued in basal half (these markings may be highly varied, ranging from almost absent on some specimens to quite fully developed with some fusion toward apex). Ventral surface of body black. Legs rufotestaceous.

Elytron with punctation fine and of more or less uniform size and density. Both sexes with fine microsculpture on elytron and metacoxal plates, but less deeply impressed on male. Males more shiny than females.

Clypeus without raised anterior margin. Prosternal process normal. Pronotum narrow, sides almost straight behind front angles, divergent posteriorly but pronotum at base narrower than elytra across humeral angles on many specimens, hence outline of body irregular and discontinuous at shoulders. Sternum 6 not modified. Male protarsus (Fig. 34) with articles 1 to 3 dilated, article 2 broader than 1 and 3, article 1 broader than 3; claws slender, anterior claw shorter than posterior and strongly arcuate. Female protarsal articles very elongate and slender. Aedeagus evenly arcuate: parameres short and broad (Fig. 20).

*Natural history notes.* -- Members of this species are usually in shallow, turbid, saline or alkaline ponds, where the bottom is bare clay or clay with scattered rocks. Such ponds are usually temporary and are dry by June in most years. Occasional specimens are found in fresh or clear water, probably because of recent dispersal.

*Distribution.* -- This is a western species whose range extends from Arizona and Nevada to British Columbia. It is known from east of the Rocky Mountains only in southern Alberta. I examined 71 Alberta specimens (map, Fig. 340).

*Hygrotus punctilineatus* (Fall, 1919)

*Coelambus punctilineatus* Fall, 1919: 17. (Type locality -- Stony Mountain, Manitoba.) Leng and Mutchler 1927: 17. -- Wallis 1973: 102.

*Diagnosis.* -- The combination of the vittate elytra, dual punctation of elytral disc, strongly ascending lateral margin of elytron and the peculiar male protarsal claws characterize this species.

*Description.* -- Measurements of 20 Alberta specimens are: TL -- 3.72 to 4.12 mm ( $\bar{X}$  = 3.93  $\pm$  0.12 mm); MW -- 2.0 to 2.28 mm ( $\bar{X}$  = 2.17  $\pm$  0.07 mm); TL/MW -- 1.73 to 1.87 ( $\bar{X}$  = 1.81  $\pm$  0.03).

Head testaceous except posterior margin of frons and forward extension along inner margin of each eye, black: antennae pale except terminal articles infuscate: palpi pale except terminal article of each palpus infuscate apically. Pronotum testaceous except anterior border medially, and on some specimens also posterior border, narrowly piceous: disc with small medial brown spot. Elytron testaceous except sutural margin narrowly piceous; disc with four or five longitudinal piceous or black vittae; vittae 1 to 3 complete, narrowest anteriorly and broadened behind but on most specimens separate throughout length; vitta 4 shorter, broken on many specimens into elongate anterior mark and broad posterior spot usually contacted to vitta 3 internally; vitta 5 absent or infrequently represented by small spot. Ventral surface black. Legs testaceous.

Head very densely and deeply punctate. Elytral punctation dual (Fig. 275), with larger punctures, subequal in size to serial punctures, situated mainly on vittae but also scattered over remainder of disc: interspaces with numerous very small punctures. Male elytron smooth and shiny, without microsculpture; female elytron with microsculpture which tends to obscure finer punctures: metacoxal plates and abdominal sterna sculptured on specimens of both sexes.

Body short and broadly oval. Clypeus without anterior bead. Elytral margin in lateral view strongly ascendent to humeral angle. Prosternal process normal. Abdominal sternum 6 normal. Male protarsal articles (Fig. 35) 1 to 3 subequal in width; anterior protarsal claw elongate and slender, more or less straight medially, posterior claw about one half length of anterior

claw and very slender. Aedeagus slender, more or less evenly arcuate basally with apex slightly recurved (Fig. 21).

*Natural history notes.* – These dytiscids are usually found in saline or alkaline water, (although seldom in highly saline lakes surrounded by thick deposits of crustose salts) in shallow water where the bottom is clay, sand or fine gravel and vegetation is either lacking or consists of scattered emergent rushes. General specimens were collected from August 7 to September 3.

*Distribution.* – This species is known from the Canadian Prairies only. I have seen specimens from Manitoba, Saskatchewan and Alberta. I examined more than 100 Alberta specimens (map, Fig. 341).

### *Hygrotus impressopunctatus* (Schaller, 1783)

*Dytiscus impressopunctatus* Schaller, 1783: 312. (Type locality – unknown to me.) Crotch 1873: 389. – Sharp 1882: 403. – Wickham 1895a: 74. – Blatchley 1910: 216. – Fall 1919: 19. – Zimmermann 1919: 152. – Carr 1920: 3. – Leng 1920: 77. – Brown 1930: 234. – Guignot 1933: 288. – J. Balfour-Browne 1948: 159, 162. – Hatch 1953: 201. – Zaitsev 1953: 134. – Leech and Chandler 1956: 316. – Anderson 1962: 60. – Gordon and Post 1965: 16. – James 1970: 92. – Wallis 1973: 103.

*Hydroporus similis* Kirby, 1837: 68. (Type male in BMNH labelled as follows: Type H.T.; N. Amer. ♂ 5770 a; *Hydrop. similis* Kirby, N. Amer., 5770 Rev. W. Kirby.) Melsheimer 1853: 32. – LeConte 1855: 292. – LeConte 1863: 16. – Gemminger and Harold 1868: 441. (Old World synonymy omitted.)

*Diagnosis.* – Specimens of this species are generally recognized by large size, longitudinally confluent serial punctures of the elytron, dense elytral punctation, and presence of at least faintly suggested longitudinal vittate markings on the elytra. Specimens of this species are extremely similar to those of *H. picatus*, from which they can best be separated by the characters presented in the key.

*Description.* – Measurements of 30 Alberta specimens are: TL – 4.40 to 5.08 mm ( $\bar{X}$  = 4.77 ± 0.19 mm); MW – 2.20 to 2.64 mm ( $\bar{X}$  = 2.47 ± 0.10 mm); TL/MW – 1.85 to 2.00 ( $\bar{X}$  = 1.93 ± 0.04).

Head rufous except frons beside each eye piceous, piceous areas convergent posteriomedially and continuous with piceous basal margin of head; antennae pale except articles 4 or 5 to 11 infuscate apically; palpi testaceous except terminal article of each maxillary palpus lightly infuscate. Pronotum testaceous to rufous except transverse piceous band on basal 0.33 to 0.5, this band on most specimens not extended to lateral margin and somewhat prolonged medially. Elytron varied in color: disc largely dark brown or piceous, most specimens with lateral and humeral pale areas as well as several somewhat irregular and often poorly defined pale vittae on disc; (these vittae or longitudinal pale markings evident on almost all specimens; on some darker specimens vittae pale lines inside sutural margin and just external to each serial row of punctures); epipleuron pale. Ventral surface black. Legs rufous with pro- and mesotarsal articles infuscated on many specimens.

Elytral punctation (Fig. 276, 277) dual on basal half; each elytron with subsutural, two discal and subhumeral longitudinal row of punctures on most specimens closely situated and confluent in form of four striae on at least basal portion of disc (not well developed or evident on some coarsely sculptured females); area between striae with scattered coarse punctures as well as numerous small secondary punctures in interspaces, punctation denser but more regular on apical third of elytron (pattern of punctation obscured on some coarsely sculptured females). Male without microsculpture on elytra; some females similar to males, or with microsculpture restricted to apical one third of elytron; many females with dense microsculpture over entire disc of elytron, with smaller punctures and serial punctures separated from one another and not in form of evident longitudinal striae. Metacoxal plates microsculptured. Abdominal sterna of male largely smooth and shiny without microsculpture; sternum 3 posteriomedially without trace of sculpture; female with sterna sculptured.

Clypeus without anterior bead. Prosternal process normal. Mesotrochanter with ventral surface densely punctate, posterior ventral surface with row of long setae preceded by a dense field of very short stout setae. Metacoxal lines strongly divergent. Pro- and mesotarsi broadly dilated in both sexes. Male anterior protarsal claw stout, strongly arcuate basally. Aedeagus more or less straight in apical half (Fig. 22). Ovipositor with apex short and not strongly produced (Fig. 26 and Guignot 1933: 289, Fig. 166).

*Taxonomic notes.* – This species exhibits marked variation in size, body proportions, color and punctation. This coupled with parallel variation in the following species has led almost all previous authors to regard them as constituting one widespread highly variable species. Because of this, most literature citations cannot be definitely referred to one or the other of these species. The name *H. picatus* Kirby is not a synonym of *H. impressopunctatus* Schaller but rather applies to the following species.

*Natural history notes.* – This species was collected from nearly all types of shallow weedy

or vegetation-choked water throughout the province. Specimens are not found in strongly saline water and to some extent the species is replaced in cold *Carex* marshes by *H. picatus* Kirby. Most teneral specimens were collected during the latter part of July and August. Specimens were collected in flight (Calgary, May 30, 1972) and at light (Flatbush, June 24, F. Schott).

*Distribution.* — This species occurs from New England to California and north to Yukon (CARR, !) and Alaska, I examined more than 600 specimens from Alberta localities (map, Fig. 342).

*Hygrotus picatus* (Kirby, 1837)

*Hydroporus picatus* Kirby, 1837: 68. (Type — female in BMNH, labelled as follows: Type H. T.; N. Amer. 5769 Rev. Wm. Kirby.) (Type locality given as Lat. 54.) LeConte 1850: 215. — Melsheimer 1853: 32. — LeConte 1855: 298. — LeConte 1863: 16. — Gemminger and Harold 1868: 438. — Crotch 1873: 388.

*Diagnosis.* — Specimens of this species are very similar to dark specimens of *H. impressopunctatus*, these two species being separated best on the basis of the characters presented in the key.

*Description.* — Measurements of 30 Alberta specimens are: TL — 4.72 to 5.32 mm ( $\bar{X}$  = 5.06 ± 0.17 mm); MW — 2.44 to 2.72 mm ( $\bar{X}$  = 2.59 ± 0.08 mm); TL/MW — 1.89 to 2.02 ( $\bar{X}$  1.95 ± 0.03).

Color darker than *H. impressopunctatus*, elytron without distinct pattern. Head rufous with posterior margin and frons broadly medial to each eye, piceous; antennae with articles 1 to 4 pale rufous, articles 5 to 11 infuscate at least apically; palpi rufous with terminal article of maxillary palpus and on some specimens also terminal article of labial palpus lightly infuscate. Pronotum with apical half rufous, basal half piceous to lateral margins, or some specimens with entire disc piceous. Elytra uniformly dark rufous to brown or rarely piceous, without suggestion of longitudinal pale areas on disc. Ventral surface black. Legs rufous; metafemur medially and tarsi infuscate on some specimens.

Pattern of punctation and microsculpture similar to that described for *H. impressopunctatus*. Punctation of disc of pronotum and elytra very coarse. Pronotum with numerous coarse umbilicate and often somewhat elongate punctures on basal half (dark areas), less numerous anteriorly; interspaces with scattered fine punctures. Elytra with dense coarse punctures; serial punctures slightly smaller than discal punctures, more or less confluent basally on disc to form four longitudinal impressions or striae (not as well developed as that shown by *H. impressopunctatus*); interspaces with numerous very fine punctures. Males and male-like female morph with disc of pronotum and elytra smooth and shiny between punctures, dorsal microsculpture only on lateral margins of pronotum of some females and towards apex of elytron on both males and females; metacoxae sculptured; abdominal sterna strongly sculptured on female, male with finely impressed somewhat stretched meshes, visible even on posterior medial portion of sternite 3. Coarsely sculptured female with evident microsculpture on disc of pronotum, elytra and entire ventral surface.

Male similar to male of *H. impressopunctatus* in most structural characters including the shape of the protarsus and its claws. Aedeagus (Fig. 23) slightly broader in lateral view, especially near middle. Ovipositor (Fig. 27) with apical margin relatively strongly produced.

*Taxonomic notes.* — All authors since Sharp (1882) have regarded the name *H. picatus* (Kirby) as a junior synonym of *H. impressopunctatus* (Schaller). However, consistent differences in female ovipositor, color and sculpture as well as distribution and habitat characteristics, have convinced me that the name *H. picatus* applies to a separate species. Alberta populations of *H. picatus* north of the Bow River and in the Cypress Hills contain both nonsculptured and sculptured female morphs. However, all female specimens that I have seen from the Rocky Mountains and the adjacent foothills south of the Bow River are nonsculptured.

*Natural history notes.* — This is the only strictly boreal species of *Hygrotus* in the fauna. All collecting records are within the forested portions of the province and no specimens were seen from prairies or southern parklands. Most specimens were collected from *Sphagnum* bogs or cold *Carex* marshes.

*Distribution.* — The continental distribution is unknown. However, the species is probably widespread in the boreal portions of the continent north to at least the southern Northwest Territories (Hay River, UC). In Alberta, the species is found throughout the northern and western portions of the province and is isolated in the Cypress Hills. I examined more than 190 specimens from Alberta localities (map, Fig. 343).

*Hygrotus masculinus* (Crotch, 1874)

*Hydroporus masculinus* Crotch, 1874: 74. (Type locality – “Lake Labache” (Anderson (1962) interprets this as Lac La Hache, B.C.)). Sharp 1882: 801. – Fall 1919: 17. – Leng 1920: 77. – Hatch 1953: 202. – Leech and Chandler 1956: 316. – Anderson 1962: 60. – Wallis 1973: 103.

**Diagnosis.** – This species is well defined on the basis of the following characters: body elongate-oval, clypeus with anterior bead, ventral surface of body black, elytral margin strongly ascending to humeral angle, and male protarsal claws very large and laterally expanded.

**Description.** – Measurements of 20 Alberta specimens are: TL – 3.68 to 4.64 mm ( $\bar{X} = 4.30 \pm 0.22$  mm); MW – 1.88 to 2.36 mm ( $\bar{X} = 2.21 \pm 0.12$  mm); TL/MW – 1.89 to 1.97 ( $\bar{X} = 1.94 \pm 0.02$ ).

Head rufotestaceous except short piceous band along posteriomedial portion of frons; antennae pale except outer articles lightly infuscate; palpi pale, without apical infuscation. Pronotum testaceous to rufotestaceous, without medial discal spot; anterior and posterior margins narrowly translucent and appearing piceous when overlying maculations of head and elytron. Elytron testaceous except sutural margin narrowly piceous; disc with four brown or piceous longitudinal vittae, vittae 1 to 3 complete on most specimens, vitta 4 broken near middle on many specimens. Ventral surface black.

Elytra densely punctate; punctures of various sizes but not evidently dual; male, smooth and shiny, without microsculpture; female with microsculpture. Metacoxae and abdominal sterna sculptured in both sexes.

Clypeus with anterior bead. Pronotum with sides more or less straight or only slightly arcuate, diverging behind but base of pronotum slightly narrower than elytra across humeral angles on most specimens: lateral outline of body discontinuous. Prosternal process short and broad: apex bluntly rounded and deflected upward, not extended to level of metasternum: mesocoxae contiguous. Elytron with lateral margin strongly ascendent towards humeral angle. Metatarsus article 1 with longitudinal series of 13 to 20 short spines along ventral margin. Male protarsus (Fig. 37) with articles 1 to 3 only slightly dilated; protarsal claws greatly elongate and dorsoventrally flattened; anterior claw slightly shorter than posterior, broader and more rounded apically. Male genitalia as in Figure 24: paramere with setae divided into ventral and internal apical patch.

**Taxonomic notes.** – The species *H. masculinus* and *H. salinarius* form a group well separated from the other large vittate species of *Hygrotus*. On the basis of the structure of the clypeus, the prosternal process, and metatarsal article 1, it appears as though these species occupy a rather isolated position within the genus.

**Natural history notes.** – This species inhabits shallow saline or alkaline lakes, characterized by very turbid water and bare clay bottoms devoid of rooted vegetation. Scudder (1969) recorded this species from lakes with surface conductivities of 2,820 to 60,500 micromhos/cm., in which the major cation was Na and the major anions CO<sub>3</sub>, HCO<sub>3</sub> and SO<sub>4</sub>. Single individuals no doubt of stray or accidental occurrence, have been taken from fresh water ponds. Teneral specimens were collected during September, October and late April.

**Distribution.** – The range is from southern Manitoba and South Dakota (UASM) to Utah and southern British Columbia. I examined more than 140 specimens from Alberta localities (map, Fig. 344).

*Hygrotus salinarius* (Wallis, 1924)

*Coelambus salinarius* Wallis, 1924: 105. (Type locality – Cobb's Lake near Baldur, Manitoba.) Leng and Mutchler 1927: 17. – Anderson 1971: 507. – Wallis 1973: 103.

**Diagnosis.** – Members of this species are similar to those of *H. masculinus* but in the former group the lateral margin of the elytron rises more obliquely to the humeral angle. Males of *H. salinarius* have the protarsal claws shorter and not expanded laterally.

**Description.** – Measurements of 20 Alberta specimens are: TL – 4.40 to 5.00 mm ( $\bar{X} = 4.76 \pm 0.16$  mm); MW – 2.24 to 2.48 mm ( $\bar{X} = 2.40 \pm 0.09$  mm); TL/MW – 1.89 to 2.04 ( $\bar{X} = 1.98 \pm 0.04$ ).

Similar to members of *H. masculinus* in most features but differing as follows: Color paler, head of most specimens lacking posteriomedial piceous spot of frons; pronotum entirely rufous; vittae of elytra slightly narrower. Elytron with fine punctation denser; lateral margin less strongly ascendent to humeral angle when viewed from side, more oblique and not almost perpendicular. Metatarsal article 1 with longitudinal row of 18 to 30 setae along ventral margin. Male with protarsal articles 1 to 3 broader (Fig. 38); protarsal claws shorter and not laterally expanded; anterior claw shorter than posterior, narrower and more strongly arcuate, posterior claw twisted anteriorly when viewed from above. Male genitalia as in Figure 25: paramere with single patch of apical setae.

*Natural history notes.* – Specimens of this species inhabit highly saline turbid, clay-bottomed prairie ponds as well as a large, clear although highly saline, lake with gravel bottom (Gooseberry L., Alta.). Teneral specimens were collected on August 17 (Tompkins, Sask., CARR).

*Distribution.* – This species is known only from the Canadian prairies. I have seen specimens from Manitoba (Baldur, UASM; Strathclair, UASM), Saskatchewan (several localities in the south), and Alberta. I examined 71 specimens from Alberta localities (map, Fig. 345).

#### Genus *Hydroporus* Clairville, 1806

*Hydroporus* Clairville, 1806: 182. (Type species – not known to me. See Leech (1948b: 395) for a discussion regarding the problem of the type species for the genus. Guignot (1946) designated *Hydroporus pubescens* Gyll. as type species but Zaitsev (1953) gives *Dytiscus erythrocephalus* L. as type species.)

*Deronectes* Sharp, 1882: 418. (Type species – *Hydroporus latus* Stephens, 1828, designated by F. Balfour-Browne, 1934b (Leech, 1948b).)

*Oreodytes* Seidlitz, 1887: 57. (Type species – *Hydroporus borealis* Gyllenhal, 1827, designated by F. Balfour-Browne, 1936. (Guignot, 1946).)

*Suphrodytes* Des Gozis, 1913: 110. (Type species – *Dytiscus dorsalis* F. (Zaitsev, 1953).)

*Heterosternus* Zimmermann, 1919: 161. (Type species – *Hydroporus concinnus* LeConte, designated by Leech, 1949b.)

*Potamodytes* Zimmermann, 1919: 186.

*Potamonectes* Zimmermann, 1921: 87. New name for *Potamodytes* Zimmermann, 1919. (Type species – *Hydroporus elegans* Panz., designated by Guignot, 1946.) (Old World generic synonymy omitted.)

This is a very large and multiformous group of small water beetles. Characters common to Alberta members of the genus are: – Hydroporinae of small to moderate size (TL – 2.6 to 6.3 mm). Shape of body various, broadly oval to elongate and more or less parallel sided. Punctuation various: many specimens distinctly setose. Elytron without humeral carina of epipleuron; internal subapical ligula absent. Metacoxal process not adpressed medially to level of abdominal sternum 1; with prominent lateral lobes covering bases of metatrochanters but not attaining base of metafemur.

As defined here, the genus is much broader than that of most recent authors, who generally choose to treat at least *Deronectes* and *Oreodytes* as separate genera. There is certainly a good case for the latter approach as these groups are rather distinct. However, the species remaining in *Hydroporus* constitute a heterogeneous assemblage, many of which differ between themselves at least as much as they differ from members of *Deronectes* and *Oreodytes*. A number of genus-group names are available for various North American species groups, but for the most part, these subgenera are poorly defined and their limits are not understood. Although it is probably desirable and practical to group the species of *Hydroporus* into a number of subgenera, I have not used a formal subgeneric classification. Related species are placed sequentially in the following accounts, and notes on relationship are given. Following current usage (Leech and Chandler, 1956; Anderson, 1962), *Deronectes* includes *H. elegans*, *H. depressus*, *H. striatellus*, *H. griseostriatus*, *H. spenceri*, and *H. quadrimaculatus*; and *Oreodytes* includes *H. snoqualmie*, *H. laevis*, *H. alaskanus*, *H. scitulus*, *H. rivalis*, *H. congruus*, *H. crassulus*, and *H. angustior*.

Species identifications in the genus *Hydroporus* are difficult because of the large number of included species, small size of their members, and general uniformity in many characters. The primary character used to assign species to groups, is shape of the hind margin of the metacoxal processes. Although this character is somewhat gradational, generally it is easily interpreted.

The other principal characters for species recognition are size, color and punctuation. In some critical cases the aedeagus is useful, but as a rule, within a group of closely related species, differences in its shape are subtle and difficult to appreciate. A character of considerable value is shape of the lateral margin of the elytron when examined in side view. It ranges from almost perfectly straight from the humeral angle to the apex, to very arcuate. The expression “lateral margin of elytron ascending to humeral angle” means that, when examined in side view, the lateral margin is curved upwards away from the horizontal plane as it approaches the humeral



angle. Also of value, is whether the epipleuron is visible to the humeral angle in lateral view or if it is impressed towards the shoulder and hidden by the lateral margin.

Protarsal characters are useful, especially for identifying males. The protarsal claws are distinctly modified in a few species, but generally the best characters are degree of widening of the basal three articles and their shapes. Protarsal articles 1 and 2 of the males of most species bear a few small rounded adhesive scales on the ventral surface. The number and size of such scales is valuable for species identification and for recognition of males in species in which sexual dimorphism is slight.

Although there is no comprehensive treatment, descriptions and illustrations of immature stages are given by Needham and Williamson (1907), Matheson (1914); Wilson (1923); Bertrand (1928); F. Balfour-Browne (1940); Watts (1970); and Galewski (1971).

The members of this genus occupy a wide variety of habitats, and one or more species can generally be found in almost every habitat inhabited by dytiscid beetles, with the exception of saline ponds. Species, as well as individuals, are generally more numerous in cold water habitats than in warm exposed ones.

#### Key to Alberta Species of *Hydroporus*

- 1 Posterior margin of metacoxal processes conjointly truncate<sup>4</sup> (Fig. 41), medially angulate (Fig. 42), or sinuate (Fig. 39, 40, 43): processes with midline extended to or past level of posterior lateral angles . . . . . 2
- 1' Posterior margin of metacoxal processes incised at middle (Fig. 44, 45): midline of processes not extending as far posteriorly as level of external apical angles . . . 43
- 2 (1) Metacoxal processes conjointly with hind margin sinuate (Fig. 39, 40, 43) (each process with hind margin emarginate lateral to midline: some specimens with elytron rufous with black maculations and ventral surface of body rufous) . . . . . 3
- 2' Metacoxal processes together with hind margin truncate or angulate medially (Fig. 41, 42), not emarginate on each side lateral to midline and combination of characters not as above . . . . . 13
- 3 (2) Elytron with definite well delimited pattern of maculations . . . . . 4
- 3' Elytron immaculate or lateral and basal portions of disc paler than medial and apical portions . . . . . 8
- 4 (3) Elytron virtually glabrous, with large shallow punctures separated by minute punctulae: female with apex of abdominal sternum 6 produced . . . . .  
. . . . . *H. quadrimaculatus* Horn, p. 318
- 4' Elytron densely covered with fine golden setae and with numerous small setiferous punctures . . . . . 5
- 5 (4') Pale elytral markings transverse, pale band on anterior medial portion of disc separated from pale band on apical half except along lateral margin (Fig. 105) . . . . .  
. . . . . *H. undulatus* Say, p. 286
- 5' Pale elytral markings longitudinal with at least some pale vittae extended through medial half of disc (Fig. 106, 107, 108) . . . . . 6
- 6 (5') Elytron with three dark vittae: broad sutural, medial, and sublateral (Fig. 106): lateral bead of pronotum narrow, at front angle not or only slightly broader than bead near middle . . . . . *H. vittatus* LeConte, p. 287
- 6' Elytral vittae narrower, more numerous, and more irregular (Fig. 107 and 108);

4. Best seen by examining metacoxal process when specimen is placed on its back with head directed towards observer.

- lateral bead of pronotum broadly expanded at front angle, about twice as wide as bead near middle . . . . . 7
- 7 (6') Anterior margin of pronotum with small medial piceous spot; antenna entirely testaceous; male with protarsal claws subequal; anterior claw strongly bent at base, apical half more or less straight . . . *H. dimidiatus* Gemminger and Harold, p. 287
- 7' Pronotum with anterior margin along medial emargination, broadly piceous or black; antenna with at least article 11 infuscate on apical half; male with anterior protarsal claw shorter than posterior, more or less evenly arcuate throughout its length . . . . . *H. superioris* Balfour-Browne, p. 288
- 8 (3') Metatrochanter very large, ratio length metafemur/length of metatrochanter from apex of metacoxal process = 1.9 to 2.2; protibia of male without emargination on internal basal margin . . . . . 11
- 8' Metatrochanter smaller, ratio length metafemur/length of metatrochanter = 2.3 to 2.8; protibia of male with emargination on internal basal face (Fig. 46) . . . . . 9
- 9 (8') Total length 3.5 to 4.0 mm . . . . . *H. paugus* Fall, p. 289
- 9' Total length 2.8 to 3.4 mm . . . . . 10
- 10 (9') Lateral bead of pronotum very broad (Fig. 48), at middle subequal in width to maximum width of an outer antennal article . . . . . *H. stagnalis* Gemminger and Harold, p. 291
- 10' Lateral bead of pronotum narrower (Fig. 47), one half or less width of one outer antennal article . . . . . *H. rubyi* new species, p. 290
- 11 (8) Small (TL = 2.6 to 3.1 mm), broad (TL/MW = 1.87 to 1.97); prosternal process with a low medial convexity visible throughout most of length; female with apex of sternum 6 slightly but evidently deflexed downwards . . . . . *H. edwardsi* Wallis, p. 291
- 11' Larger (TL = 2.9 to 3.5 mm), narrower (TL/MW = 1.90 to 2.15); prosternal process flat or slightly concave medially, with medial longitudinal convexity visible only towards apex; female with sternum 6 not modified . . . . . 12
- 12(11') Size larger (TL = 3.08 to 3.48 mm); color dark, pronotum with disc dark brown or piceous, elytron of many specimens more or less bicolored, base distinctly paler than apical portion . . . . . *H. compertus* Brown, p. 292
- 12' Size smaller (TL = 2.88 to 3.24 mm); color paler, disc of pronotum brown to dark brown, seldom piceous, elytron pale basally, gradually darkened towards apex; punctation finer . . . . . *H. planiusculus* Fall, p. 293
- 13 (2') Size large (TL = 4.5 to 6.3 mm); punctation of elytron relatively fine and dense; elytron lacking defined pale maculations; male with protarsal article 1 bearing numerous small rounded adhesive scales on ventral surface and anterior protarsal claw modified . . . . . 14
- 13' Size smaller, TL less than 4.5 mm or combination of characters not as above; punctation of elytron coarser, sparser; elytron maculate or not; male protarsal article 1 of most specimens bearing two pairs of scales; anterior protarsal claw modified or not . . . . . 15
- 14(13) Head rufous, frons with isolated piceous spot medial to each eye; pronotum with lateral margins broadly rufous; male anterior protarsal claw (Fig. 81) shorter and more arcuate than unmodified posterior claw . . . . . *H. columbianus* Fall, p. 294
- 14' Head darker, frons with a transverse piceous or black band between eyes; lateral margin of pronotum piceous or only narrowly rufous; male with protarsal claws (Fig. 82) similar in shape, both elongate, strongly arcuate basally . . . . . *H. notabilis* LeConte, p. 294

- 15(13') Head rufous with at most frons bearing poorly defined dark rufous or piceous spot medial to each eye; pronotum with disc dark rufous to piceous, anterior and posterior margins darker; body elongate-oval, slightly arcuate medially and more or less pointed behind . . . . . 16
- 15' Head darker, frons with expanded piceous or black areas or head largely black; pronotum with disc piceous to black; body varied in shape . . . . . 17
- 16(15) TL – 4.0 to 4.5 mm: male anterior protarsal claw with large ventral tooth (Fig. 83) . . . . . *H. dentellus* Fall, p. 295
- 16' TL – 3.0 to 3.5 mm: male anterior protarsal claw without ventral tooth . . . . . *H. hockingi* new species, p. 296
- 17(15') Elytron with at least distinct pale humeral and rounded subapical spot . . . . . 18
- 17' Elytron immaculate or diffusely paler basally and laterally but without defined pale areas. . . . . 22
- 18(17) TL – 4.0 to 4.8 mm. . . . . 19
- 18' TL less than 4.0 mm . . . . . 20
- 19(18) Pronotum dark piceous with sharply delimited pale margins; elytral maculations well developed, humeral band extended well onto disc, also most specimens with anti- and postmedial lateral spots. . . . . *H. mannerheimi* Balfour-Browne, p. 297
- 19' Pronotum dark rufous or brown, diffusely paler laterally; elytral maculations of most specimens consisting of humeral and subapical spots. . . *H. tademus* Leech, p. 297
- 20(18') Lateral margin of elytron more or less straight in side view, not ascending to humeral angle; male with anterior protarsal claw strongly arcuate basally, ventral margin sinuate . . . . . *H. signatus* Mannerheim, p. 298
- 20' Lateral margin of elytron slightly but evidently ascending to humeral angle; male with anterior protarsal claw unmodified, similar in shape to posterior claw . . . . . 21
- 21(20') Ground color of pronotum and elytron of most specimens brown to piceous, seldom black; elytral maculations well developed (Fig. 109); antenna slender, article 2 with maximum width towards apex; pronotum with lateral margin evenly arcuate (Fig. 103) . . . . . *H. appalachius* Sherman, p. 299
- 21' Ground color of pronotum and elytron black; elytral maculations of most specimens humeral and subapical spot; antenna stout, article 2 oval with point of maximum width at or near middle; pronotum robust, relatively strongly broadened in apical half (Fig. 104) . . . . . *H. occidentalis* Sharp, p. 300
- 22(17') Microsculpture reduced, metacoxal plates medially and on most specimens disc of pronotum and basal portion of elytron, smooth and shiny between punctures, without microsculpture . . . . . 23
- 22' Metacoxal plates, disc of pronotum and elytron bearing evident although sometimes finely impressed reticulate microsculpture . . . . . 24
- 23(22) Male with anterior protarsal claw strongly arcuate basally; article 1 of protarsus with more than two pairs of rounded scales on ventral surface; intralinear space of metacoxa with dense, short, suberect brown setae. *H. criniticoxis* new species, p. 301
- 23' Male anterior protarsal claw not modified or only slightly more arcuate basally than posterior claw; protarsal article 1 bearing two pairs of scales beneath; intralinear space of metacoxa with only normal sparse elongate setae. . . . . *H. fuscipennis* Schaum, p. 301
- 24(22') TL – 3.5 mm or less . . . . . 25
- 24' TL greater than 3.5 mm . . . . . 34
- 25(24) Lateral margin of pronotum and elytron in dorsal view strongly discontinuous in outline (Fig. 113, 114); pronotum with point of maximum width clearly in front

- of obtuse hind angles ..... 26
- 25' Lateral margins of pronotum and elytra together more or less continuous curve, or at least pronotum with point of maximum width at hind angle ..... 28
- 26(25) Dorsal surface of head with triangular bright rufous area on clypeus and anterior-medial portion of frons ..... *H. rufinatus* Mannerheim, p. 303
- 26' Head piceous to black with anterior margin of clypeus at most diffusely paler, dark rufous or piceous ..... 27
- 27(26') TL – 2.8 to 3.2 mm: male anterior protarsal claw without ventral tooth ..... *H. glabriusculus* Aubé, p. 303
- 27' TL – 3.0 to 3.6 mm: male anterior protarsal claw with ventral tooth ..... *H. morio* Aubé, p. 304
- 28(25') Prosternal process prolonged anteriorly onto basal half of prosternum as narrow longitudinal convexity; lateral margin of elytron strongly ascending to humeral angle (Fig. 115) ..... *H. tristis* (Paykull), p. 305
- 28' Prosternum rugose, flat, or concave medially, without base of process prolonged anteriorly as a distinct convexity ..... 29
- 29(28') Lateral margin of elytron straight or almost so in side view, not ascending to humeral angle; male with anterior protarsal claw as in Figure 84 ..... *H. signatus* in part, p. 298
- 29' Without above combination of characters ..... 30
- 30(29') Male anterior protarsal claw with ventral tooth; color dark, most specimens with disc of pronotum and elytron black, or elytron very slightly paler ..... *H. morio* in part, p. 304
- 30' Male anterior protarsal claw without ventral tooth: color various, many specimens with elytron distinctly paler than disc of pronotum, or both piceous; if both black, lateral margin of pronotum (at least apically) and humeral angle of elytron pale ..... 31
- 31(30') TL – 2.6 to 3.0 mm: body elongate, TL/MW – 2.0 to 2.2; pronotum dark piceous or black with at most anterior and posterior angles, rufous; elytron dark rufous or rarely piceous; procoxae close to anterior margin of prosternum; prosternum anterior to procoxae inflated and coarsely punctate or rugose ..... *H. badiellus* Fall, p. 307
- 31' Size larger, 2.9 mm or more: body broader, TL/MW – 1.89 to 2.13: color various, if pronotum entirely black, elytron also black or if elytron paler in color, lateral margins of pronotum even inside bead, rufous ..... 32
- 32(31') Ventral surface of head with genae testaceous to pale rufous, gula rufous to dark rufous and distinctly darker in color than genae; elytron brown to piceous: male anterior protarsal claw not modified: TL/MW – 1.89 to 1.95 ..... *H. tartaricus* LeConte, p. 313
- 32' Ventral surface of head with genae infusate, or if pale, then darker in color or of same color as gula ..... 33
- 33(32') Disc of pronotum and elytron black or dark piceous; body robust, pronotum broadly rounded anteriorly; male anterior protarsal claw simple ..... *H. occidentalis* Sharp, p. 300
- 33' Disc of pronotum dark brown to piceous, rarely black, elytron brown to piceous; pronotum narrower, evenly and gradually broadened to hind angles; male with anterior protarsal claw conspicuously broadened in side view ..... *H. striola* Gyllenhal, p. 306
- 34(24') TL – 4.2 to 4.8 mm: body elongate and subparallel medially; labial palpus testaceous,

- without apical infuscation . . . . . *H. rectus* Fall, p. 309
- 34' Size various but many specimens less than 4.3 mm; body more or less distinctly rounded laterally and somewhat oval in outline; labial palpus with terminal article infuscate . . . . . 35
- 35(34') Lateral margin of elytron more or less straight, not or only slightly ascending to humeral angle; male anterior protarsal claw arcuate at base, ventral margin sinuate (Fig. 84) . . . . . *H. signatus* in part, p. 298
- 35' Lateral margin of elytron distinctly ascending towards humeral angle; male with anterior protarsal claw not so modified . . . . . 36
- 36(35') Male anterior protarsal claw with medial ventral tooth. . . . . *H. morio* in part, p. 304
- 36' Male anterior protarsal claw without ventral tooth . . . . . 37
- 37(36') Male protarsus article 1 with three or more pairs of scales: head black with frontal bar and small triangular spot above base of each antenna, rufous; pronotum with punctation of disc very fine and sparse; protarsal article 3 short and rounded, more or less circular in outline . . . . . 38
- 37' Male protarsus article 1 with two pairs of scales on ventral surface; head of most specimens with at least anterior margin of clypeus rufous; pronotum with disc more coarsely punctate: protarsal article 3 more elongate, broadly oval, or with lateral margins subparallel . . . . . 39
- 38(37) Lateral bead of pronotum rufous; protarsal article 1 of male with three pairs of ventral scales; protarsal claws subequal, elongate and slender . . . . . *H. carri* new species, p. 307
- 38' Lateral bead of pronotum black; protarsal article 1 of male with more than three pairs of ventral scales; anterior protarsal claw slightly shorter and stouter than posterior . . . . . *H. transpunctatus* Chandler, p. 308
- 39(37') Male anterior protarsal claw about two thirds length of posterior, stouter and strongly arcuate; head very coarsely punctate . . . . . *H. pervicinus* Fall, p. 311
- 39' Male protarsal claws subequal in length; punctation of head various . . . . . 40
- 40(39') Male with articles 3 of pro- and mesotarsus very long and broad, much more robust than articles 1 and 2 (Fig. 97); female with elytral sculpture very fine and dense hence elytra appearing opaque . . . . . *H. tenebrosus* LeConte, p. 310
- 40' Male with articles 3 of pro- and mesotarsus shorter and less strongly dilated; female with sculpture similar to that of male or with lines more deeply impressed, but not fine and dense . . . . . 41
- 41(40') Head with genae testaceous to pale rufous in color, paler than rufous gula; lateral margin of pronotum narrow but distinct basally, narrowed and more or less obsolete anteriorly because of swollen sublateral margin of pronotum: TL — 3.25 to 3.60 mm, TL/MW — 1.89 to 1.95. . . . . *H. tartaricus* LeConte, p. 313
- 41' Genae dark rufous to piceous, darker than gula; lateral margin of pronotum narrow but of even width and visible throughout length . . . . . 42
- 42(41') Protarsal article 3 rounded laterally, broader . . . . . *H. despectus* Sharp, p. 311
- 42' Protarsal article 3 narrow, sides more or less straight and divergent apically . . . . . *H. species near despectus*, p. 312
- 43 (1') Metafemur densely punctate over entire surface; dorsal surface of elytron with dense short pubescence; pronotum without sublateral longitudinal impression on disc . . . . . 44
- 43' Metafemur with single longitudinal row of setiferous punctures on ventral surface, otherwise with only few scattered punctures; elytron glabrous except for serial setiferous punctures; pronotum with short sublateral longitudinal impression on disc . . . . . 48

44(43)	Lateral margin of elytron with a small acute subapical tooth . . . . .	45
44'	Lateral margin of elytron without subapical tooth . . . . .	46
45(44)	Male with anterior protarsal claw (Fig. 85) 0.25 or more longer than posterior; aedeagus evenly tapered to narrowly rounded apex (Fig. 76) . . . . .	<i>H. elegans</i> (Panzer), p. 314
45'	Male protarsal claws subequal or anterior claw only slightly longer than posterior (Fig. 86); apex of aedeagus broad (Fig. 77) . . . . .	<i>H. depressus</i> (Fabricius), p. 315
46(44')	Elytron with impressed sutural stria and on most specimens additional one or two (some specimens with as many as five) longitudinal discal striae: body broad, ratio TL/MW — 1.75 to 1.92 ( $\bar{X}$ = 1.86) . . . . .	<i>H. striatellus</i> LeConte, p. 315
46'	Elytron without distinct longitudinal striae: body more elongate, TL/MW — 1.90 to 2.10 ( $\bar{X}$ = 2.00) . . . . .	47
47(46)	Metacoxal lines divergent anteriorly (Fig. 44): TL — 4.32 to 5.16 mm . . . . .	<i>H. griseostriatus</i> (DeGeer), p. 316
47'	Metacoxal lines nearly parallel (Fig. 45): size larger, TL — 5.4 to 6.0 mm ( $\bar{X}$ = 5.70 mm) . . . . .	<i>H. spenceri</i> (Leech), p. 318
48(43')	Epipleuron of elytron visible to humeral angle when examined in lateral view (Fig. 118) . . . . .	49
48'	Epipleuron hidden behind lateral margin of elytron posterior to humeral angle (Fig. 119) . . . . .	51
49(48)	Protibia strongly dilated in apical half, inner margin sinuate (Fig. 124); epipleuron dark piceous to black . . . . .	<i>H. alaskanus</i> Fall, p. 321
49'	Protibia evenly broadened toward apex, inner margin more or less straight (Fig. 123); epipleuron pale yellow to light piceous . . . . .	50
50(49)	Base of pronotum as broad as or broader than elytra across humeral angles (Fig. 120); female elytron without subapical tooth; elytral maculations dark brown to pale piceous, not black: TL — 3.4 to 3.9 mm . . . . .	<i>H. snoqualmie</i> Hatch, p. 319
50'	Pronotum narrower at base than elytron across humeral angles on many specimens (Fig. 121); female elytron with lateral subapical tooth; elytral maculations dark piceous to black: TL — 4.4 to 4.9 mm . . . . .	<i>H. laevis</i> Kirby, p. 320
51(48')	Small specimen, TL — 2.5 to 3.2 mm: body broadly oval, TL/MW — 1.6 to 1.75 . . . . .	52
51'	Larger specimen, TL — 3.3 to 3.9 mm; body more elongate, TL/MW — 1.85 to 1.95 . . . . .	<i>H. scitulus</i> LeConte, p. 322
52(51)	Elytron impunctate or with punctures smaller than serial punctures and more or less inconspicuous . . . . .	53
52'	Elytron conspicuously punctate, at least basomedially; punctures as large as or larger than serial punctures . . . . .	54
53(52)	Elytron with origin of dark piceous or black vittae near basal margin; most specimens with vittae 1 to 4 distinct and not fused; metacoxal plates internally with conspicuous punctures, externally smaller and shallower . . . . .	<i>H. rivalis</i> Gyllenhal, p. 323
53'	Elytron with origin of brown to piceous vittae well behind basal margin; vittae 1 to 4 more or less fused basally; metacoxal plates evenly covered with conspicuous punctures . . . . .	<i>H. congruus</i> LeConte, p. 324
54(52')	Lateral bead of pronotum broadened at posterior lateral angle; punctuation of elytron evident over entire disc; elytral vittae complete, single or on some specimens (non-Alberta) with tendency towards fusion . . . . .	<i>H. crassulus</i> Fall, p. 324
54'	Lateral bead of pronotum of more or less even width throughout length, not expanded at posterior lateral angle; elytral punctuation best developed medially, lateral	

portion of disc shallowly punctate or impunctate; elytral vittae 1 to 3 complete on most specimens, vittae 4 and 5 broken medially complete or on some specimens fused to each other basally and subapically as two irregular transverse fasciae . . . . .  
 . . . . . *H. angustior* Hatch, p. 325

*Hydroporus undulatus* Say, 1823

- Hydroporus undulatus* Say, 1823a: 154. (Type locality – “Upper Missouri”.) Say 1823b: 102. – Melsheimer 1853: 31. – LeConte 1855: 291. – LeConte 1859b: 99. – LeConte 1863a: 16. – Gemminger and Harold 1868: 441. – Crotch 1873: 393. – Sharp 1882: 157. – Wickham 1895a: 75. – Needham and Wilson 1908: 492. – Zimmermann 1919: 178. – Leng 1920: 78. – Zimmermann 1920: 109. – Fall 1923: 31. – Brown 1930b: 235. – Balfour-Browne 1948: 150. – Hatch 1953: 203. – Gordon and Post 1965: 17. – Wallis 1973: 103.
- Hydroporus fasciatus* Harris, 1828b: 164. (Type locality – not stated by author. Ipswich, Mass. (Fall 1923: 34).)
- Hydroporus pubipennis* Aubé, 1838: 480. (Type locality – North America.)
- Hydroporus velutinus* Aubé, 1838: 481. (Type locality – North America.)
- Hydroporus punctatissimus* Aubé, 1838: 484. (Type locality – North America.) Melsheimer 1853: 32. – LeConte 1863a: 16.
- Hydroporus consimilis* LeConte, 1850: 214. (Type locality – not given, assumed to be Lake Superior.) Melsheimer 1853: 32. – LeConte 1855: 291. – LeConte 1863a: 16. – Gemminger and Harold 1868: 431. – Crotch 1873: 393. – Sharp 1882: 441. – Wickham 1895a: 75. – Leng 1920: 78. – Zimmermann 1920: 107. – Fall 1923: 36. – Hatch 1933: 10. – Wallis 1973: 103.
- Hydroporus scrutator* Sharp, 1882: 440. (Type locality – Ega?, North America.)
- Hydroporus anticus* Sharp, 1882: 441. (Type locality – North America (Pennsylvania, Louisiana).)
- Hydroporus placatus* Fall, 1917: 177. (Type locality – Corvallis, Oregon.)

*Diagnosis.* – The transverse pattern of pale elytral maculation as opposed to the longitudinal pattern shown by the following three related species is the best characteristic for field recognition of *undulatus* adults.

*Description.* – Measurements of 20 specimens collected 6 mi s Smith, Alberta, are: TL – 4.20 to 4.72 mm ( $\bar{X}$  = 4.48 ± 0.13 mm); MW – 2.24 to 2.48 mm ( $\bar{X}$  = 2.36 ± 0.07 mm); TL/MW – 1.85 to 1.97 ( $\bar{X}$  = 1.90 ± 0.03).

Head rufous; antenna testaceous except outer articles, beginning with article 6 or 7 of some specimens, infusate apically; palpi testaceous. Pronotum rufous with basal margin narrowly piceous; piceous area expanded medially, or some specimens with only single or bilobed basomedial spot continuous with hind margin; anterior margin with medial piceous spot on some specimens expanded laterally to lateral limits of anterior pronotal emargination; anterior and posterior pronotal spots expanded and continuous along midline on some specimens. Elytron with pale maculations varied in development but markings more or less transverse in shape (Fig. 105), i.e., no pale discal markings extended through both basal and apical halves of elytron. Ventral surface of body and legs, rufous.

Frons medially with small but deep, densely situated punctures; interspaces coarsely reticulate. Disc of pronotum and elytron with dense golden pubescence. Pronotum medially with large clearly separated setiferous punctures, laterally and posteriorly punctures denser and more or less confluent; interspaces with fine sculpture, irregularly effaced on male, deeper and more conspicuous on female. Elytron with punctation similar to that of pronotum but punctures slightly smaller, denser and more or less even in distribution over disc; male smooth and shiny or with sculpture faintly impressed and more or less obsolete basally, deeper laterally and apically; female with elytral sculpture various, like male or with lines very fine and dense, elytron dull and opaque. Metasternal wing, metacoxal plate, and sterna 1 and 2, with coarse punctures; sterna 3 to 6 with punctation finer.

Clypeus with anterior ridge evident, at least laterally anterior to frontal impressions. Pronotum with lateral bead various: narrow basally and widened more or less evenly towards anterior angle where it is rather broad and more or less flattened; or some specimens with bead narrow throughout most of length and widened only at front angle (specimens showing intermediate conditions have been seen). Prosternal prominence large, file with only few transverse ridges; prosternal process broad, flattened with low median ridge. Metasternum anterolaterally between and behind mesocoxae with conspicuous angulate convexity. Metacoxal processes conjointly sinuate.

Male with articles 1 to 3 of pro- and mesotarsus strongly dilated: articles 1 and 2 each with numerous elongate or rounded scales on ventral surface; anterior protarsal claw slightly shorter or subequal in length to posterior claw, strongly arcuate basally, more or less straight apically with ventral margin faintly sinuate. Aedeagus as in Figure 49.

*Taxonomic notes.* – *H. undulatus* shows a great deal of inter- and intrapopulation variation which in turn is reflected in the large number of names that have been applied to the species. Fall (1923) discussed this synonymy at some length, and I have followed him, for the most part. However, I consider the name *H. consimilis* to be a junior synonym of *H. undulatus*. Fall considered the two names to refer to distinct species. Hatch (1953) and Wallis (1973) proposed this synonymy. Several population samples from central Alberta include specimens

which possess characteristics of *H. consimilis*, that is, the narrow lateral pronotal bead and the expanded dark maculations on the pronotum. Other population samples possess the typical characteristics of *H. undulatus*. Specimens showing an intermediate condition occur also. Within a given population sample, almost all specimens agree with one another in color and width of the pronotal bead. Also, the aedeagi of males of the two forms are identical. For these reasons, I regard *consimilis*-like Alberta specimens as conspecific with those possessing the more typical characters of *H. undulatus*. A very careful study of the variation shown by this species is required.

*Natural history notes.* – These beetles are found in permanent bodies of water, usually where rooted vegetation is sparse and the bottom is bare, at least in spots. Specimens are often abundant along the banks of beaver ponds, especially recently formed ones, and among emergent *Carex* growing on sand or clay bottoms along sheltered margins of lakes.

*Distribution.* – If *H. undulatus* and *H. consimilis* are conspecific, the total range of this species extends from Newfoundland to Oregon and British Columbia, and south to Virginia and North Carolina. In Alberta, the species is known from the Red Deer River and north. I examined 180 specimens from Alberta localities (map, Fig. 346).

#### *Hydroporus vittatus* LeConte, 1855

*Hydroporus vittatus* LeConte 1855: 296. (Type locality – Fort Laramie, Nebraska (Wyoming).) LeConte 1859a: 36. – LeConte 1863a: 16. – Gemminger and Harold 1868: 442. – Crotch 1873: 393. – Sharp 1882: 443. – Wickham 1895: 75. – Leng 1920: 78. – Zimmermann 1920: 109. – Fall 1923: 42. – Gordon and Post 1965: 17. – Wallis 1973: 103.

*Diagnosis.* – The narrow lateral bead of the pronotum and the characteristic maculation of elytron make this species readily recognizable.

*Description.* – Measurements of seven Alberta specimens from Bare Creek (Tp. 3 Rge. 2 W 4), are: TL – 4.12 to 4.28 mm ( $\bar{X} = 4.21 \pm 0.05$  mm); MW – 2.04 to 2.24 mm ( $\bar{X} = 2.15 \pm 0.07$  mm); TL/MW – 1.89 to 2.02 ( $\bar{X} = 1.95 \pm 0.05$ ).

Head rufous; antenna and palpi without apical infuscation. Pronotum rufous except anterior and posterior margins piceous, more broadly so medially. Elytron (Fig. 106) rufous except basal and sutural margins broadly black; disc with broad medial longitudinal black fascia and shorter lateral black spot. Ventral surface rufous with abdominal sternum 2 dark rufous to piceous laterally on many specimens. Legs rufous.

Dorsal surface of pronotum and elytron with short decumbent golden or pale brown setae. Male with disc of elytron between punctures more or less shiny, microsculpture finely impressed; female with punctation denser, interspaces dull.

Pronotum with lateral bead narrow, of more or less equal width throughout length or only slightly and narrowly widened toward front angle. Prosternal prominence low, slightly elevated above level of file. Metacoxal processes with hind margin conjointly sinuate. Male with anterior protarsal claw shorter than posterior, broadened and evenly arcuate throughout length. Aedeagus (Fig. 50) with apex slightly sinuate in lateral view.

*Taxonomic notes.* – Color or punctation varies slightly among the eight Alberta specimens examined. However, many specimens from the eastern portion of the species' range have the dark maculations of the elytron expanded and at least partially confluent, the infuscation of abdominal sternum 2 lacking, and the females resemble males in elytral punctation and microsculpture.

*Natural history notes.* – I found specimens amid emergent vegetation along banks of Bare Creek, near Wildhorse, Alberta, a small permanent, low gradient creek which flows through short grass prairie, with water generally clear and warm.

*Distribution.* – This species ranges from Illinois and Indiana to Wyoming and Alberta. A single specimen in UASM labelled Weeki Wachee, Fla. may be mislabelled because Young (1956) did not find this species in Florida. Eight Alberta specimens have been examined, from the southeastern portion of the province (Fig. 347).

#### *Hydroporus dimidiatus* Gemminger and Harold, 1868

*Hydroporus dimidiatus* Gemminger and Harold, 1868: 432. (New name for *semirufus* LeConte.) Sharp 1882: 443. – Fall



1923: 43.

*Hydroporus semirufus* LeConte, 1855: 296. (Type locality – Fort Laramie, Nebraska (Wyoming). Not Germar, 1823. LeConte 1859: 36. – LeConte 1863a: 16. – Crotch 1873: 393. – Leng 1920: 78. – Zimmermann 1920: 108.

*Diagnosis.* – Similar to *superioris* but differing in smaller size, paler color, and structure of the male protarsus.

*Description.* – Measurements of 20 specimens from near the Junction of Hwy. 6 and Belly River, Waterton National Park, Alberta are: TL – 4.00 to 4.44 mm ( $\bar{X} = 4.17 \pm 0.11$  mm); MW – 2.08 to 2.28 mm ( $\bar{X} = 2.15 \pm 0.05$  mm); TL/MW – 1.85 to 2.00 ( $\bar{X} = 1.94 \pm 0.03$ ).

Head including appendages, testaceous: palpi and antenna without apical infuscation. Pronotum testaceous with basal margin narrowly piceous: anterior margin narrowly brown or piceous near middle, piceous area not reaching lateral margins of anterior emargination. Elytron variegated as in Figure 107: disc with longitudinally arranged vittae. Ventral surface rufous. Legs testaceous to light rufous.

Dorsal surface of pronotum and elytron with short, pale, decumbent setae. Disc of pronotum densely and evenly punctate, punctures separated by less than own diameters; interspaces with evident reticulate microsculpture. Elytron with discal punctures more irregular, punctures smaller than those on pronotum and less distinct; interspaces with microsculpture more or less effaced on male, better developed on female with elytron dull. Ventral surface relatively finely and densely punctate.

Clypeus not or only slightly thickened. Lateral bead of pronotum narrow basally, broadly expanded towards front angle: flattened dorsally. Prosternal prominence present but low; file represented by deep excavation. Metasternal sulcus present, metasternum anteriolateral to sulcus raised into definite longitudinal convexity. Epipleuron, when viewed from side, disappearing very shortly behind humeral angle.

Male with articles 1 to 3 of pro- and mesotarsi dilated; anterior protarsal claw subequal in length to posterior, claw slightly bent at base then more or less straight to the acute, slightly arcuate apex; outer margin more or less straight, ventral margin sinuate. Aedeagus (Fig. 51) short and stout.

*Taxonomic notes.* – Alberta specimens of this species resemble the eastern species *H. solitarius* Sharp in color of the pronotum and to a lesser extent color of the elytron, but possess an aedeagus similar to that of *H. dimidiatus*. These specimens are also intermediate between *H. dimidiatus* and *H. solitarius* in size and punctuation. The thickening of the clypeal margin, a character Fall used to separate the two species, is unreliable. Further study may indicate that *H. dimidiatus* and *H. solitarius* are Western and Eastern forms respectively, of the same species. I have used the name *H. dimidiatus* for Alberta specimens because the shape of the aedeagus and geographical distribution suggests a closer relationship with the southern and western species, *H. dimidiatus*, than with the eastern species, *H. solitarius*.

*Natural history notes.* – A long series of specimens was collected from a borrow-pit situated beside the Belly River in Waterton National Park, with clear cool water entering from a small spring and also probably from seepage or overflow from the river. The beetles were in water from six inches to several feet deep along a steep clay bank with numerous tangled roots and waterlogged-wood chips. Other areas in the pond where stands of *Carex* or *Chara* grew, or where the bottom was gravel, did not yield specimens of *H. dimidiatus*. Several specimens were slightly teneral (July 7).

*Distribution.* – Fall records this species from Wyoming to Texas and west to New Mexico and Arizona. Alberta specimens have been collected in the Rocky Mountain foothills from the international border to Sundre. I examined 82 specimens from localities indicated in Figure 348.

#### *Hydroporus superioris* J. Balfour-Browne, 1944

*Hydroporus superioris* Balfour-Browne, 1944: 349. (new name for *H. sericeus* LeConte). Hatch 1953: 203. – Gordon and Post 1965: 17. – Wallis 1973: 104.

*Hydroporus sericeus* LeConte, 1850: 214. (Type locality – not stated, vicinity of Lake Superior.) Not Eschscholtz, 1818, or Costa, 1847. Melsheimer 1853: 32. – LeConte 1855: 291. – LeConte 1863a: 16. – Gemminger and Harold 1868: 441. – Crotch 1873: 393. – Sharp 1882: 443. – Wickham 1895a: 75. – Leng 1920: 78. – Zimmermann 1920: 108. – Fall 1923: 43.

*Diagnosis.* – The most useful characters for recognizing this species are presented in the preceding key to species.

*Description.* — Measurements of 20 specimens from the Little Bow River near Travers Dam, Alberta, are: TL — 4.36 to 4.84 mm ( $\bar{X} = 4.57 \pm 0.13$  mm); MW — 2.31 to 2.52 mm ( $\bar{X} = 2.40 \pm 0.06$  mm); TL/MW — 1.82 to 1.95 ( $\bar{X} = 1.90 \pm 0.03$ ).

Ground color of body pale rufous. Antenna testaceous except articles 7 or 8 to 11 infusate apically; palpi entirely testaceous. Pronotum with anterior margin inside anterior emargination, broadly piceous or black; basal margin with black border broadened internally, narrower towards posterolateral angles. Elytron (Fig. 108) testaceous or very pale rufous with sutural margin and about four longitudinal discal vittae and two longitudinal lateral spots, piceous or black; development of dark maculations various; some specimens with distinct longitudinal vittae, others with dark maculations expanded and elytral disc largely piceous with few narrow longitudinal pale markings — but even darkest specimens with subsutural pale band extended at least two thirds length of elytron hence basic pattern of elytral coloration of alternating longitudinal pale and dark vittae.

Dorsal surface of pronotum and elytron densely covered with short golden setae. Head coarsely punctate, interspaces microsculptured and dull; disc of pronotum and elytron densely punctate; interspaces on male smooth or with lightly impressed microsculpture, sculpture more deeply impressed laterally on pronotum and laterally and apically on elytron; female duller than male and more or less opaque due to fine dense microsculpture.

Clypeal ridge obsolete or suggested laterally as low convexity. Pronotum with lateral bead narrow basally, gradually widened toward front angles, subequal in width to maximum width of antennal article 3. Lateral margin of elytron more or less straight or very slightly ascending towards humeral angle: epipleuron visible to humeral angle in side view. Prosternum with medial prominence large and well developed, transversely truncate anteriorly; file, with several shallow transverse ridges. Metasternum with medial longitudinal sulcus well developed, area anterolateral to sulcus evenly rounded and without suggestion of longitudinal lateral ridge. Metafemur with posterobasal margin with scattered golden setae.

Male with articles 1 to 3 of protarsus dilated: articles 1 and 2 bearing many small oval adhesive scales on ventral surface: anterior protarsal claw shorter and broader than posterior, strongly and evenly arcuate. Aedeagus (Fig. 52) elongate, more or less straight apically in lateral view: apex broadly rounded.

*Natural history notes.* — Specimens are found in permanent, warm water, usually in situations where the bottom is clay or sand, with sparse rooted plants. Some beetles were found where vegetation was dense, but relatively little plant debris had accumulated. I found specimens in slow streams, beaver ponds, protected lake shores, borrow-pits and drainage ditches, sites in which the water is warmed by the sun. The beetles are often active during the day and in some sites many specimens were observed swimming along the bottom. Many teneral specimens were collected at Fickle Lake near Edson, on August 9, 1971.

*Distribution.* — The known range of this species is from Lake Superior and Manitoba to southeastern British Columbia, south to Minnesota and Indiana, and north to Aklavik, N.W.T. (UASM). The species probably occurs throughout the province excepting the Rocky Mountains. I examined approximately 250 specimens from Alberta localities (map, Fig. 349).

#### *Hydroporus paugus* Fall, 1923

*Hydroporus paugus* Fall, 1923: 50. (Type locality — Tyngsboro, Mass.) Long and Mutchler 1927: 17. — Brown 1932b: 201. — Hatch 1953: 204. — Wallis 1973: 104.

*Diagnosis.* — This and the following two species are characterized by the male protibia which is emarginate basoventrally. Specimens of *H. paugus* are larger and more depressed than are specimens of *H. rufiplanulus*, *H. rubyi* and *H. stagnalis*.

*Description.* — Measurements of 24 Alberta specimens are: TL — 3.52 to 4.00 mm ( $\bar{X} = 3.84 \pm 0.12$  mm); MW — 1.72 to 1.92 mm ( $\bar{X} = 1.83 \pm 0.06$  mm); TL/MW — 2.05 to 2.18 ( $\bar{X} = 2.10 \pm 0.03$ ).

Dorsal surface pale rufous to piceous. Head brown except anterior margin broadly pale rufous; antenna rufous, articles 3 or 4 to 11 infusate; palpi rufous, terminal article of each palpus lightly infusate apically. Pronotum with disc dark brown or piceous, lateral bead and margin broadly inside of bead, pale brown to rufous. Elytron brown, darkest medially on disc, paler laterally: epipleuron pale brown. Ventral surface dark brown to black with proepisternum, hind margins of sterna 3 to 6, and lateral spot on each of sterna 3 to 5, pale brown or rufous. Legs pale brown.

Pronotum with large deep punctures along anterior and basal margins: disc with sparse smaller punctures. Elytron uniformly punctate, punctures large and deep, separated by one to two times their own diameters; each puncture with short inconspicuous brown seta. Metasternal wing and metacoxal plate with strong but widely and evenly separated punctures.

Body flattened, more or less parallel-sided medially. Pronotum with lateral bead about one half width of one distal antennal article, well delimited and of about uniform width throughout length; hind angles of pronotum right or slightly obtuse: base more or less straight laterally, medial lobe short and broad. Elytron long and almost parallel-sided in basal two-thirds but with very slight lateral arcuation. Prosternum with prominence low, file weak or absent; prosternal process broad and long, more or less flattened laterally but with low longitudinal medial convexity, setose, apex bluntly pointed. Metacoxal processes conjointly sinuate (Fig. 40); metacoxal lines deep, slightly divergent anteriorly. Metatrochanter short, ratio length

of femur/length of trochanter about 1.5. Metafemur with longitudinal row of setae on ventral face.

Male protibia (Fig. 46) with internal basal emargination; protarsal articles 1 to 3 slightly dilated, article 1 bearing four small elongate adhesive setae on ventral surface; protarsal claws unmodified. Aedeagus (Fig. 53) strongly and abruptly narrowed towards apex.

*Taxonomic notes.* — Specimens of *H. paugus* vary somewhat in size, color and punctuation, but I have examined too few specimens to determine if there is a pattern to this variation. J. Balfour-Browne (1948) described a very similar species, *H. acadianus*, from Nova Scotia. As this species differs only slightly from *H. paugus* in characters such as color, punctuation and the relative width of the eyes and pronotal bead, it may represent either a valid species or a well defined eastern form of *H. paugus*.

*Natural history notes.* — These beetles are restricted to the forested portions of the province where they are found in small, cold pools of water usually situated in moss carpets and shaded by *Carex*. Teneral specimens were collected from August 5 to 27.

*Distribution.* — The known range of this species is from Massachusetts, New Hampshire (Mt. Washington, UASM), and Quebec to British Columbia. I examined over 40 specimens from Alberta localities (map, Fig. 350).

#### *Hydroporus rubyi* new species

Holotype — male and Allotype female; Township 1 Range 14 E, Manitoba, July 11, 1929, J. B. Wallis [CNC]. Paratypes — ALBERTA — Tp 27 Rge 7 W 5 (1); Tp 29 Rge 8 W 5 (1); Hwy 18, 12 mi S Swan Hills (1); Obed L (2); Forestry Trunk Road, 53 mi N Hinton (1); MANITOBA — Tp 1 Rge 14 E (1). [CARR, CNC and UASM].

*Diagnosis.* — This species belongs to Fall's (1923) *H. oblitus* group. The most similar species are *H. stagnalis* G. & H. and *H. rufiplanulus* Fall. It differs from the species *stagnalis* in that the pronotal bead is narrow, and from the very similar eastern North American species, *H. rufiplanulus*, in a number of characters (see taxonomic notes).

*Description.* — Measurements of four Alberta and three Manitoba specimens are: TL — 2.88 to 3.12 mm ( $\bar{X} = 3.00 \pm 0.08$  mm); MW — 1.40 to 1.48 mm ( $\bar{X} = 1.45 \pm 0.03$  mm); TL/MW — 2.03 to 2.17 ( $\bar{X} = 2.07 \pm 0.05$ ).

Dorsal surface dark brown to piceous. Anterior margin of head narrowly pale; antenna pale brown or rufous except articles 3 or 4 to 11 infuscate; palpi pale except terminal article of maxillary palpus infuscate apically. Lateral bead of pronotum and disc narrowly inside of bead, pale brown. Epipleuron pale to dark brown. Ventral surface of body dark brown to piceous with proepisternum, prosternal process, apical margins of abdominal sternites and lateral portions of sterna 3 to 6, paler. Legs pale brown to rufous.

Dorsal surface with evident, although generally finely impressed, isodiametric sculpture, deepest on head, shallower on disc of more or less shiny pronotum and elytron. Pronotum with series of irregular coarse punctures inside basal and apical margins; disc sparsely and finely punctate. Elytral disc with coarse punctures separated by two or more times their own diameters, each puncture with small inconspicuous brown seta. Metasternal wing and metacoxal plate laterally with sparse but more or less evenly scattered punctures.

Head very broad, eyes relatively small. Antenna with outer articles broad. Lateral bead of pronotum (Fig. 47) more or less inflated, well delimited internally and of about uniform width throughout length; at widest point, about half maximum width of one distal antennal article. Pronotum with base more or less straight laterally, medial lobe short and broad: postero-lateral angle slightly obtuse; pronotum very convex, sides evenly rounded anteriorly, almost parallel toward base, or sides slightly convergent behind with maximum width slightly anterior to hind angle; pronotum slightly wider at base than elytra across humeral angles. Elytra subparallel in basal half, expanded slightly to middle then evenly rounded to apex. Prosternum with file and prominence present; prosternal process broad, sparsely setose, broadly and smoothly convex medially, apex bluntly pointed. Metacoxae with hind margins conjointly sinuate, lines deeply impressed, slightly divergent anteriorly. Male protibia with internal basal emargination; pro- and mesotarsi with articles 1 to 3 slightly dilated, articles 1 each with four small elongate brown scales beneath. Aedeagus (Fig. 54) narrow, evenly tapered toward apex.

*Taxonomic notes.* — Of the species included in Fall's *oblitus* group, members of this species most closely resemble those of *H. rufiplanulus* Fall. I have examined a male paratype of *H. rufiplanulus* and although it is very similar to specimens of *H. rubyi* in most features, the latter differ in the following characters: body shorter and more convex; color darker, (the specimen of *rufiplanulus* is more or less evenly rufous on both dorsal and ventral surfaces); micro-sculpture stronger; elytron with punctures finer; eyes larger; antenna with articles stouter; pronotum with lateral bead narrower; and aedeagus slenderer, narrowing evenly from base to

apex in dorsal view while that of *rufiplanulus* is parallel-sided to apex of dorsal groove then narrowing to apex.

*Etymology.* – The specific epithet is based on the given name of Dr. Ruby Larson, a geneticist with the Agriculture Canada Research Station, Lethbridge, Alberta. Her enthusiasm and interest in many aspects of biology has been an inspiration to me as well as many other amateur and professional biologists.

*Natural history notes.* – I collected two specimens of this species: one, from a small, barren, recently dug borrow-pit; the other, from a cold, willow-ringed *Carex-Sphagnum* bog. The species may be an inhabitant of *Sphagnum* bogs, because related species occur in this habitat.

*Distribution.* – This species is known from only the localities listed above. Alberta localities are indicated in Figure 351.

#### *Hydroporus stagnalis* Gemminger and Harold, 1868

*Hydroporus stagnalis* Gemminger and Harold, 1868: 441. (new name for *H. collaris* LeConte). Wickham 1895a: 76. – Leng 1920: 79. – Zimmermann 1920: 108. – Fall 1923: 52. – Fall 1932: 145. – Wallis 1973: 104.

*Hydroporus collaris* LeConte, 1855: 297. not Hope, 1841. (Type locality – “Lake Superior”), LeConte 1863a: 16. – Crotch 1873: 395. – Sharp 1882: 483.

*Hydroporus persimilis* Fall, 1923, not Crotch, 1873.

*Diagnosis.* – This species is well separated from the two similar preceding species by the very broad margins of the pronotum.

*Description.* – Measurements on two females from Tp. 31 Rge. 5 W 5, Alberta are: TL – 3.40 and 3.32 mm; MW – 1.68 and 1.68 mm; TL/MW – 2.02 and 1.98.

Body dark brown to piceous. Anterior margin of head, pronotal bead, disc of pronotum narrowly inside of bead, and hind margin of pronotum, pale brown. Ventral surface of body testaceous to brown. Antenna testaceous with articles 3 to 11 infuscate. Palpi testaceous.

Dorsal surface with coarse isodiametric microsculpture: sculpture of sterna 2 and 3 shallowly impressed, strongly stretched laterally. Margins of pronotum and disc of elytra with scattered coarse punctures; pronotal disc and elytron basally with widely separated fine punctures.

Pronotum (Fig. 48) with sides slightly but evenly arcuate, greatest width at or slightly ahead of hind angles; lateral bead very broad, subequal in width to maximum width of an outer antennal article. Prosternal process elongate, broadly and evenly convex medially, sparsely setose laterally, apex bluntly pointed. Elytra elongate and parallel-sided. Body more depressed than in *H. rufiplanulus*. Male not seen: according to Fall (1923) male with protibia emarginate internally near base, protarsal articles broadly expanded.

*Natural history notes.* – Two teneral specimens of this species were collected on August 29, 1972 from small pools which were shaded by willows and situated in moss and dense *Carex* along the margin of a small cold creek.

*Distribution.* – Fall (1923) records *H. stagnalis* from Massachusetts and Rhode Island to Wisconsin and north to Quebec and Manitoba. I have seen two Alberta specimens from the following locality (Fig. 352): Tp. 31 Rge. 5 W 5 (6 mi SW Bergen) (UC).

#### *Hydroporus edwardsi* Wallis, 1933

*Hydroporus edwardsi* Wallis, 1933: 261. (Type locality – Grand Coulee, Grant Co., Washington). – Hatch 1953: 204.

*Diagnosis.* – *H. edwardsi* and the two following species, *H. compertus* Brown and *H. planiusculus* Fall, belong to Fall's (1923) *H. vilis* group. The Alberta members of the group superficially resemble the three preceding species, belonging to Fall's *oblitus* group, in terms of habitus, color and the shape of the metacoxal processes. However, they differ in that males lack a ventral protibial emargination, the metatrochanter is very large, and the aedeagus is bilobed apically. In addition, the members of the *oblitus* group tend to inhabit swamps and bogs while those of the *vilis* group occur in sand and gravel or under detritus along the margins of cold creeks, springs and lakes.

Among the Alberta species of the *vilis* group, specimens of *edwardsi* can be recognized by their small size, broad shape, more or less complete medial prosternal carina and slightly modified abdominal sternum 6 of the female.

*Description.* — Measurements of 30 Alberta specimens are: TL — 2.64 to 3.12 mm ( $\bar{X} = 2.90 \pm 0.10$  mm); MW — 1.36 to 1.64 mm ( $\bar{X} = 1.50 \pm 0.06$  mm); TL/MW — 1.87 to 1.97 ( $\bar{X} = 1.94 \pm 0.04$ ).

Head rufopiceous to piceous except anterior margin paler, testaceous to rufous; antenna rufous, or some specimens with articles 5 to 11 infusate; palpi pale. Pronotum black medially, piceous towards lateral margin: anterior angle, lateral bead and on some specimens margin inside of bead, rufous. Elytron laterally and basally reddish-brown, gradually darkening medially and posteriorly to dark brown or piceous: epipleuron rufous at least basally, darker apically. Ventral surface largely black or piceous. Legs rufous.

Dorsal surface with evident isodiametric microsculpture. Head with small scattered more or less inconspicuous punctures on frons. Pronotum with margins evidently punctate, punctures medially on disc fine and sparse. Elytron strongly and more or less evenly punctate, each puncture bearing a short inconspicuous seta: basally interspaces with very minute sparse punctures. Ventral surface finely and sparsely punctate.

Body depressed. Pronotum with lateral bead well defined, narrower than basal width of antennal article 3. Prosternal prominence represented by a low transverse ridge at base of prosternal process: file reduced or obsolete; prosternal process convex with a narrow longitudinal ridge on at least distal half and on most specimens running entire length of process, process laterally with few short semierect setae. Elytron with lateral margin slightly sinuate in lateral view, evidently ascending to humeral angle. Metacoxal processes conjointly bisinuate. Metatrochanter large. Apex of sternum 6 of male evenly rounded, of female very slightly and bluntly pointed medially, slightly deflexed. Male with articles 1 of pro- and mesotarsus each bearing pair of large rounded adhesive scales beneath; article 2 with one pair of ventral scales. Aedeagus (Fig. 55) with apex emarginate medially, dorsal subapical projection rounded and inconspicuous.

*Taxonomic notes.* — F. Young identified specimens of this species as close to *edwardsi* but it is not certain that the two groups are conspecific. Members of *H. pacificus* Fall and *H. rossi* Leech (Leech 1941a: 129) resemble members of this species in that abdominal sternum 6 of the females are slightly produced at apex. Wallis did not record sexual characters of his specimens of *edwardsi* but sexual differences in this group are generally of a minor nature and are easily overlooked.

*Natural history notes.* — Most specimens collected by me were under rocks along margins of small cold springs and creeks, where the substrate was sand-clay to gravel. Teneral specimens were collected in August.

*Distribution.* — This species has been recorded from Washington. Distribution in Alberta is incompletely known. The species occurs primarily in the Rocky Mountains and adjacent foothills, but also in the Cypress Hills and south of McMurray. Perhaps the species is widely distributed in the province wherever cold springs occur. I examined 52 specimens from Alberta localities (map, Fig. 353).

#### *Hydroporus compertus* Brown, 1932

*Hydroporus compertus* Brown, 1932a: 4. (Holotype — Copper Mountain, B.C.; CNC type no. 3241.) Hatch 1953: 204.

*Diagnosis.* — This species includes the largest adults of Fall's (1923) *vilis* group to be found in Alberta. The tendency of the elytron to be bicolored and the strong elytral punctuation usually separate specimens of *H. compertus* from those of *H. planiusculus*.

*Description.* — Measurements of 30 specimens from Waterton Lakes National Park and the Crownsnest Pass areas of Alberta are: TL — 3.08 to 3.48 mm ( $\bar{X} = 3.28 \pm 0.11$  mm); MW — 1.52 to 1.76 mm ( $\bar{X} = 1.67 \pm 0.06$  mm); TL/MW — 1.90 to 2.05 ( $\bar{X} = 1.97 \pm 0.03$ ).

Head dark rufous to brown except paler along anterior margin and anteromedially on frons; antenna rufous except at least articles 10 and 11 lightly infusate apically and many specimens with articles 5 to 9 also very lightly infusate; palpi entirely testaceous; mentum and gula pale, ventral surface of head rufous to piceous laterally. Pronotum with disc dark brown to piceous medially, lateral bead and disc broadly inside of bead, rufous. Elytron testaceous or pale brown on basal quarter to half, becoming darker brown posteriorly and internally (on some specimens abruptly so) due to depigmented apical portion of elytron: epipleuron pale basally, becoming rufous apically. Ventral surface of body largely rufopiceous to black. Legs pale brown or rufous.

Dorsal surface with isodiametric microsculpture: meshes large and flat and more or less shiny. Head with scattered small punctures on frons. Pronotum with row of coarse punctures inside anterior margin, disc more finely punctate. Elytron

relatively coarsely punctate, each puncture with small seta about equal in length to diameter of puncture. Ventral surface evidently punctate, punctures deeper and slightly denser than in *H. planiusculus* adults, especially on sterna 1 and 2.

Antenna broad, outer articles noticeably thick. Pronotum with lateral bead well delimited internally throughout length, bead inflated, of even width or broadened slightly and evenly toward front angle and subequal in width to base of antennal article 3; prosternal prominence small and low, without file: prosternal process flat to slightly concave medially, or some specimens with low rounded medial longitudinal convexity best developed toward apex; lateral margins fringed with long semierect pale setae. Metacoxal processes conjointly sinuate. Metafemur with row of ventral medial setae on apical half. Male with ventral surface of pro- and mesotarsal articles 1 each bearing two pairs of oval adhesive scales; articles 2 each bearing one pair. Male aedeagus as in Figure 56: apex bilobed in ventral view; subapical dorsal projection relatively low as compared to *H. planiusculus*. Female with abdominal sternum 6 unmodified apically.

*Natural history notes.* — The Alberta distribution of this species is along the Rocky Mountains and adjacent foothills. Here, the beetles are found along margins of cold springs, rivers or alpine and subalpine lakes, usually under cover such as pieces of wood or rocks at or slightly below waterline along the shore.

*Distribution.* — This species is western, from eastern British Columbia and western Alberta. I examined more than 230 specimens from Alberta localities (map, Fig. 354).

### *Hydroporus planiusculus* Fall, 1923

*Hydroporus planiusculus* Fall, 1923: 58. (Type locality — Mt. Adams (3500'), White Mountains, New Hampshire.) Fall 1926: 138. — Brown 1932a: 4. — Leng and Mutchler 1927: 17. — Fall 1934: 171. — Hatch 1953: 204. — Young 1953b: 117. — Anderson 1962: 63. — Wallis 1973: 104.

*Diagnosis.* — Adults of this species are very similar to those of the preceding species but differ in a tendency to smaller size, narrower and more depressed form, with color paler and punctuation of the body finer.

*Description.* — Measurements of 30 specimens from the Cascade River near Banff Townsite are: TL — 2.88 to 3.24 mm ( $\bar{X} = 3.06 \pm 0.19$  mm); MW — 1.36 to 1.60 mm ( $\bar{X} = 1.47 \pm 0.06$  mm); TL/MW — 2.00 to 2.14 ( $\bar{X} = 2.08 \pm 0.03$ ).

Head rufous to piceous except anterior margin testaceous; pale anterior area not prolonged posteromedially on frons; antenna testaceous to pale rufous except articles 5 to 11 lightly infuscate apically on some specimens; palpi entirely pale. Pronotum dark rufous or brown medially, rarely piceous: lateral bead and disc broadly inside of bead, testaceous to pale rufous. Elytron testaceous to pale brown basally and basolaterally; distally variously depigmented and more or less transparent, generally darkened by underlying hind wings and abdomen, but not usually abruptly darkened in apical three quarters to half and not as dark as specimens of *H. compertus*. Ventral surface largely black. Legs flavous to pale rufous.

Dorsal surface with well developed isodiametric sculpture; meshes flat and shiny. Head finely and sparsely punctate. Pronotum with submarginal series of coarse punctures along anterior margin, otherwise more or less evenly and finely punctate. Punctures of elytron conspicuously smaller than anterior submarginal pronotal punctures, more or less elongate in shape, each with very small inconspicuous seta. Ventral surface finely and sparsely punctate.

Antenna with articles 5 to 11 relatively slender. Pronotal bead as in *compertus*. Prosternal prominence and file reduced or absent. Male protarsal characters as in *H. compertus*. Aedeagus (Fig. 57) with apical emargination deep, subapical dorsal projection strong; paramere with apex not prolonged. Female with sternum 6 not modified apically.

*Taxonomic notes.* — This species is a member of a group whose species are difficult to identify because “each population seems to constitute a distinct or incipient species, and the isolation of populations makes it difficult to demonstrate relationship” (Young, 1953b). The members of this group offer few good taxonomic characters; most are qualitative and difficult to appreciate without reference to type material. Fall (1934) placed the names *H. brumalis* Brown (1930: 235), *H. compertus* Brown and *H. falsificus* Brown as junior synonyms of the name *H. planiusculus*. Hatch (1953) places *H. edwardsi* Wallis (1933a) as an additional junior synonym of *H. planiusculus* but then states that the species so defined may actually be composite. Other species belonging to this group are *H. vilis* LeConte, *H. palliatus* Horn, *H. malkini* Hatch, *H. belfragei* Sharp and *H. pseudovilis* Young. The group requires revision.

In Alberta *H. compertus* Brown, seems distinct from *H. planiusculus*. No one character is sufficient to reliably separate the two, but when taken together, the differences in size, shape, color and punctuation as well as a minor difference in the form of the aedeagus usually permit specimens to be assigned to one species or the other with a high degree of reliability especially

when series are available.

*Natural history notes.* – Adults of this species are usually found under rocks deeply embedded along the shorelines of cool or cold springs, creeks, lakes or spring or seepage-fed borrow-pits, with sandy-clay to gravel bottom. Teneral specimens were collected from July 17 to August 23.

*Distribution.* – The published records, if they all refer to the same species, indicate a very wide range, from New Hampshire to Alaska. I have seen specimens from Manitoba (Riding Mts., UASM), British Columbia (several localities) and Yukon Territories (Mile 459, Alaska Hwy, CARR) which I have tentatively assigned to this species. I examined more than 150 specimens from Alberta localities (map, Fig. 355).

#### *Hydroporus columbianus* Fall, 1923

*Hydroporus columbianus* Fall, 1923: 78. (Type locality – Golden, B.C.). Leng and Mutchler 1927: 17. – Hatch 1953: 206. – Wallis 1973: 104.

*Diagnosis.* – The extremely large size (always over 5 mm in total length) and the rather pale frons are sufficient to characterize adults of this species.

*Description.* – Measurements of 20 Alberta specimens are: TL – 5.32 to 6.24 mm ( $\bar{X} = 5.75 \pm 0.23$  mm); MW – 2.68 to 3.20 mm ( $\bar{X} = 2.91 \pm 0.13$  mm); TL/MW – 1.92 to 2.01 ( $\bar{X} = 1.98 \pm 0.03$ ).

Head rufous except spots on frons medially to each eye (some specimens with spots narrowly confluent posteromedially) and posterior margin of head narrowly piceous; antenna rufous with articles 2 or 3 to 11 infuscate on apical half to two-thirds; palpi rufous except terminal article of each palpus infuscate. Pronotum piceous medially, lateral margins broadly rufous. Elytron with epipleuron and lateral and basal margins rufous, disc gradually darkened medially and apically. Ventral surface of body black with prosternal process, metacoxal process and posterior and lateral margins of sterna 3 to 6, rufous. Legs rufous with basal two-thirds of each femur darkened.

Head conspicuously punctate, interspaces with isodiametric microsculpture; frontal impressions broad, shallow and more or less circular. Dorsal surface of pronotum and elytron with numerous punctures, each puncture with elongate pale seta. Male pronotum and elytron evidently reticulately microsculptured; meshes more or less isodiametric on pronotum slightly transversely stretched on elytron; female with lines of sculpture dense and deeply impressed, surface dull. Metasternal wings and sterna 1 and 2 laterally, with numerous distinct punctures; metacoxa with punctures similar in size to those of metasternal wing but on many specimens more widely separated and shallower.

Pronotum with lateral bead well defined, of even width throughout length or slightly broader near middle. Prosternal process low; prominence weak and poorly defined; file well developed with numerous transverse ridges. Elytral margin sinuate and ascending to humeral angle, epipleuron disappearing behind lateral margin posterior to humeral angle. Metacoxal lines diverging anteriorly: metacoxal processes conjointly slightly angulate.

Male with articles 1 to 3 of pro- and mesotarsi broadly dilated (Fig. 87) (female protarsus slender, Fig. 88): articles 1 each with numerous round adhesive scales beneath; articles 2 with two to four scales along basal margin: protarsal claws equal, anterior claw slightly broadened otherwise little modified (Fig. 81). Aedeagus as in Figure 58.

*Natural history notes.* – Specimens were collected from beaver ponds, *Carex* marshes, *Sphagnum* bogs, borrow-pits and small iron-rich springs, but no more than two or three from one collecting site. Probably the true habitat of this species is not known and most records indicate accidental occurrence.

*Distribution.* – Fall (1923) records this species from Michigan, Manitoba and British Columbia. I have examined specimens from British Columbia (several localities) and Wyoming (Smoot, CARR), and 28 specimens from Alberta localities (map, Fig. 356).

#### *Hydroporus notabilis* LeConte, 1850

*Hydroporus notabilis* LeConte, 1850: 216. (Type locality – Black Bay, Lake Superior.) Melsheimer 1853: 32. – LeConte 1855: 292. LeConte 1863a: 16. – Gemminger and Harold 1868: 437. – Crotch 1873: 395. – Sharp 1882: 803. – Wickham 1895a: 76. – Leng 1920: 78. – Zimmermann 1920: 95. – Fall 1923: 72. – Fall 1926: 138. – Brown 1932b: 201. – Hatch 1953: 206. – Anderson 1962: 63. – Gordon and Post 1965: 17. – Wallis 1973: 104.

*Diagnosis.* – The combination of large size, dark head and distinctive male protarsal claws make this species easily recognizable.

*Description.* – Measurements of 30 Alberta specimens are: TL – 4.56 to 5.44 mm ( $\bar{X} = 4.99 \pm 0.21$  mm); MW – 2.40 to 2.80 mm ( $\bar{X} = 2.57 \pm 0.11$  mm); TL/MW – 1.86 to 2.00 ( $\bar{X} = 1.94 \pm 0.05$ ).

Head black with following rufous: frontal margin, transverse vitta on frons between hind angles of eyes, and on some specimens narrow ring around each eye; antenna with article 1 testaceous to rufous, articles 2 to 11 pale basally, infuscate medially and apically; palpi testaceous, terminal article of each palpus infuscate. Pronotum black with anterior angles and lateral margins narrowly rufous to piceous. Elytron black medially, lateral margins paler, dark rufous to piceous; epipleuron rufous. Ventral surface black with apex of metacoxal process, posterior margin of sterna 3 to 5, and apical half of sternum 6, rufous. Legs rufous to rufopiceous.

Male with dorsal surface of body rather shiny, elytron with fine isodiametric sculpture; female elytron with extremely fine, dense sculpture, dull. Disc of pronotum and elytron with numerous punctures, each bearing long pale (white, yellow or greenish) seta. Metasternum laterally, and sterna 1 and 2 with coarse distinct punctures, metacoxal plates with punctures smaller and less distinct.

Sexes different in habitus: male elongate, almost parallel-sided medially; female more evenly rounded laterally: both sexes strongly convex dorsally. Lateral bead of pronotum well defined, narrow basally and widened and distinctly inflated anteriorly at front angle. Prosternum with file and prominence; prosternal process broad, broadly but strongly convex, rounded medially; densely and uniformly setose. Lateral margin of elytron arcuate in lateral view behind shoulder, epipleuron disappearing slightly posterior to humeral angle. Metacoxal process as in Figure 41.

Male with articles 1 to 3 of pro- and mesotarsi strongly dilated (Fig. 89) (female protarsus, Fig. 90): articles 1 and 2 bearing numerous small, rounded, adhesive scales beneath: protarsal claws (Fig. 82) elongate, strongly bent at base, more or less straight medially and shortly arcuate at apex (anterior claw more strongly bent both at base and at apex than posterior claw). Aedeagus and paramere as in Figure 59.

*Taxonomic notes.* – Fall (1923) and other subsequent authors have suggested that the species *H. arcticus* Thoms. includes small northern adults of *H. notabilis*. The relationship between these two is still in doubt.

*Natural history notes.* – This species is found throughout the province, but is much less common on the prairies than in the forested areas. Most specimens were collected from *Carex* marshes but many were in shallow warm ponds. I have not seen adults earlier in the year than May 30, and most specimens taken during June and early July were teneral. Larvae, pupae and newly emerged adults were found under logs around a small forest pool near Fort McKay on June 10, 1970. Only immature stages may hibernate, perhaps the egg or partially grown larvae. James (1970) characterized the latter.

*Distribution.* – The species is probably transcontinental in Canada, ranging south to Michigan, Wisconsin, and Utah. If *H. arcticus* Thoms. is conspecific with *H. notabilis*, the range of the species extends to arctic and boreal portions of the Palaearctic Region (Zaitsev, 1953). I examined more than 450 specimens from Alberta localities (map, Fig. 357).

#### *Hydroporus dentellus* Fall, 1917

*Hydroporus dentellus* Fall, 1917: 181. (Type locality – Tyngsboro, Mass.) Leng 1920: 78. – Fall 1923: 68. – Hatch 1953: 206. – Wallis 1973: 104.

*Diagnosis.* – The elongate, posteriorly tapering body gives adults of this species a very characteristic habitus. In addition, the rufous head, and toothed anterior protarsal claw of the male, are distinctive.

*Description.* – Measurements of 30 Alberta specimens are: TL – 4.12 to 4.32 mm ( $\bar{X} = 4.21 \pm 0.05$  mm); MW – 1.96 to 2.08 mm ( $\bar{X} = 2.04 \pm 0.03$  mm); TL/MW – 2.02 to 2.12 ( $\bar{X} = 2.06 \pm 0.03$ ).

Head rufous except frons of many specimens with diffuse dark rufous or piceous spot medially to each eye; posterior margin of head somewhat darkened: antenna rufous basally, articles 2 or 3 to 11 infuscate, at least apically; palpi rufous except terminal article of each palpus infuscate. Pronotum with disc dark brown to piceous, paler laterally with lateral margin of disc and bead, rufous. Elytron dark brown or piceous medially and apically, paler towards rufous lateral margin; epipleuron rufous. Ventral surface largely black: prosternum and process, metacoxal process, sterna 2 and 3 medially, and sterna 3 to 6 apically and laterally, rufous. Legs rufous to rufopiceous.

Dorsal surface with evident microsculpture: male somewhat shiny, with meshes open; female with elytral sculpture very dense and fine, surface dull. Elytron coarsely punctate, each puncture with pale brown seta about 1.5 as long as distance between punctures. Ventral surface sculptured and punctate; punctures of metacoxa large, equal to or larger than those of metasternal wing and sterna 1 and 2.

Head with frontal furrows linearly punctate, broad and shallow. Pronotum with lateral bead narrow but well defined;



lateral margin arcuate in outline, pronotum widest at hind angles; posterolateral angle narrowly rounded, more or less right angled; basal lobe broad, hind margin slightly sinuate near posterolateral angles. Elytron elongate, sides subparallel in basal half, gradually and more or less evenly narrowing to pointed apex. Lateral margin of pronotum and elytron in form of almost straight line in side view, epipleuron disappearing well posterior to humeral angle. Prosternal prominence low and obsolete or almost so, file of several coarse transverse ridges. Prosternal process broad, broadly convex medially. Metacoxal processes conjointly with posterior margin slightly produced medially.

Male with articles 1 to 3 of pro- and mesotarsi dilated: article 1 narrower than subequal articles 2 or 3; articles 1 each bearing two, and articles 2 each bearing one pair of large oval scales beneath: anterior protarsal claw with a large medial ventral tooth (Fig. 83). Aedeagus as in Figure 60.

*Natural history notes.* — This species is in the northern forested portions of the province where specimens are usually found among dense emergent vegetation in small, usually cold, ponds, or in small pools in *Sphagnum* or *Drepanocladus* bogs.

*Distribution.* — This species ranges from the New England States to southeastern British Columbia and north to the Mackenzie delta (Aklavik, UASM). Specimens were collected in many localities in the forested portions of northern Alberta, and south along the eastern slope of the Rocky Mountains to the Bow River. I examined more than 115 specimens from Alberta localities (map, Fig. 358).

#### *Hydroporus hockingi* new species

Holotype male and allotype female — Township 37 Range 5 W of the fifth meridian, Alberta, May 13, 1973, D. & M. Larson. [CNC].

Paratypes — 18 specimens from the following Alberta localities: Tp 37 R 5 W 5; Jumpingpound Creek; 3 mi S Crimson Lake. [CARR, CNC and UASM].

*Diagnosis.* — Individuals of this species look very much like diminutive specimens of *H. dentellus* in general habitus and color. However, males lack the tarsal modifications shown by specimens of *H. dentellus*.

*Description.* — Measurements of 14 specimens collected from the vicinity of Rocky Mountain House, Alberta, are: TL — 3.00 to 3.24 mm ( $\bar{X} = 3.12 \pm 0.07$  mm); MW — 1.44 to 1.60 mm ( $\bar{X} = 1.52 \pm 0.05$  mm); TL/MW — 2.00 to 2.08 ( $\bar{X} = 2.05 \pm 0.03$ ).

Head light rufous except frons with vague darkened spot medially to each eye; antenna rufous except articles 2 or 3 to 11 infusate apically; palpi rufous except terminal article of maxillary palpus infusate apically. Pronotum with disc dark rufous: anterior and basal margins darker, lateral margins broadly pale rufous. Elytron rufous laterally and basally, becoming gradually darker medially and posteriorly; epipleuron rufous. Ventral surface dark rufous to piceous with prosternum and its process, metacoxal process, abdominal sternum 2 medially, and sterna 3 to 6 posteriorly and laterally, rufous. Legs rufous.

Dorsal surface microreticulate. Head with small but evident punctures sparsely scattered over frons. Pronotum coarsely punctate along margins, disc medially with only very small sparse punctures. Elytron coarsely and evenly punctate, each puncture with short brown seta generally shorter in length than distance between punctures. Ventral surface coarsely punctate and microsculptured.

Body elongate (Fig. 112), convex dorsally but slightly depressed beneath; pronotum and elytra meeting in even line; elytra parallel-sided or very broadly rounded basally, evenly convergent toward relatively sharply pointed apex. Antenna short and stout, articles 6 to 9 about as wide as long. Pronotum with greatest width at hind angles, hind angles almost right angled; lateral bead narrow but clearly limited throughout length. Pronotum and elytron in side view in form of almost straight line; epipleuron disappearing posterior to humeral angle. Prosternal prominence obsolete or at most only slightly suggested; file evident; prosternal process angularly convex in cross section, margined laterally, setose. Metacoxal lines strongly diverging; metacoxal processes with hind margin very shallowly sinuate inside lateral angle, slightly and bluntly angulate medially.

Male with articles 1 to 3 of pro- and mesotarsi only slightly dilated: articles 1 and 2 with two and one pairs of oval adhesive scales beneath respectively; claws unmodified, subequal in length. Aedeagus as in Figure 61.

*Taxonomic notes.* — Specimens of *H. hockingi* are darker and smaller than those of *H. melsheimeri* Fall, 1917, but otherwise fit the description of the latter. However, R. Gorden (in litt., 1974), considers these specimens to represent a separate undescribed species.

*Etymology.* — The specific epithet is based on the surname of Dr. Brian Hocking, former chairman of the Department of Entomology, University of Alberta.

*Natural history notes.* — Several specimens were collected from amid tufts of *Carex* growing in small pools of very cold water in an extensive black spruce — *Sphagnum* bog west of Rocky Mountain House. The species is common in moss mats of quaking bogs near Stauffer, Alta.

*Distribution.* — All specimens seen by me are in the type series. Localities are indicated in Fig. 359.

*Hydroporus mannerheimi* Balfour-Browne, 1944

*Hydroporus mannerheimi* J. Balfour-Browne, 1944: 349. (new name for *H. humeralis* Aubé). Leech 1949a: 245. — Hatch 1953: 209. — Leech and Chandler 1956: 317.

*Hydroporus humeralis* Aubé, 1838: 578. Not Marsham, 1802. (Type locality — “Etats-Unis d’Amerique”). Mannerheim 1843: 222. — Melsheimer 1853: 32. — LeConte 1863a: 16. — Gemminger and Harold 1868: 434. — Crotch 1873: 394. Sharp 1882: 474. — Leng 1920: 78. — Zimmermann 1920: 88. — Fall 1923: 68. — Hatch 1933: 10.

*Diagnosis.* — The combination of large size, ascending elytral margin and maculate elytra characterizes members of this species.

*Description.* — Measurements of 30 Alberta specimens are: TL — 4.20 to 4.72 mm ( $\bar{X} = 4.47 \pm 0.13$  mm); MW — 2.04 to 2.36 mm ( $\bar{X} = 2.22 \pm 0.07$  mm); TL/MW — 1.95 to 2.07 ( $\bar{X} = 2.01 \pm 0.03$ ).

Head piceous except anterior margin and frons narrowly beside eye and medially between posterior inner angles of eyes, rufous (palest specimens with head rufous; frons with hind margin and spot medially to each eye, piceous); antenna with articles 1 to 2 or 3 testaceous, outer articles infusate apically; palpi testaceous except terminal article of each palpus infusate on most specimens. Pronotum with disc piceous to black, anterior angle and side margin medially to lateral bead, broadly testaceous to rufous (most specimens with pale lateral areas sharply delimited from darker medial portion of disc); basal margin narrowly black, even laterally towards posterolateral angle. Elytron piceous to black except testaceous to rufous marks; humeral angle testaceous with pale area on most specimens extended obliquely onto disc in form of distinct baso-medial band not extended to either basal or sutural margin; lateral margin pale on at least basal two-thirds; disc with lateral spot just anterior to middle and on most specimens continuous with pale lateral margin, sublateral spot just behind middle isolated or not, and small rounded subapical spot (on some specimens this pattern may be reduced); epipleuron testaceous to dark rufous, paler basally. Ventral surface black with prosternal process, metacoxal process, sternum 2 medially and sterna 3 to 6 posteriorly and laterally, rufous to piceous. Legs rufous with base of femur and tarsi infusate.

Dorsal surface of head and pronotum with fine isodiametric sculpture, less deeply impressed on male than on female, male more shiny; male elytron with evident meshes, on some specimens somewhat stretched transversely; female elytron very finely and densely sculptured, dull and opaque. Disc of pronotum and elytron with long pale setae. Metasternal wing and lateral portions of sterna 1 and 2, coarsely punctate; metacoxal wings relatively shallowly punctate.

Pronotum various in shape: most specimens with maximum width slightly in front of posterolateral angles, posterolateral angles broadly rounded and obtuse hence lateral outline of pronotum and elytron discontinuous: lateral bead of pronotum narrow, indistinctly defined and on many specimens traceable only near anterolateral angles. Prosternum with prominence and file; prosternal process broad, evenly convex to broadly angulate medially, apex broadly pointed. Lateral margin of elytron strongly ascendent to humeral angle (Fig. 111), epipleuron visible to, or almost to, base. Metacoxal lines slightly diverging anteriorly; metacoxal processes with hind margin truncate or slightly produced medially.

Male with articles 1 to 3 of pro- and mesotarsus dilated (Fig. 91), articles 2 and 3 subequal in width, slightly broader than article 1; articles 1 each bearing 2 pairs of elongate scales beneath, articles 2 lacking such scales; anterior protarsal claw slightly broader and more arcuate apically than posterior claw. Aedeagus as in Figure 62.

*Natural history notes.* — Leech (1949a) states that *H. mannerheimi* is typically a species of streams and rivers. However, in Alberta very few specimens were in running water, and these in pond-like situations such as beaver dams. Most specimens were collected from shallow, bare rocky shorelines of subalpine lakes or from open *Carex* stands along margins of cool, clear water, beaver ponds. Teneral specimens were collected from July 7 to August 9, the majority toward the end of July.

*Distribution.* — *H. mannerheimi* is known from northwestern California to Alaska, and east to western and north central Alberta. I examined more than 170 specimens from Alberta localities (map, Fig. 360).

*Hydroporus tademus* Leech, 1949

*Hydroporus tademus* Leech, 1949a: 243. (Type locality — Vernon, B.C.; Holotype — ♂, CAS no. 6151.) Hatch 1953: 209. — Leech and Chandler 1956: 317.

*Diagnosis.* — Adults of this species differ from those of *H. mannerheimi* as follows: the body is more robust and color is darker with the pronotum more uniformly reddish and elytral maculations reduced. Additionally, there are differences in the shape of the protarsus and aedeagus.

*Description.* – (based on Leech's original description.) Measurements of 18 Alberta specimens are: TL – 4.28 to 4.72 mm ( $\bar{X} = 4.56 \pm 0.12$  mm); MW – 2.20 to 2.40 mm ( $\bar{X} = 2.33 \pm 0.06$  mm); TL/MW – 1.91 to 2.03 ( $\bar{X} = 1.96 \pm 0.03$ ).

Head dark rufous except frons with area medially to each eye (these areas may be isolated, or continuous medially and extended anteriorly to level of base of clypeus) and laterally behind eye, piceous; antenna with articles 1 and 2 testaceous, articles 3 to 11 piceous except at least base of each article testaceous; palpi testaceous except terminal article of each palpus infusate apically. Pronotum with disc dark rufous to piceous medially, gradually paler toward lateral margins; pale areas near lateral margin not definitely limited internally. Elytron piceous, except humeral angle, pale narrow marginal band on basal half, and subapical spot; epipleuron pale brown. Ventral surface piceous to black: prosternal process, apex of metacoxal process and sterna 3 to 6 posteriorly and laterally, rufous to piceous. Legs pale brown to rufous, with femora infusate basally.

Sculpture similar to that of *mannerheimi* adults: lines of microsculpture somewhat shallower on disc of elytron. Setae of pronotum and elytron pale.

Body more robust than *mannerheimi*, dorsal surface more convex: elytra more broadly rounded laterally with maximum width at or just behind middle. Pronotum broader, lateral margin more arcuate than in *mannerheimi*: hind angle rounded and obtuse, pronotum widest just anterior to posterolateral angles: lateral bead narrow, well delimited on anterior half to two-thirds, becoming obsolete towards hind angle. Prosternal prominence and file well developed: prosternal process broadly subangularly convex, lateral margins sparsely setose. Elytron with lateral margin strongly ascendent, as in *mannerheimi*.

Male with articles 1 to 3 of pro- and mesotarsi dilated, articles 1 each bearing two pairs of elongate scales beneath: protarsus (Fig. 92) differing from that of *mannerheimi* in being slightly narrower, article 2 asymmetrical, and article 3 in both sexes more parallel-sided than in *mannerheimi*. Aedeagus (Fig. 63) narrower, apex more sharply pointed than in *mannerheimi*.

*Taxonomic notes.* – Although the species *H. tademus* is largely sympatric in distribution with the very closely related, widespread species, *mannerheimi*, Leech (1949a) states that the two occupy somewhat different habitats. Leech regards *H. tademus* as a species of ponds and lakes while *H. mannerheimi* occupies flowing water. In Alberta, where *H. tademus* is largely absent, *H. mannerheimi* is most frequently found in still water.

*Natural history notes.* – Specimens of *H. tademus* were collected from amid sparse *Carex* along the margin of a beaver dam in clear and cold water, and a bottom of largely bare organic silt or waterlogged plant debris.

*Distribution.* – This species has been recorded from northern California to southern British Columbia, and is known in Alberta from the headwaters of the Castle River. I have examined 18 specimens from Alberta localities (map, Fig. 361).

#### *Hydroporus signatus* Mannerheim, 1853

*Hydroporus signatus* Mannerheim, 1853: 161. (Type locality – Kodiak Island, Alaska.) – LeConte 1863a: 16. – Gemminger and Harold 1868: 441. – Crotch 1873: 394. – Wickham 1895a: 76. – Zimmermann 1920: 102. – Leng 1920: 78. – Fall 1923: 87. – Brown 1930b: 236. – Leech 1948a: 95. – Hatch 1953: 208. – Wallis 1973: 105.

*Hydroporus niger* Sharp, 1882, not Say, 1825.

*Hydroporus inornatus* Sharp, 1882: 478. (Type locality – Massachusetts.) – Leng 1920: 78. – Zimmermann 1920: 88. – Fall 1923: 128.

*Diagnosis.* – The maculate elytron of most Alberta specimens coupled with the straight lateral margin of the elytron, are characteristic for this species. In addition, the modified protarsal claw and medially constricted aedeagus permit males to be readily identified.

*Description.* – Measurements of 11 Alberta specimens are: TL – 3.48 to 3.72 mm ( $\bar{X} = 3.57 \pm 0.07$  mm); MW – 1.76 to 1.88 mm ( $\bar{X} = 1.80 \pm 0.04$  mm); TL/MW – 1.92 to 2.02 ( $\bar{X} = 1.98 \pm 0.03$ ).

Head dark brown to piceous except anterior margin of clypeus and frons above base of antenna, rufous and frons medially, between posterior margin of eyes, with a transverse pale mark; antenna with basal articles pale beneath, articles 2 or 3 to 11 infusate; palpi pale with terminal article of each palpus infusate apically. Pronotum with disc black medially, paler laterally; anterolateral angles and lateral margin rufous. Elytron various in color, from piceous medially and rufous toward lateral and basal margins, to distinctly maculate with lateral margin pale basally and oblique subhumeral fascia, antemedian fascia connected with lateral margin, an isolated postmedial spot, and subapical spot (this basic pattern may be variously reduced). Ventral surface mainly black with prosternal process, metacoxal process apically, and abdominal sterna 3 to 6 apically and laterally, rufous. Legs rufous with tarsi, tibia externally, and base of metafemur infusate on most specimens.

Dorsal surface with evident microsculpture: some males with lines very shallow on disc of pronotum and elytron, body rather shiny. Head with small irregularly scattered punctures on frons. Pronotum with punctures small and dense toward margins, smaller and sparser medially on disc (laterally punctures of many specimens situated in shallow longitudinal grooves). Elytron evenly and conspicuously punctate. Pronotum and elytron with conspicuous pale setae. Abdominal sterna with microsculpture of shallow lines, obvious meshes not formed.

Head and pronotum broad, pronotum evenly rounded laterally and more or less continuous in outline with lateral margin of elytra. Prosternal prominence and file well developed; process broad, subangularly convex in cross-section. Lateral bead of pronotum well defined. Elytral margin more or less straight, not conspicuously ascendent in lateral view; epipleuron evident well behind humeral angle. Metacoxal processes together very broadly and slightly angulate medially.

Male with articles 1 to 3 of pro- and mesotarsi strongly dilated: articles 2 and 3 broader than 1: articles 1 each with two pairs, and articles 2 each with one pair of large rounded adhesive scales on ventral surface. Anterior protarsal claw (Fig. 84) strongly arcuate basally, ventral margin sinuate and apex shortly arcuate. Aedeagus constricted medially in ventral view (Fig. 64).

*Taxonomic notes.* — Fall (1923) placed the name *H. inornatus* Sharp as a junior synonym of the name *H. signatus* Mannerheim. Leech (1948) reported that Sharp's *H. niger* was actually *H. signatus*, and suggests that *H. niger* Say, *H. rufilabris* Sharp and *H. signatus* form a natural group, a conclusion borne out by resemblances between the species in the male genitalia and protarsal characters.

*Natural history notes.* — Specimens were collected from *Carex* marshes, *Sphagnum* bogs and from among flooded grasses in a roadside pond. A very teneral male was collected on July 17 near the southern border of the Northwest Territories.

*Distribution.* — This species is widely distributed from Newfoundland to Alaska and south to Alabama and Kansas. The species is uncommon and sporadic in occurrence in the northern forested portions of Alberta. I examined 14 specimens from Alberta localities (map, Fig. 362).

### *Hydroporus appalachius* Sherman, 1913

*Hydroporus appalachius* Sherman, 1913: 53. (New name for *H. signatus* Sharp, 1882). — Carr 1920: 4. — Leng 1920: 78.

— Fall 1923: 89. — Hatch 1953: 208. — Wallis 1973: 105.

*Hydroporus signatus* Sharp, 1882: 469. (Type locality — Hermit Lake, Mt. Washington, New Hampshire.) Not Mannerheim, 1853.

*Hydroporus occidentalis* Gordon and Post, 1965, not Sharp, 1882.

*Diagnosis.* — Specimens with the well developed elytral maculations are distinctive and can only be confused with specimens of *H. signatus* Mannerheim and *H. mannerheimi* Balfour-Browne. They differ from *H. signatus* in being narrower with the male protarsal claw not modified. Specimens of *H. mannerheimi* are much larger than are specimens of *H. appalachius*. Specimens on which the elytral maculations are reduced are much more difficult to identify and are best recognized on the basis of the characters presented in the key to species.

*Description.* — Measurements of 40 specimens from southeastern Alberta, are: TL — 3.12 to 3.64 mm ( $\bar{X}$  = 3.38 ± 0.14 mm); MW — 1.48 to 1.80 mm ( $\bar{X}$  = 1.65 ± 0.08 mm); TL/MW — 1.98 to 2.13 ( $\bar{X}$  = 2.05 ± 0.04).

Head dark brown or piceous (some specimens, black), except narrow transverse rufous vitta between eyes; anterior margin broadly rufous gradually darkened behind; antenna with articles 1 to 3 testaceous, outer articles testaceous to rufous basally, broadly infuscate apically; palpi testaceous, terminal article of each palpus infuscate apically. Pronotum with disc piceous to black (dark brown on occasional specimens), anterior angle and lateral margins broadly rufous to pale piceous (on darkest specimens only anterior angle noticeably paler). Elytron with disc dark brown or piceous, rarely black: most specimens with disc distinctly maculate, pattern as in Figure 109: extent of elytral maculation varied through reduction in extent of pale areas but even darkest individuals with humeral angle pale; epipleuron dark rufous, rarely piceous. Ventral surface black with prothorax laterally, prosternal process, metasternum and metacoxa along medial line, sternum 2 medially, and sterna 3 to 6 posteriorly and laterally, dark rufous or piceous. Legs rufous with femora basally, tibia apically and tarsi, infuscate.

Dorsal surface with evident microsculpture: meshes transverse on head behind eye, lines shallow medially on disc of pronotum, otherwise sculpture well impressed and isodiametric: similar for both sexes. Disc of pronotum and elytron with punctures, each bearing long pale seta: punctures on pronotum smaller and sparser medially on disc; elytral punctation deep, evenly spaced. Metacoxal plates evenly punctate, punctures smaller than largest punctures on either metasternal wings or sterna 1 and 2.

Body elongate-oval, with greatest width behind middle; somewhat depressed. Antenna slender, article 5 relatively little dilated apically. Pronotum (Fig. 103) broad, maximum width at hind angles: sides gradually and evenly rounded, not so strongly broadened in front as in *H. occidentalis* Sharp. Prosternal file and prominence. Metacoxal lines slightly divergent or on some specimens more or less parallel anteriorly. Lateral elytral-pronotal angle very broad, elytron with lateral margin slightly arcuate; epipleuron disappearing behind side margin posterior to humeral angle.

Male with articles 1 to 3 of pro- and mesotarsi slightly dilated: articles 1 each bearing two pairs, articles 2 each bearing one pair of oval adhesive scales on ventral surface. Protarsal claws unmodified. Aedeagus as in Figure 65.

*Taxonomic notes.* – Dark specimens of *H. appalachius* are very similar to specimens of *H. occidentalis*, differing primarily by being slightly larger, with antenna slenderer and thorax narrower. However, these characters exhibit variation and certain specimens must be arbitrarily placed in one species or the other. In spite of this, two species are recognized here for the following reasons: a) the vast majority of specimens can be confidently assigned to one species or the other; b) the two forms are largely allopatric with the eastern *H. appalachius* occupying prairie and parkland areas of Alberta and the western *H. occidentalis* occurring principally in the mountains and foothills; c) the two forms occupy somewhat different habitats – hence in southwestern Alberta where both are in the same general area, they are seldom found in the same habitat.

*Natural history notes.* – This species is most commonly found in small prairie or parkland streams, both in permanent creeks, and, more often, in pools in intermittent creeks. Specimens are occasionally found in borrow-pits or small ponds, but usually only when these are fed by, at least, a temporary stream. I collected teneral specimens in early August.

*Distribution.* – This species ranges from New England to Alberta and eastern British Columbia, and north to Aklavik, N.W.T. (Bryant, UASM). I examined 210 specimens from Alberta localities (map, Fig. 363).

#### *Hydroporus occidentalis* Sharp, 1882

*Hydroporus occidentalis* Sharp, 1882: 456. (Type locality – “Lake Labache, British Columbia” = Lac LaHache?). Leng 1920: 78. – Zimmermann 1920: 96. – Fall 1923: 90. – Hatch 1953: 208. – Leech and Chandler 1956: 317. – Anderson 1962: 62.

*Diagnosis.* – The members of this species resemble small dark specimens of *H. appalachius* from which they are best separated on the basis of characters presented in the key to species.

*Description.* – Measurements of 40 specimens from selected localities between Banff and Waterton National Parks, are: TL – 2.96 to 3.36 mm ( $\bar{X} = 3.18 \pm 0.09$  mm); MW – 1.44 to 1.68 mm ( $\bar{X} = 1.57 \pm 0.06$  mm); TL/MW – 1.95 to 2.10 ( $\bar{X} = 2.03 \pm 0.03$ ).

Body black. Head anterior margin dark rufous to piceous, and with transverse spot on frons between hind margins of eyes, rufous; antenna with articles 1 to 2 or 3 testaceous, outer articles largely piceous; palpi pale except terminal article of each palpus piceous apically. Pronotum black except anterior angles and on some specimens also lateral margins, dark rufous or piceous. Elytron black except humeral angles on most specimens, dark rufous to piceous, rarely specimens with humeral angle entirely black: some specimens with lateral margin pale on basal half, with humeral and antimedial spots extended shortly on disc, also post-medial and subapical spots on some specimens; epipleuron piceous. Ventral surface of body black with prosternal process and apex of metacoxal process, vaguely rufous; sterna 3 to 6 piceous along posterior margin, rarely with more expanded pale areas. Legs dark rufous; femora medially, tibiae apically and tarsi infusate.

Dorsal surface with coarse isodiametric microsculpture, similar for both sexes. Punctuation as in *H. appalachius* but slightly deeper on elytron. Setae of pronotum and elytra dark, piceous, shorter than *H. appalachius* and about equal in length or slightly longer than distance between elytral punctures. Metasternal wing, metacoxa and abdominal sterna 1 and 2 with evenly situated coarse punctures.

Habitus more robust than *H. appalachius*. Pronotum broad (Fig. 104), sides broadly and evenly rounded anteriorly, more strongly so than *H. appalachius*, more or less parallel behind; posterolateral angle slightly obtuse. Elytron basally with side slightly rounded laterally or almost parallel, greatest width at or just behind middle. Body more depressed than in *H. appalachius*. Antennal articles stout; article 2 stout and oval, with greatest width near middle; article 5 more strongly dilated apically, more definitely triangular in lateral view than corresponding article of *H. appalachius*. Lateral bead of pronotum narrow but traceable. Elytron with lateral margin slightly ascendent to humeral angle; epipleuron disappearing posterior to humeral angle. Metacoxal processes with posterior margin slightly produced along mid-line. Aedeagus as in Figure 66.

*Taxonomic notes.* – See discussion under *H. appalachius*.

*Natural history notes.* – This is the most abundantly represented species of *Hydroporus* in small, cold, silt-bottomed alpine pools. At lower elevations, specimens are usually taken from small cold springs among emergent vegetation where the bottom is soft black organic silt. I collected teneral specimens on August 9, 1970 (Jasper National Park).

*Distribution.* – Although Wallis (1973) and Gordon and Post (1965) recorded *H. occidentalis* from the eastern portions of the prairies, their records almost certainly refer to dark specimens

of *H. appalachius*. This species is probably confined to the western mountains, from California and Utah north to at least British Columbia and western Alberta. I examined more than 250 specimens from Alberta localities (map, Fig. 364).

*Hydroporus fuscipennis* Schaum, 1868

*Hydroporus fuscipennis* Schaum, 1868: 64. (Type locality – unknown, type in Zoological Museum of the Bavarian State, Munich, Germany.) – Zimmermann 1919: 176. – Carr 1920: 4. – Leng 1920: 78. – Fall 1923: 93. – Brown 1930b: 236. – Brown 1932b: 201. – Hatch 1953: 208. Zaitsev 1953: 166. Anderson 1962: 63. – Gordon and Post 1965: 18. – Wallis 1973: 105.

*Hydroporus puberulus* Mannerheim, 1853: 163. (Type locality – “Ad ostia fl. Kaktnu peninsulae Kenae” (Alaska), not *H. puberulus* LeConte, 1850.

**Diagnosis.** – The obsolete microsculpture of much of the dorsal and ventral surfaces of the body separates specimens of *H. fuscipennis* from all other dark Alberta species of *Hydroporus* except *H. criniticoxis*. Specimens of *H. fuscipennis* tend to be narrower and paler in color than those of *H. criniticoxis* and in addition males lack the secondary sexual characters of *H. criniticoxis*.

**Description.** – Measurements of 30 specimens from central Alberta are: TL – 2.96 to 3.32 mm ( $\bar{X}$  = 3.11 ± 0.09 mm); MW – 1.48 to 1.68 mm ( $\bar{X}$  = 1.57 ± 0.05 mm); TL/MW – 1.90 to 2.08 ( $\bar{X}$  = 1.98 ± 0.04).

Head piceous to black except frons with transverse rufous fascia between hind margins of eyes and anterior margin of clypeus rufous, pale area on most specimens prolonged medially onto frons; antenna with article 1 testaceous, articles 2 to 4 infusate apically and articles 5 to 11 largely piceous; palpi testaceous except terminal article of each palpus infusate. Pronotum piceous medially, lateral margins broadly rufous. Elytron with epipleuron and lateral margins pale brown, darker brown to piceous medially and apically. Ventral surface black with prosternal process, metacoxal process, posterior margins of sterna 3 to 6 and sterna laterally of some specimens, rufous to piceous. Legs pale brown to rufous.

Head evenly reticulate; disc of pronotum with microsculpture obsolete medially, evident laterally; disc of elytron with sculpture reduced, evident on only apical half to third on most specimens (few females with entire disc lightly sculptured); metacoxal plates and abdominal sterna smooth and polished, microsculpture absent or obsolete. Punctuation of body coarse, pronotum with punctures deepest and densest marginally, but discal punctures only slightly smaller and sparser; punctures of sternum 6 subequal to those of sterna 1 and 2. Pronotum and elytra with long golden or brown setae, each about twice as long as distance between punctures.

Pronotum with sides slightly arcuate, more or less evenly broadened behind and almost continuous in outline with lateral margin of elytron; greatest width of pronotum at hind angles; hind angles more or less right angled; lateral bead well defined. Prosternal prominence absent or reduced, file reduced. Metacoxal processes together, slightly angulate medially or truncate; intralinear space of both sexes with evident scattered punctures, punctures each with moderately long decumbent pale seta.

Male articles 1 to 3 of pro- and mesotarsi slightly dilated: articles 1 each bearing two pairs of small oval scales beneath, articles 2 each bearing one pair; protarsal claws with slight suggestion of basal arcuation, anterior claw very slightly broader and more arcuate basally than posterior. Aedeagus as in Figure 67.

**Natural history notes.** – This species is commonly represented in shallow water of *Carex* marshes throughout forest and parkland regions of the province. Most prairie records are for single specimens.

**Distribution.** – This species is Holarctic, ranging from northern and central Europe to Siberia (Zaitsev, 1953) and from Alaska to New England, and south to Utah and North Dakota. However, many specimens of *H. criniticoxis* have been misidentified as *H. fuscipennis*, and many of the more southern records may actually be based on *H. criniticoxis* specimens. I have seen specimens of *H. fuscipennis* from the Northwest Territories (Aklavik, UASM) and Yukon Territory (Mayo, CARR). I examined more than 230 specimens from Alberta localities (map, Fig. 365).

*Hydroporus criniticoxis* new species

Holotype male and Allotype, female – 0.5 mi E Brownvale, Alta., July 18, 1970, D. & M. Larson. [CNC.] Paratypes – 90 specimens from localities in the Peace River area of Alberta: 7 mi N Peace R. (21); 5 mi N Grimshaw (14); 0.5 mi E Brownvale (35); 10 mi N Rycroft (20). [CARR, CAS, CNC, UASM, USNM]

**Diagnosis.** – On specimens of this species, like those of *H. fuscipennis*, the microsculpture

of the dorsal surface is greatly reduced, and pronotal disc, disc of elytra, metacoxal plates, and abdominal sterna are shiny. Females of the two species are similar, with specimens of *criniticoxis* darker in color and broader in outline. However, males of *criniticoxis* possess the following distinctive characters: anterior protarsal claw strongly arcuate basally, articles 1 of pro- and mesotarsi possess more than two pairs of oval adhesive scales beneath; and intralinear space of metacoxa densely setose with short, suberect brown setae.

*Description.* – Measurements of 30 paratypes are: TL – 2.92 to 3.48 mm ( $\bar{X}$  = 3.27 ± 0.12 mm); MW – 1.40 to 1.76 mm ( $\bar{X}$  = 1.63 ± 0.07 mm); TL/MW – 1.93 to 2.09 ( $\bar{X}$  = 2.00 ± 0.04).

Head black except frons with vague dark rufous transverse vitta between eyes, anterior margin dark rufous or piceous, pale area of anterior margin of clypeus not prolonged medially onto frons; antenna with articles 1 to 4 testaceous, outer articles piceous apically; palpi pale except terminal article of each palpus infuscate apically. Pronotum black except lateral margin narrowly piceous. Elytron piceous or black, or rarely, specimen with elytra dark rufous; epipleuron dark rufous to black. Ventral surface black; apex of metacoxal process and hind margin of sterna 3 to 6, piceous. Legs rufous to piceous.

Head with isodiametric microsculpture. Pronotum with disc medially, smooth and shiny between punctures, microsculpture obsolete; laterally, toward margin, sculpture evident. Elytron of males and most females basomedially devoid of microsculpture; evident reticulation present towards apex (rarely female with entire surface reticulate). Metacoxal plate and sterna with microsculpture obsolete. Disc of pronotum and elytron setose; setae pale grey to dark brown in color, each about twice as long as distance between elytral punctures. Pronotum laterally with coarse dense punctation, punctures smaller and sparser medially on disc. Elytron coarsely punctate. Metacoxal plates and abdominal sterna coarsely punctate.

Pronotum with lateral margin evenly arcuate, with greatest width at hind angles: base of pronotum about as wide as elytra across base: lateral bead well developed and clearly delimited internally. Prosternal file and prominence evident. Metacoxal lines only slightly divergent anteriorly; metacoxal processes together with hind margin truncate or very slightly angulate.

Male with articles 1 to 3 of pro- and mesotarsi slightly dilated: articles 1 each bearing four to five, and articles 2 each bearing one to two pairs of small oval scales on ventral surface: anterior protarsal claw strongly arcuate basally. Metacoxae with intralinear space densely covered with suberect golden or pale brown setae. Aedeagus as in Figure 68.

*Taxonomic notes.* – This species and *H. fuscipennis* may be closely related, for in addition to many other similarities, males of *fuscipennis* show a tendency towards having the base of the anterior protarsal claws arcuate. Males of *H. polaris* Fall possess a similar form of male protarsal claw and the densely setose interlineal area of the metacoxa, but are very coarsely sculptured.

*Etymology.* – The specific epithet is derived from the latin adjective criniti, meaning bearded, and the latin noun coxa, meaning hip. This name refers to the densely setose intralinear area of the male metacoxae.

*Natural history notes.* – Specimens of *H. criniticoxis* are found in vegetation-choked waters around the margins of ponds, both permanent and temporary. Specimens are most commonly found in the parkland and mixed forest regions, but have been collected from almost all areas in the province. Teneral specimens were collected from June 4 to 7, and August 17. Specimens were collected in flight (May 30, 1972) and at light (Ft. Garry, Manitoba, July 4, 1956, UASM).

*Distribution.* – The distribution is incompletely known and is probably much wider than is indicated here. I examined 401 specimens from the following localities (Fig. 366).

ALBERTA: Aden (CARR); Jct. Hwy. 62 & Shanks Creek; Jct. Hwy. 62 & Milk R; 18 & 6 mi S Magrath; 8 mi S Cardston; 5 mi W Spring Coulee; 15 mi SE Lethbridge; 10 mi S Lethbridge; 10 mi W Lethbridge; 2 mi S Beauvis L; 3 mi N Beauvis L; 4 mi N Lundbreck; Manyberries (CARR); Cypress Hills (CARR); Tp. 8 Rge. 2 W 4; 14 mi S Irvine; 6 mi W Redcliff; Empress (Brooks, CNC); 6 mi N Acadia Valley; Lanfine; 2 mi N Jenner; Blood Indian Reservoir; 1 & 20 mi E Hussar; Hussar (CARR); Tp. 24 Rge. 22 W 4; 5 mi N Standard; Jct. Hwys. 23 & 24; Tp. 21 Rge. 25 W 5 (CARR); Cheadle; Calgary (CARR); 8 mi NW Calgary; 2 mi S Big Hill Springs; Cochrane (CARR); 1 mi S Longview; Sheep R. (CARR); Tp. 24 Rge. 8 W 5 (CARR); Forestry Trunk Rd., 21 mi N Hwy 1A; Waiparous (CARR); Tp. 29 Rge. 5 W 5 (CARR); Tp. 29 Rge. 4 W 5 (CARR); Sundre (CARR); Tp. 33 Rge. 2 W 5 (CARR); Sylvan L (CARR); 9 mi N Trochu; 7.8 mi N Morin; Tp. 29 Rge. 22 W 4 (CARR); 24 mi N Consort; 7 mi E Donald; 2 mi S Daysland; Rocky Mtn. House; Nordegg; Jct. Forestry Trunk Road and Blackstone R; Drayton Valley (CARR); Edmonton (F. Carr, UASM); Andrew (F. Carr, UASM); 20 mi W Cold L; 2 mi W Iron R; 5 mi E La Corey; 1 mi N Plamondon; 42 mi S McMurray; McMurray (Brown, CNC); 4 mi S Ft. McKay; Athabasca (CARR); 2 mi S Lawrence L; 10 mi E Smith; 7 mi N Ft. Assiniboine; 12 mi S Swan Hills; 14 mi S Kinuso; Slave L (CARR); Jasper Nt'l Park, 5 mi N Jasper; Fickle L; 6.5 mi N Edson; 6 mi N Peers; Valleyview (Brooks, CNC); 3 mi E Valleyview; 8 mi SW Triangle; 2 mi S Grouard; 26 & 31 mi N Gift L; Forestry Trunk Road 22 & 7 mi S Hwy. 34; Grande Prairie (CARR); 29 & 4.5 mi S Rycroft; 6 mi W Spirit R; 10 mi N Rycroft; ½ mi E Brownvale; 7 mi N Peace R; 5 mi N Grimshaw; 5 mi N Dixonville; 18 mi S Manning; 15 & 23 mi N Manning; 4 mi S High Level; 2 mi N Jct. Hwy. 35 & Hay R; 2 mi S Indian Cabins; Hwy. 35, 5.6 mi S Alta. – N.W.T. border.

BRITISH COLUMBIA: Pouce Coupe (CARR).

MANITOBA: Aweme (Wallis, UASM); Ft. Garry (Comma, UASM); Onah (Wallis, UASM); Thornhill (UASM).

ONTARIO: Prince Edward Co. (Brimley, CARR).

UTAH: Wasatch Forest (CARR).

*Hydroporus rufinatus* Mannerheim, 1852

*Hydroporus rufinatus* Mannerheim, 1852: 305. (Type locality – Sitka Island, Alaska.) LeConte 1863a: 16. – Gemminger and Harold 1868: 440. – Sharp 1882: 908. – Leng 1920: 78. – Zimmermann 1920: 101. – Fall 1923: 96. – Wallis 1973: 106.

**Diagnosis.** – Small size, bright rufous anteromedial triangularly-shaped area of the frons and relatively broadly rounded hind angles of the pronotum, make this one of the more distinctive species of *Hydroporus*.

**Description.** – Measurements of 30 specimens from selected Alberta localities are: TL – 2.88 to 3.20 mm ( $\bar{X} = 3.03 \pm 0.09$  mm); MW – 1.36 to 1.52 mm ( $\bar{X} = 1.45 \pm 0.04$  mm); TL/MW – 2.03 to 2.18 ( $\bar{X} = 2.09 \pm 0.04$ ).

Head dark piceous to black except clypeus rufous, frons between anterior lateral impressions with bright rufous triangularly-shaped area, and between eyes with rufous transverse vitta; antenna with articles 1 and 2 rufous, articles 3 to 11 piceous with base of most articles pale; palpi pale, terminal article of each palpus infusate apically. Pronotum black except lateral margin piceous. Elytron rufous or brownish basally and laterally, to piceous medially and apically; epipleuron rufous. Ventral surface mainly black. Legs rufous with base of metafemur, tibia apically and tarsi darkened.

Dorsal surface with evident isodiametric sculpture, more deeply impressed and more or less granular on some females. Disc of pronotum and elytron punctate, each puncture with long pale seta slightly longer than distance between punctures.

Antenna moderately elongate. Pronotum with sides evenly rounded throughout length, maximum width anterior to broadly rounded, obtuse hind angles; lateral bead very narrow, well delimited along anterior half but obsolete posteriorly. Pronotum and elytron discontinuous in outline in dorsal view (Fig. 113). Prosternal prominence and file obsolete; prosternum flat medially. Lateral margin of elytron strongly ascendent toward humeral angle; epipleuron visible to humeral angle. Metacoxal processes truncate behind or very slightly produced medially.

Male with articles 1 to 3 of pro- and mesotarsi dilated; articles 2 slightly broader than 1, articles 3 symmetrical and shorter than that of *H. tristis*; articles 1 each with two pairs, and articles 2 each with one pair of rounded adhesive scales beneath; protarsal claws unmodified. Mesotibia with inner margin arcuate. Aedeagus simple, evenly narrowed to apex.

**Natural history notes.** – This species is found in *Carex* and *Sphagnum* marshes throughout the forested northern portions of the province. The insects usually are in very small pools of water surrounded by, or more or less filled with, moss or dense emergent vegetation. Teneral specimens were collected from May 5 to August 13.

**Distribution.** – Fall (1923) recorded this species from Manitoba, Alberta and Alaska. I examined 127 specimens from Alberta localities (map, Fig. 367).

*Hydroporus glabriusculus* Aubé, 1836

*Hydroporus glabriusculus* Aubé, 1836: 312. (Type locality – “Laponie”). Leng 1920: 78. – Zimmermann 1920: 87. – Fall 1923: 95. – Brown 1937: 109. – Hatch 1953: 209. – Zaitsev 1953: 156. – Wallis 1973: 105.

*Hydroporus puberulus* LeConte, 1850: 215. (Type locality – Lake Superior.). – Melsheimer 1853: 32. – LeConte 1855: 292. – LeConte 1863a: 16. – Gemminger and Harold 1868: 439. – Sharp 1882: 807. (Old World synonymy omitted.)

**Diagnosis.** – Small dark adults with the following characteristics: pronotum with lateral margin rounded, maximum width anterior to hind angles; lateral margin of elytron ascending, epipleuron visible to or almost to humeral angle; elytron rounded laterally; greatest width at about middle.

**Description.** – Measurements of 30 Alberta specimens are: TL – 2.88 to 3.16 mm ( $\bar{X} = 3.02 \pm 0.08$  mm); MW – 1.40 to 1.56 mm ( $\bar{X} = 1.48 \pm 0.04$  mm); TL/MW – 2.00 to 2.13 ( $\bar{X} = 2.04 \pm 0.03$ ).

Head black except frontal bar and anterior margin of clypeus, rufous; antenna with basal two to five articles testaceous, articles 7 to 11 entirely piceous or pale at base; palpi testaceous except terminal article of each palpus almost entirely piceous. Pronotum black except anterior angle and lateral margin of some specimens, narrowly piceous. Elytron piceous to black or many specimens with lateral and apical portions of disc faintly rufescent or piceous. Ventral surface mainly black. Pro- and mesofemora pale rufous and on most specimens noticeably paler than rufous tibiae and tarsi.

Dorsal surface with reticulate microsculpture. Meshes of elytron flat, relatively large and somewhat irregular in size and



shape; males somewhat shiny; females with lines more deeply impressed, duller. Head with scattered small but deep punctures. Pronotum coarsely punctate marginally, punctures medially on disc subequal to lateral punctures but much sparser. Elytron with widely spaced, small, deep punctures, separated by about two or more times their own diameters. Each puncture of pronotum and elytron with long slender pale conspicuous seta, about 1.5 as long as distance between elytral punctures. Metacoxal plates with sparse deep punctures, subequal in size to those of metasternal wings and abdominal sterna 1 and 2.

Outline of body as in Figure 114. Pronotum with sides broadly rounded, maximum width slightly anterior to narrowly rounded, slightly obtuse hind angles; lateral bead very narrow, traceable along anterior half but on many specimens obsolete behind. Prosternal prominence low but evident; file reduced, absent or with only a few irregular transverse rugae; prosternal process narrowly rounded medially, margined laterally. Elytron with sides rounded, maximum width at or slightly behind middle; lateral margin strongly ascendent to humeral angle; epipleuron visible to, or almost to, humeral angle.

Male with articles 1 to 3 of pro- and mesotarsi slightly dilated: articles 1 each with two pairs and articles 2 each with one pair of small elongate adhesive scales on ventral surface; protarsal claws unmodified. Aedeagus simple, evenly narrowed to apex.

*Taxonomic notes.* — Fall (1923), stated that the name *H. puberulus* LeConte was not a junior synonym of *H. melanocephalus* as was indicated by Crotch (1873).

*Natural history notes.* — Although found in *Sphagnum* bogs, this species is not restricted to this habitat. Along the Rocky Mountains, most specimens were collected from shallow water of small, cold ponds, among dense stands of emergent *Carex* and detritus or in small mosses along the waters edge. Teneral specimens were collected on June 18. However, many mature adults were collected during April and May indicating that overwintering may occur in the adult stage.

*Distribution.* — This species is circumpolar in boreal regions. I examined 46 specimens from Alberta localities (map, Fig. 368).

#### *Hydroporus morio* Aubé, 1836

*Hydroporus morio* Aubé, 1836: 307. (Type locality — not given.) Gemminger and Harold 1868: 437. — Sharp 1882: 471. — Leng 1920: 78. — Brown 1937: 109. — Balfour-Browne 1940: 298.

*Hydroporus melanocephalus* Gyllenhal, 1808: 537, not Marsham 1802: 423. Zimmermann 1919: 161. — Zimmermann 1920: 91. — Fall 1923: 91. — Fall 1926: 138. — Leng and Mutchler 1927: 17. — Brown 1930b: 236. — Gordon and Post 1965: 18. — Wallis 1973: 105.

*Hydroporus caliginosus* LeConte, 1850: 215. (Type locality — Lake Superior.). Melsheimer 1853: 32. — LeConte 1855: 292. — LeConte 1863a: 16. — Gemminger and Harold 1868: 431. — Crotch 1873: 395. — Sharp 1882: 789. — Wickham 1895a: 76. — Leng 1920: 78. — Zimmermann 1920: 82. (European synonymy omitted.)

*Diagnosis.* — Males are distinguished from males of all other species of *Hydroporus* in the fauna (except *H. dentellus*), by the ventrally toothed anterior protarsal claws. Females resemble those of *H. glabriusculus* but differ in larger size, denser elytral microsculpture, deeper and denser punctation and less rounded pronotal hind angles.

*Description.* — Measurements of 20 Alberta specimens are: TL — 3.00 to 3.56 mm ( $\bar{X} = 3.31 \pm 0.13$  mm); MW — 1.46 to 1.76 mm ( $\bar{X} = 1.63 \pm 0.08$  mm); TL/MW — 1.98 to 2.11 ( $\bar{X} = 2.03 \pm 0.03$ ).

Head black except frontal band and anterior margin of clypeus, rufous; antenna with basal articles pale, articles 2 or 3 to 11 progressively darkened, but distal articles with at least extreme base rufous; palpi pale except terminal article of each palpus infusate. Pronotum black, anterolateral angle and lateral margin vaguely piceous. Elytron black medially, most specimens distinctly rufescent laterally; epipleuron dark rufous basally, piceous apically. Ventral surface mainly black. Legs rufous with femora basally, tibia, and tarsi infusate.

Dorsal surface with coarse reticulate microsculpture; head with meshes on clypeus and anterior margin of frons more or less transverse, posteriorly, meshes irregular and without definite arrangement; pronotum with meshes coarse laterally and basally, medially lines shallower and meshes slightly transverse (faintly on male, more so on female); male elytron with meshes large, flat and irregular in size and shape but not distinctly transverse, surface shiny; many females with surface duller and opaque, lines dense and deeply impressed, meshes smaller than on male and on some specimens more or less transverse. Frons with scattered small but deep punctures, punctures in frontal grooves not arranged linearly. Pronotum more densely and deeply punctate marginally, disc more sparsely and finely punctate. Elytron with evenly scattered coarse punctures, punctures for most part separated by several times their own diameters. Pronotum and elytron bearing pale grey setae. Metasternal wing, metacoxa, and lateral portion of sterna 1 and 2 with relatively sparse but coarse punctures.

Body subparallel to ovoid in shape; pronotum with maximum width at or slightly before obtuse hind angle; lateral margin of pronotum and elytron more or less continuous. Lateral bead of pronotum narrow, poorly defined throughout most of length. Prosternal prominence evident, file indistinctly developed; prosternal process convex, margined laterally. Lateral margin

of elytron ascendent to humeral angle. epipleuron of most specimens disappearing posteriorly to shoulder.

Male with articles 1 to 3 of pro- and mesotarsi dilated, stout: articles 1 each with two pairs and articles 2 each with one pair of moderate oval scales on ventral surface: anterior protarsal claw with broad ventral tooth. Aedeagus simple, narrowed to apex.

*Taxonomic notes.* — If the name *H. melanocephalus* Marsham does not apply to this species (F. Balfour-Browne, 1937, 1940) then *H. morio* Aubé is the next one available because *H. melanocephalus* Gyllenhal is a junior homonym and *H. morio* Dejean (1833) is a *nomen nudum*. On the other hand, various authors including Zaitsev (1953), Guignot (1947) and Zimmermann (1931) consider *H. melanocephalus* Marsham and *H. melanocephalus* Gyllenhal to refer to the same species, in which case *H. melanocephalus* Marsham has priority and becomes the name of the species. I have not examined type material and have accepted Balfour-Browne's conclusions.

*Natural history notes.* — The only series of this species examined from Alberta was collected by Peter Kuchar in the Bald Hills, Maligne Range, Jasper National Park, along with *H. occidentalis*, from a small drying waterhole in hummocky tundra at 7300 feet. Elsewhere, few specimens were collected from mosses and *Carex* stands along margins of small cold woodland pools, usually in or near coniferous forests. Some of the Jasper National Park specimens collected on August 9, are slightly teneral.

*Distribution.* — This is a circumpolar species from Britain and north and central Europe, to Siberia and from Alaska to Labrador and New Hampshire. I examined 24 specimens from Alberta localities (map, Fig. 369).

### *Hydroporus tristis* (Paykull, 1798)

*Dytiscus tristis* Paykull, 1798: 232. (Type locality — unknown to me.) Gemminger and Harold 1868: 441. — Crotch 1873: 395. — Sharp 1882: 472. — Wickham 1895a: 76. — Zimmermann 1919: 162. — Carr 1920: 4. — Leng 1920: 78. — Zimmermann 1920: 105. — Fall 1923: 97. — Brown 1932b: 201. — Hatch 1938: 146. — Hatch 1953: 210. — Zaitsev 1953: 155. — Wallis 1973: 106.

*Hydroporus varians* LeConte, 1850: 215. (Type locality — Lake Superior.) Melsheimer 1853: 32. — LeConte 1855: 292. — LeConte 1863a: 16.

*Hydroporus ruficapillus* Mannerheim, 1852: 304. (Type locality — “In palude prope Nov. Archangelsk frequens”.)

*Diagnosis.* — Small adults, with a narrow, elongate-oval outline, strongly ascending elytral margin, and prosternal process prolonged anteriorly on prosternum as a narrow longitudinal convexity.

*Description.* — Measurements of 30 specimens from the Swan Hills, Alberta, are: TL — 2.84 to 3.20 mm ( $\bar{X}$  = 3.05 ± 0.09 mm); MW — 1.36 to 1.52 mm ( $\bar{X}$  = 1.46 ± 0.04 mm); TL/MW — 2.03 to 2.17 ( $\bar{X}$  = 2.10 ± 0.04).

Head rufous except frons beside each eye, and laterally behind eye, piceous (on some specimens piceous areas broadly expanded to most of head with only transverse mark between hind margins of eyes and anterior margin of head, rufous); antenna with articles 1 and 2 and also 3 on some specimens, rufous; outer articles piceous at least apically; palpi rufous, except terminal article of each palpus infusate apically. Pronotum black, anterolateral angle and lateral margin narrowly rufous or piceous. Elytron brownish or rufous laterally and basally, gradually darkened to piceous medially and apically (some specimens with disc almost entirely piceous and only slightly paler basally). Ventral surface black: prosternal process, metacoxal process and posterior margin of sterna 3 to 6, rufous or piceous. Legs bright rufous, tarsi infusate.

Dorsal surface, metacoxal plates and abdominal sterna with microsculpture: some specimens with sculpture shallowly impressed on disc of pronotum and elytron, body somewhat shiny in these areas. Head with punctures small, sparse and evenly scattered. Pronotum with margins densely and coarsely punctate, disc with smaller more sparsely situated punctures. Elytron conspicuously punctate, punctures relatively small and sparse, separated by two or more times their own diameters. Setae of pronotum and elytra dark in color, inconspicuous, subequal in length to distance between elytral punctures. Ventral surface punctate, punctures of metasternal wings discrete, not contiguous: punctures on metacoxal wings separated by 1.5 to twice their own diameters; sterna 1 and 2 with punctures sparser but deeper.

Outline of body as in Figure 115. Antenna with articles relatively elongate. Pronotum with lateral margin broadly arcuate, maximum width at or slightly in front of hind angles, latter narrowly rounded, right angled; lateral bead very fine, distinct throughout length and gradually widening toward anterior angle; disc convex, somewhat inflated laterally, convexity clearly delimited towards hind angle by oblique series of punctures. Prosternum with prominence and file well developed, prosternal process extended anteriorly on medial portion of prosternum as narrow convexity. Elytron with lateral margin strongly ascendent in lateral view: epipleuron visible to humeral angle. Metacoxal lines divergent anteriorly: metacoxal processes very slightly

sinuate behind, slightly produced medially.

Male with articles 1 to 3 of pro- and mesotarsi slightly dilated: articles 1 and 2 subequal in width, articles 3 rather elongate and asymmetrical with posterior lobe slightly longer than anterior: articles 1 each bearing three (sometimes two), and articles 2 each bearing one pair of small adhesive scales beneath: protarsal claws more or less equal in length, anterior claw slightly broadened when examined from side. Aedeagus simple.

*Taxonomic notes.* – European references and synonymy are not presented above. Crotch (1873) first synonymized the names *H. varians* LeConte and *H. ruficapillus* Mannerheim with *H. tristis*. Fall (1923) confirmed this synonymy.

*Natural history notes.* – Specimens are often found in small *Carex*-choked pools in *Sphagnum* bogs, but have also been collected from shallow areas of *Carex* marshes of the forested portions of the province. Teneral specimens have been collected from July 9 to August 29.

*Distribution.* – This is a Holarctic species, ranging from northern and central Europe to Siberia, and in North America from Labrador to British Columbia and Alaska and south to Virginia and New Mexico. I examined 130 specimens from Alberta localities (map, Fig. 370).

#### *Hydroporus striola* Gyllenhal, 1827

*Hydroporus striola* Gyllenhal, 1827: 393. (Type locality – not known to me.) Gemminger and Harold 1868: 441. – Sharp 1882: 473. – Zimmermann 1919: 165. – Fall 1923: 94. – Fall 1926: 138. – Brown 1930b: 236. – Hatch 1953: 210. – Zaitsev 1953: 158. – Gordon and Post 1965: 18. – Wallis 1973: 105.

*Hydroporus subtonsus* LeConte, 1855: 297. (Type locality – Lake Superior, designated by Fall, 1923). – LeConte 1863a: 16. – Gemminger and Harold 1868: 441. – Crotch 1873: 395. – Sharp 1882: 811. – Zimmermann 1920: 105. – Leng 1920: 78. – Fall 1923: 94. – Hatch 1953: 210.

*Hydroporus vittula* Erichson, 1837: 178. (Type locality – not known.) – Zimmermann 1920: 105. (Old World synonymy omitted.)

*Diagnosis.* – Small adults, resembling those of *H. fuscipennis* in habitus but differing in that the dorsal surface is strongly microsculptured. In addition, the following combination of characters is distinctive: lateral margin of elytron rises strongly to humeral angle, the epipleuron visible to humeral angle, and anterior protarsal claw of male broadened in lateral view.

*Description.* – Measurements of 30 specimens from the Peace River – Rycroft area of Alberta are: TL – 2.96 to 3.36 mm ( $\bar{X} = 3.18 \pm 0.11$  mm); MW – 1.44 to 1.76 mm ( $\bar{X} = 1.59 \pm 0.06$  mm); TL/MW – 1.91 to 2.08 ( $\bar{X} = 2.00 \pm 0.04$ ).

Head dark brown to piceous, rarely black; transverse band between eyes, clypeus and anterior margin of frons, rufous on most specimens, or some specimens with triangular rufous area on anteromedial portion of frons; antenna with articles 1 and 2 testaceous, articles 3 to 11 piceous, at least apically; palpi testaceous, terminal article of each palpus infusate apically. Pronotum with disc dark brown to piceous medially, rarely black; lateral margins broadly rufous darkened toward base. Elytron varied in color, from brown to dark rufous or piceous; most specimens with lateral margin and base paler, many with poorly defined basomedial pale spot; disc darkened medially and posteriorly; epipleuron rufous basally, darker apically. Ventral surface black with prosternal process, metacoxal process, and sterna 3 to 6 posteriorly, rufous to piceous. Legs rufous, femora basally, tibia externally, and tarsi, infusate.

Dorsal surface completely microsculptured. Head coarsely punctate. Pronotum with scattered coarse setiferous punctures, smaller and sparser medially. Elytron with more or less evenly spaced setiferous punctures. Setae of pronotum and elytron pale on most specimens, rarely dark brown or piceous. Ventral surface of body reticulate, punctuation normal.

Body somewhat depressed dorsally; outline oval with slight discontinuity between pronotum and elytra. Pronotum with greatest width at hind angles, lateral margin evenly rounded throughout length; hind angle narrowly rounded, about right angled; lateral bead narrow but traceable. Prosternal prominence blunt, file present; prosternum narrowly concave medially, process not extended anteriorly onto prosternum; prosternal process angularly convex in cross section. Metacoxal process truncate or only very slightly produced medially. Elytra oval, evenly rounded laterally with greatest width at about middle; lateral margin ascendent toward humeral angle (Fig. 117), epipleuron visible to humeral angle in lateral view.

Male with articles 1 to 3 of pro- and mesotarsi slightly broadened, articles 1 each with three and articles 2 each with two pairs of adhesive scales on ventral surface; anterior protarsal claw subequal in length to posterior but conspicuously broadened in side view. Aedeagus as in Figure 69.

*Taxonomic notes.* – The name *H. vittula* Erichson was placed as a synonym of *H. striola* by Zimmermann (1920), as previously suggested by Sharp (1882). The name *H. subtonsus* LeConte was shown to be a junior synonym of *H. striola* by Fall (1923).

*Natural history notes.* – These insects are found in shallow stagnant water, either permanent or temporary, usually in association with large amounts of plant debris and dense emergent

vegetation. This is the most commonly collected species of dytiscid in *Carex* marshes of the forested portions of the province. Many general specimens were collected from July 8 to August 24.

*Distribution.* — This species occurs throughout the boreal portions of North America, from Newfoundland to British Columbia, and from New England and Colorado (Dugleville, CARR) to Great Slave Lake (UC) and Alaska. I examined more than 650 specimens from Alberta localities (map, Fig. 371).

*Hydroporus badiellus* Fall, 1923

*Hydroporus badiellus* Fall, 1923: 89. (Type locality — Marquette, Michigan.) Leng and Mutchler 1927: 17. — Brown 1930b: 236. — Wallis 1973: 105.

*Diagnosis.* — Adults are small, more or less parallel-sided, dorsally convex, with the elytra not or only slightly ascending to the humeral angles and epipleura disappearing posterior to humeral angles.

*Description.* — Measurements of 29 specimens from Winchell Coulee (near Water Valley) and Crimson Lake (near Rocky Mountain House), Alberta, are: TL — 2.64 to 3.00 mm ( $\bar{X} = 2.82 \pm 0.09$  mm); MW — 1.24 to 1.48 mm ( $\bar{X} = 1.34 \pm 0.05$  mm); TL/MW — 2.03 to 2.20 ( $\bar{X} = 2.11 \pm 0.04$ ).

Head piceous except clypeus, frons above base of antenna, and transverse mark between posterior margins of eyes, rufous; antenna with articles 1 to 3 rufous, outer articles piceous, at least apically; palpi testaceous except terminal article of each palpus infusate apically. Pronotum black except front angle and lateral margin dark rufous to piceous. Elytron rufous to brown laterally, darker piceous medially on disc; epipleuron rufous. Ventral surface black except prosternal process, metacoxal process apically, and sterna 3 to 6 apically and laterally, rufous to piceous. Legs dark rufous except femora basally, tibiae externally, and tarsi, dark rufous to piceous on most specimens.

Dorsal and ventral surfaces with reticulate microsculpture. Frons with small sparse punctures. Pronotum with margins coarsely punctate, disc medially with sparse inconspicuous punctures. Elytron with evident but small punctures, separated by 2 to 3 times their own diameters. Pronotum and elytron with punctures each bearing a small inconspicuous dark seta. Metasternal wings, metacoxal plates and sterna 1 and 2 with coarse punctures of more or less equal size and density, and separated from each other by own diameter or more.

Body narrowly oval (Fig. 116): lateral margin of pronotum and elytron meeting in a more or less continuous line: lateral margin of elytron slightly arcuate, maximum width at middle. Antennal articles elongate, articles 5 to 7 markedly broadened apically. Lateral bead of pronotum fine but clearly delimited from disc; hind angle narrowly rounded, right angled. Prosternum anterior to procoxae, narrow, more or less inflated and coarsely punctato-rugose; prominence obsolete or at most poorly defined, file with evident transverse ridges; process not prolonged medially on prosternum anterior to file; prosternal process broadly subangularly convex, narrowly bordered laterally. Elytron only slightly and shortly ascendent to humeral angle, epipleuron disappearing posterior to humeral angle. Metacoxal process with metacoxal lines strongly divergent, process slightly and broadly angulate behind.

Male with articles 1 to 3 of pro- and mesotarsi slightly dilated, articles 1 each bearing two pairs, and articles 2 each bearing one pair of small rounded adhesive scales beneath: protarsal claws not modified. Aedeagus (Fig. 70) with apex shortly arcuate.

*Taxonomic notes.* — Fall (1923) wrote that this species differs only very slightly from *H. obscurus* Strum, but he had only two specimens of *H. obscurus* for reference. Wallis (1973) suggests that the two are conspecific.

*Natural history notes.* — The few Alberta specimens were collected from small pools in moss carpet of *Sphagnum* or *Drepanocladus* bogs.

*Distribution.* — The recorded range of *H. badiellus* includes Michigan, Newfoundland, Quebec and Manitoba. I examined material from New Hampshire (Eagle L, UASM), Quebec (Harrington Harb, UASM) and 50 specimens from Alberta localities (map, Fig. 372).

*Hydroporus carri* new species

Holotype male, and allotype, female, — spring nr. headwaters of Trout Creek, Porcupine Hills, Alta. (Tp. 13 Rge. 29 W 4); August 15, 1972; D. and M. Larson. [CNC]. Paratypes — Ft. Macleod (1); Tp. 26 Rge. 4 W 5 (1); 1.5 mi S Longview (1). [CNC and UASM].

*Diagnosis.* — Moderate sized specimens, characterized by brownish elytra, shiny body with

reduced punctation, short rounded male protarsal articles, article 1 with three pairs of oval adhesive scales beneath, and slender elongate protarsal claws.

*Description.* – Measurements of five type specimens are: TL – 3.92 to 4.24 mm ( $\bar{X} = 4.10 \pm 0.11$  mm); MW – 2.04 to 2.24 mm ( $\bar{X} = 2.13 \pm 0.08$  mm); TL/MW – 1.89 to 1.96 ( $\bar{X} = 1.92 \pm 0.03$ ).

Head black except frontal bar and small triangular spot above base of each antenna, rufous; antenna pale rufous basally, articles 2 or 3 to 11 infusate, piceous apically but all articles with bases pale; palpi testaceous except terminal article of each palpus infusate. Pronotum black except lateral bead and margin narrowly medially to bead, rufous. Elytron with disc dark brown or piceous medially, paler brown basally and laterally. Ventral surface mainly black. Legs rufous except coxae and basal two thirds of femora piceous and tarsal articles of some specimens slightly infusate dorsally.

Dorsal surface with reticulate microsculpture, best developed on head but also evident on disc of pronotum and elytra; males with pronotum and elytron rather shiny, sculpture lightly impressed; metacoxal plates and abdominal sterna with irregular sculpture. Head with scattered, small but deep punctures. Pronotum relatively finely punctate, with evident series of moderate punctures submarginally to anterior margin and also inside posterior lateral angles, otherwise marginal punctures small; disc with punctures smaller than meshes of microsculpture. Elytron more coarsely punctate, punctures evenly scattered and each with a very fine pale seta slightly longer than distance between punctures. Metacoxal plates with broad but very shallow and inconspicuous punctures, much less obvious than punctures of metasternal wings or sterna 1 and 2.

Body rather broadly and evenly oval in outline. Pronotum with lateral margins markedly rounded toward anterior angles, less so posteriorly; maximum width at distinctly obtuse hind angles: lateral bead clearly delimited throughout length. Prosternal prominence low but evident, file well developed; process subangularly convex, densely setose, with lateral margin extended to apex. Elytron with lateral margin distinctly ascendent toward humeral angle, epipleuron disappearing well behind shoulder. Metacoxal lines very slightly divergent anteriorly; metacoxal processes conjointly truncate with short but distinct angulate projection along midline.

Male with protarsal articles relatively short and broad (Fig. 93): article 1 very slightly broader than articles 2 and 3, latter subequal in width; article 2 transverse, article 3 almost circular in outline; article 1 with three and article 2 with one pair of relatively large oval scales beneath; protarsal claws elongate, slightly more arcuate in lateral view than mesotarsal claws. Female with protarsal articles slightly narrower, article 3 more or less parallel-sided medially. Aedeagus as in Figure 71.

*Taxonomic notes.* – Specimens of this species most closely resemble those of *H. transpunctatus* Chand. Resemblances are in the following characters: male with short rounded protarsal articles and article 1 bearing more than two pairs of adhesive scales on the ventral surface; apex of aedeagus recurved; dorsal surface of body relatively shiny; and elytron brownish in color.

*Etymology.* – The specific epithet is based on the surname of Mr. and Mrs. John Carr of Calgary, Alberta, from whom I have learned much about dytiscids.

*Natural history notes.* – Three specimens were taken from amid emergent *Carex* at the margins of very small springs in fescue grasslands, along the eastern margin of the southwestern Alberta foothills. Unlike most springs in this area, these had stable, well vegetated banks and were only lightly used by cattle.

*Distribution.* – I have seen only the type material, from southwestern Alberta (Fig. 373).

#### *Hydroporus transpunctatus* Chandler, 1941

*Hydroporus transpunctatus* Chandler, 1941: 103. (Type locality – Salamander Lake, Mt. Timpanogos, Utah County, Utah.) Blackwelder 1948: 3. – Anderson 1962: 63.

*Diagnosis.* – Specimens are similar to those of *H. carri* but average a little larger, and more elongate in shape; the appendages are darker in color; male protarsal article 1 bears numerous small scales on ventral surface; and the anterior protarsal claw is slightly shorter and stouter than the posterior claw.

*Description.* – Measurements of three specimens from Bow Lake, Banff Nat'l. Park, Alberta are: TL – 4.48 to 4.56 mm ( $\bar{X} = 4.52$  mm); MW – 2.24 to 2.32 mm ( $\bar{X} = 2.28$  mm); TL/MW – 1.97 to 2.00 ( $\bar{X} = 1.98$ ).

Head black, except frontal band and small triangular area above base of each antenna, rufous; antenna dark except all articles with at least extreme base rufous; palpi with all articles infusate, dark rufous to piceous. Pronotum black except lateral margin dark piceous; elytron dark brown or piceous medially, basal and lateral margins paler, brown to rufous; epipleuron piceous to black. Ventral surface mainly black. Legs with coxa, trochanter and femur mainly piceous to black, tibia and tarsi rufous to rufopiceous.

Head and pronotum with reticulate microsculpture: elytron shiny, reticulate sculpture over most of disc, but immediately behind each puncture, on at least basal half of disc, lines obsolete, and shiny smooth area behind and partly surrounding each puncture; metacoxal plates and sterna sculptured. Head with numerous small but deep punctures, punctures slightly varied

in size. Pronotum with margins bearing numerous relatively small punctures; punctures on disc small, dual (small setiferous punctures and smaller nonsetiferous punctulae) but larger and denser than those of *H. carri*. Elytron with punctures small, dense, tending to form irregular transverse rows; each puncture with thin pale seta. Metasternal wing coarsely punctate, slightly more so than sterna 1 and 2; metacoxa with punctures shallow.

Body elongate oval in outline, lateral margins of pronotum and elytron more or less continuous. Pronotum with sides evenly arcuate, on most specimens not so strongly widened in apical half as in *H. carri*, with maximum width at or slightly before obtuse hind angles. Lateral bead of moderate width, well delimited throughout length. Prosternal prominence and file evident; prosternal process as in *carri* but slightly longer. Lateral margin of elytron ascendent to humeral angle, epipleuron disappearing posterior to shoulder. Metacoxal lines divergent, process truncate or very slightly and broadly angulate behind.

Male with pro- and mesotarsal articles 1 to 3 short and rounded, articles 3 almost circular (Fig. 94); articles 1 each bearing numerous small oval scales on ventral surface (many more than the three pairs present on *carri*); anterior protarsal claw slightly shorter and stouter than posterior, both shorter than those of *carri* and not so strongly arcuate medially. Aedeagus as in Figure 72.

*Taxonomic notes.* — Nine specimens from Gore Pass, Colorado (CARR) (identified by R. D. Gordon) are considerably larger than the Alberta specimens (TL — 4.68 to 5.12 ( $\bar{X}$  = 4.92 ± 0.14 mm)).

*Natural history notes.* — Three specimens were collected from among small mosses and rushes bordering small, cold, seepage or spring-fed ponds situated in an alpine meadow at an elevation of 6,500' near Bow Lake, Banff Nat'l Park. J. Carr (pers. comm.) found specimens in a similar habitat at Gore Pass, Colorado.

*Distribution.* — This species was previously recorded only from Utah. I examined 12 specimens from the following localities:

ALBERTA (Fig. 374) — Banff National Park, ½ mi N Bow Lake, 6,500'.

COLORADO — Gore Pass (CARR).

#### *Hydroporus rectus* Fall, 1923

*Hydroporus rectus* Fall, 1923: 79. (Type locality — White Mountains, New Hampshire.) Leng and Mutchler 1927: 17. — Brown 1932b: 201. — Wallis 1973: 105.

*Diagnosis.* — The moderately large size, elongate shape of the body, and the entirely pale labial palpi make this one of the more easily recognizable species.

*Description.* — Measurements of 30 specimens from various Alberta localities are: TL — 4.24 to 4.72 mm ( $\bar{X}$  = 4.52 ± 0.13 mm); MW — 2.04 to 2.32 mm ( $\bar{X}$  = 2.19 ± 0.07 mm); TL/MW — 2.00 to 2.11 ( $\bar{X}$  = 2.07 ± 0.03).

Head black except clypeus, triangular area on anteromedial portion of frons, and transverse maculation between hind margins of eyes, rufous (on some specimens pale areas broadly expanded and head almost entirely rufous except piceous spot medial to each eye); antenna with articles 1 to 2 or 3 entirely pale, outer articles infusate at least apically; maxillary palpus testaceous to rufotestaceous except terminal article infusate apically; labial palpus entirely testaceous, without apical infuscation. Pronotum black except front angle and lateral margin, rufous. Elytron dark rufous to piceous medially, paler laterally; epipleuron rufous. Ventral surface black except abdominal sterna 3 to 6 rufous apically and laterally. Legs rufous except femora and tibiae of most specimens slightly darker.

Dorsal surface with reticulate microsculpture, pattern hardly different between sexes, or lines somewhat more deeply impressed on female. Head coarsely punctate medially, punctures smaller and sparser laterally. Pronotum coarsely punctate laterally, medially on disc punctures finer and sparser. Elytron more or less evenly coarsely punctate. Punctures of pronotum and elytron each bearing elongate very slender inconspicuous pale seta. Punctuation of metacoxal plates more or less even, shallower than that of metasternal wings or lateral portions of sterna 1 and 2.

Body elongate, parallel-sided or with sides gradually broadening to maximum width which occurs well behind middle. Mentum with tooth truncate or shallowly emarginate medially. Lateral bead of pronotum relatively broad, well delimited throughout length and of more or less equal width. Prosternal process and file slightly developed. Elytron with lateral margin more or less straight or only slightly ascendent in side view; epipleuron disappearing posterior to humeral angle of elytron.

Male with articles 1 to 3 of pro- and mesotarsus dilated (Fig. 95, 96), articles 1 each with two pairs and articles 2 each with one pair of rounded adhesive scales beneath: articles 1 and 2 subequal in width, slightly broader than article 3; anterior protarsal claw slightly broadened, subequal to or slightly shorter than posterior claw.

*Taxonomic notes.* — I examined two specimens from Mt. Washington, N. H., which agree well in structure with specimens from Alberta.

*Natural history notes.* — This is a characteristic species of *Sphagnum* bogs, with adults usually found in small *Carex*-filled pools in a *Sphagnum* carpet, and, occasional specimens in *Carex*

marshes or small shaded forest pools.

*Distribution.* — Fall recorded this species from New Hampshire, Michigan and Manitoba. I examined specimens from New Hampshire, Newfoundland (St. Anthony, UASM) and 67 specimens from Alberta localities (map, Fig. 375).

*Hydroporus tenebrosus* LeConte, 1850

*Hydroporus tenebrosus* LeConte, 1850: 215. (Type locality — Lake Superior.) Melsheimer 1853: 32. — LeConte 1855: 292. — LeConte 1863a: 16. — Gemminger and Harold 1868: 441. — Crotch 1873: 394. — Sharp 1882: 467. — Wickham 1895a: 76. — Carr 1920: 4. — Leng 1920: 78. — Zimmermann 1920: 103. — Fall 1923: 81. — LaRivers 1951: 407. — Hatch 1953: 207. — Anderson 1962: 63. — Gordon and Post 1965: 17. — Wallis 1973: 105.

*Hydroporus luridipennis* LeConte, 1850: 216. (Type locality — Eagle Harbor, Lake Superior) not Melsheimer, 1846.

*Hydroporus lutulentus* LeConte, 1855: 292-293. (New name for *H. luridipennis* LeConte.) LeConte 1863a: 16. — Gemminger and Harold 1868: 436.

*Diagnosis.* — This is the most frequently encountered species in Alberta of that group of *Hydroporus* including the medium sized, unpatterned, dark adults. The male protarsi are usually distinctive — article 3 of both the pro- and mesotarsus is very large, broadly oval in outline and usually evidently wider than the two preceding articles. The protarsal claws are subequal in length but the anterior are perceptibly broader in lateral view. Microsculpture of the female is fine and dense, giving these specimens a dull opaque appearance characteristic within this group. The elytra of *tenebrosus* specimens also tend to be paler in color than those of related species.

*Description.* — Measurements of 30 specimens from the Calgary — Cochrane area of Alberta are: TL — 3.76 to 4.32 mm ( $\bar{X} = 4.06 \pm 0.15$  mm); MW — 1.84 to 2.16 mm ( $\bar{X} = 2.04 \pm 0.08$  mm); TL/MW — 1.94 to 2.06 ( $\bar{X} = 1.99 \pm 0.03$ ).

Head black except frontal bar on frons, anterior margin of clypeus, and frons laterally above base of antenna, rufous; antenna with articles 1 and on most specimens also 2, pale rufous; outer articles infusate apically or largely piceous, but usually with at least extreme base pale; palpi rufous, terminal article of each palpus piceous. Pronotum with disc black, anterior angle and lateral margin rufous to piceous. Elytron rarely black; most specimens with elytron piceous to dark brown medially and apically with lateral margins brown to rufous; epipleuron piceous. Ventral surface largely piceous to black. Legs dark rufous except femora basally, tibiae apically and externally, and tarsal articles, infusate and piceous on many specimens.

Dorsal surface with reticulate microsculpture: male elytral sculpture of more or less even sized meshes irregular in shape; female elytral microsculpture of very dense, fine lines in very small meshes visible at 100 X, surface dull and opaque. Head with evident irregular punctures, deepest and densest medially on frons and finer and sparser anteriorly and laterally. Pronotum with coarse punctures, less dense medially on disc, either large and setiferous, or smaller and non-setiferous. Elytron evidently punctate. Punctures of pronotum and elytron bearing long pale setae.

Pronotum with lateral bead fine but distinct throughout length: pronotum with maximum width at hind angles. Prosternal prominence low, file well developed with low transverse ridges. Lateral margin of elytron more or less straight in side view, or slightly and gradually ascendent to humeral angle; epipleuron disappearing shortly posterior to humeral angle. Metacoxal process truncate or very slightly produced medially.

Male with articles 1 to 3 of pro- and mesotarsi dilated (Fig. 97), articles 3 broadly oval in outline, conspicuously robust in comparison to articles 1 and 2, and on many specimens broader than articles 1 and 2: articles 1 each with two pairs and articles 2 each with one pair of oval adhesive scales on ventral surface: protarsal claws subequal in length, anterior claw slightly broader with apex slightly more acute, but otherwise claws similar in shape. Female with pro- and mesotarsal articles narrow (Fig. 98), articles 3 very slender and elongate, narrowly triangular in shape.

*Taxonomic notes.* — LeConte (1855) suggested that the name *H. lutulentus* may be a junior synonym of *H. tenebrosus*. This was confirmed by Crotch (1873) and Fall (1923). Horn (1883) placed *H. rusticus* Sharp as a junior synonym of *H. tenebrosus* and this was again confirmed by Fall (1923).

*Natural history notes.* — Specimens live amid emergent vegetation and plant detritus along margins of usually small, warm ponds. They are often very abundant in small ponds in parkland zones but were also taken from prairies (most commonly on fescue grasslands), mountains, and mixed and boreal forest areas, where they are even found in *Sphagnum* bogs. On prairies, *H. tenebrosus* is to a large extent replaced by *H. pervicinus* and in the mountains, especially at higher elevations and in colder marshes, by *H. despectus*. Teneral specimens were collected from July 6 to mid-August, mostly during the latter half of July. A specimen was observed to

land on a black car in Calgary on May 30, 1972.

*Distribution.* – This species ranges widely in North America, from New England to British Columbia, and south to Utah and Nevada. I have seen specimens from as far north as Aklavik, N.W.T. (Bryant, UASM), and examined more than 600 specimens from Alberta localities (map, Fig. 376).

#### *Hydroporus pervicinus* Fall, 1923

*Hydroporus pervicinus* Fall, 1923: 84. (Type locality – Lake Tahoe, California.) Leng and Mutchler 1927: 17. – Hatch 1953: 207. – Leech and Chandler 1956: 318. – Anderson 1962: 63. – Gordon and Post 1965: 17. – Wallis 1973: 105.

*Diagnosis.* – Adults resemble those of *H. tenebrosus*, but males are recognized by the shortened anterior protarsal claws. In addition to this, specimens of *H. pervicinus* are darker in color, the head is more strongly punctate, and the microsculpture of the female elytron consists of large open meshes similar to that of the male.

*Description.* – Measurements of 30 specimens from selected localities in the vicinity of the Red Deer River, Alberta, are: TL – 3.80 to 4.24 mm ( $\bar{X} = 4.02 \pm 0.12$  mm); MW – 1.88 to 2.12 mm ( $\bar{X} = 2.01 \pm 0.08$  mm); TL/MW – 1.94 to 2.06 ( $\bar{X} = 2.01 \pm 0.03$ ).

Head black except frontal margin dark rufous or piceous, and frons with transverse rufous maculation between posterior margin of eyes; antenna with outer articles beginning at article 2, darkened apically on most specimens; palpi pale except terminal article of each palpus infuscate apically. Pronotum with disc black, lateral margin and in some specimens also basal and apical margins, narrowly piceous. Elytron black medially, lateral margin dark rufous or piceous; epipleuron piceous. Ventral surface mainly black. Legs rufous with tibia and tarsi largely infuscate.

Dorsal surface with evident microsculpture; elytral meshes isodiametric. Punctuation of frons various but on most specimens noticeably coarser than that of *H. tenebrosus*. Elytron and pronotum with pale setae. Structural characters similar to those of *H. tenebrosus*.

Males with articles 1 to 3 of protarsus dilated (Fig. 99), articles 1, 2 and 3 subequal in width; article 3 less strongly expanded than that of *tenebrosus*; article 2 less transverse, more quadrate in outline: anterior protarsal claw about two-thirds length of posterior, broader and more strongly arcuate. Females with article 3 of protarsus (Fig. 100) more rounded laterally than that of *tenebrosus*.

*Natural history notes.* – Specimens inhabit vegetation-rich margins of small, often temporary, prairie and foothill ponds, but not saline water.

*Distribution.* – This is a western species, known from California to southern British Columbia, and east to Manitoba. I examined more than 220 specimens from Alberta localities (map, Fig. 377).

#### *Hydroporus despectus* Sharp, 1882

*Hydroporus despectus* Sharp, 1882: 466. (Type locality – “North America (Canada)”.) Zimmermann 1920: 104. – Leng 1920: 78. – Fall 1923: 81. – Brown 1930: 236. – Hatch 1953: 207. – Anderson 1962: 63. – Wallis 1973: 105.

*Hydroporus rusticus* Sharp, 1882: 467. (Type locality – Nevada) Horn 1883: 278.

*Diagnosis.* – Specimens are average sized resembling those of *H. tenebrosus* in habitus, but the male has article 3 of the pro- and mesotarsus shorter and less dilated. The male protarsal claws are subequal or the anterior claw is very slightly shorter and stouter than the posterior. There is no or slight sexual dimorphism in elytral sculpture.

*Description.* – Measurements of 30 specimens from the Kananaskis Lakes – Highwood Pass area of Alberta, are: TL – 3.72 to 4.28 mm ( $\bar{X} = 4.03 \pm 0.15$  mm); MW – 1.84 to 2.14 mm ( $\bar{X} = 2.03 \pm 0.08$  mm); TL/MW – 1.90 to 2.06 ( $\bar{X} = 1.98 \pm 0.04$ ).

Head black except frontal bar rufous, anterior margin dark rufous to piceous; antenna with article 1 rufous; outer articles dark with even article 2, at least dorsally and apically, infuscate; palpi with base rufous, terminal one or two articles of each palpus infuscate; ventral surface of head piceous to black with gula rufous to piceous. Pronotum black with lateral margin piceous on some specimens. Elytron with lateral and basal margins dark rufous to piceous, disc gradually darkened medially and apically; epipleuron piceous. Ventral surface largely black. Legs piceous except trochanters, apex of femora and base of tibia, paler on most specimens.

Body with reticulate microsculpture: elytral meshes even and rounded, covering disc; no appreciable difference between sexes, or some females with lines slightly more deeply impressed; many specimens with sparse, shallow, sinuate, transverse



lines on disc of elytron. Head variously punctate but less coarsely so than in *H. pervicimus*. Pronotum densely and coarsely punctate marginally, disc more sparsely punctate with both large setiferous punctures and scattered small punctulæ. Elytron strongly punctate, punctures more or less evenly distributed over disc and separated by one and one-half to two times their own diameters. Metacoxal plate evenly punctate, metasternal wing with conspicuously larger and denser punctures. Sterna 3 to 6 with punctures small but distinct. Pronotal and elytral setiferous punctures with conspicuous golden to brown setae.

Pronotum with lateral margin evenly arcuate, maximum width at hind angles and in dorsal view in form of more or less smooth curve with lateral margin of elytron; lateral bead relatively broad, of equal width and clearly delimited throughout length. Prosternal prominence low, file well developed; prosternal process strongly convex but rounded medially and margined laterally to apex. Elytron shortly but distinctly ascendent to humeral angle: epipleuron disappearing posteriorly to shoulder. Metacoxal processes together with hind margin more or less truncate or very broadly angulate behind.

Male with articles 1 to 3 of pro- and mesotarsi dilated (Fig. 101): articles 1 and 2 subequal in width; article 3 subequal in width or slightly narrower (especially on mesotarsus) and about as long as wide, with sides rounded and maximum width near or slightly distad of middle; articles 1 each with two pairs and articles 2 each with one pair of rounded adhesive scales on ventral surface. Protarsal claws subequal in length or anterior claw slightly shorter and broader. Aedeagus as in Figure 73.

*Taxonomic notes.* — Fall (1923) examined specimens of this species from New England as well as from Alberta, British Columbia and Idaho, and indicated that they were not all alike but did not differ sufficiently to permit recognition of more than one species. The species to which I have applied the name *H. despectus* has a western mountain distribution and as a general rule, species with this form of distribution do not extend very far into eastern North America. This distribution contributes a little more evidence to suggest that eastern and western North American specimens may not be conspecific. I have not examined the type of *H. despectus*.

*Natural history notes.* — Specimens live in *Carex* marshes and among emergent vegetation along the margins of small, cold, silt-bottomed springs, seepages or creeks in the mountain and foothill regions of the province. The single specimen from northeastern Alberta was found among moss and *Carex* along the margin of a small cold spring, a somewhat uncommon type of habitat in that portion of the province. I have seen a single teneral specimen, collected July 9.

*Distribution.* — This species was recorded from New England to British Columbia (but see Taxonomic notes). In western North America it was recorded from Utah, Idaho, British Columbia and Alberta. I examined 340 specimens from Alberta localities (map, Fig. 378).

#### *Hydroporus* species near *despectus* Sharp

*Diagnosis.* — This rather undistinguished species is based, to some extent, on negative characters. The beetles are of average size with brown to piceous elytra and fine sculpture and punctuation. The best diagnostic characters are: habitus which is body somewhat depressed and broadly oval and third article of the pro- and mesotarsus relatively narrow in both sexes. Specimens of this species differ from those of *H. despectus* in slightly smaller size, more oval in outline, paler in color, and less strongly punctate.

*Description.* — Measurements of 30 specimens from the Swan Hills, Alberta, are: TL — 3.54 to 4.08 mm ( $\bar{X} = 3.83 \pm 0.12$  mm); MW — 1.78 to 2.08 mm ( $\bar{X} = 1.93 \pm 0.07$  mm); TL/MW — 1.94 to 2.04 ( $\bar{X} = 1.98 \pm 0.02$ ).

Head black except frontal bar rufous, anterior margin of clypeus dark rufous or piceous; ventral surface of head various, most specimens with gula testaceous to rufous and genae darker, rufous to piceous; antenna with articles 1 to 3 pale, distal articles piceous or at least infusate apically but with extreme base of each article rufous; palpi rufous except apical one or two articles of each palpus infusate. Pronotum black, lateral bead of some specimens piceous. Elytron with lateral and basal margins brown to dark rufous, disc gradually darkened piceous to black medially and apically; some specimens with entire disc brown; epipleuron dark brown to piceous. Ventral surface mainly black, some specimens with mediolateral portion of sternum 3, rufous. Legs dark rufous or piceous except apex of femur and base of tibia rufous, or some specimens with entire legs rufous with femora slightly darkened basally.

Dorsal surface reticulate though lines of sculpture shallowly impressed on some specimens; elytron with meshes large and rounded, elytral disc somewhat shiny in both sexes. Sexual differences in sculpture absent or slight. Head relatively lightly punctate: punctures scattered, smaller on clypeus and anteriorly on frons, becoming somewhat coarser posteriorly: punctures in frontal depressions without definite longitudinal linear arrangement. Pronotum strongly punctate submarginally, disc with punctures sparse and small. Pronotum very sparsely setose, most conspicuously so laterally and posteriorly. Elytron strongly and evenly punctate, punctures separated by several times their own diameters and each with fine brown to piceous seta about

equal in length to distance between punctures. Metasternal wings, metacoxal plates and lateral portions of sterna 1 and 2 distinctly and evenly punctate; sternum 3 very finely punctate, punctures deepened and more distinct on sterna 4 to 6.

Body slightly depressed, broadly and more evenly oval in outline than in most specimens of related species; maximum width at, or clearly behind middle. Pronotum with lateral margins rounded in form of smooth curve with margin of elytron; maximum width at slightly obtuse hind angles: lateral bead narrow but distinct and of even width throughout length. Elytron with lateral margin shortly but distinctly ascending to humeral angle, epipleuron disappearing posteriorly to shoulder. Prosternum with prominence and file well developed; process elongate, narrowly convex, sparsely setose and narrowly margined laterally. Metacoxal process truncate or slightly angulate medially.

Male with articles 1 to 3 of pro- and mesotarsi dilated (Fig. 102): articles 3 narrower than in other similar species, sides more or less straight, subparallel or slightly diverging towards apex; protarsal claws subequal in length, anterior claw slightly broadened basally. Aedeagus as in Fig. 74, apex more or less straight or slightly reflexed in lateral view: broad and medially constricted in ventral view.

*Taxonomic notes.* — The specimens included in this species differ subtly in body proportions but these forms intergrade into one another. R. D. Gordon (in litt., 1974) considers these specimens to belong to the species *H. despectus*. However, minor morphological distinctions correlated to habitat differences strongly suggest that two species are involved. I have not examined the type specimens of *H. despectus* Sharp, *H. rusticus* Sharp or *H. tartaricus* LeConte and therefore am not certain of the correct application of these names. Because of this, I have not proposed a new name for this species.

*Natural history notes.* — This is one of the commoner species of *Hydroporus* in *Carex* and *Sphagnum* bogs throughout the northern portions of the province. General specimens were collected from July 11 to August 29.

*Distribution.* — This species occurs widely throughout the forested portions of the province and south along the foothills to the Bow River. I examined more than 250 specimens from Alberta localities (map, Fig. 379).

#### *Hydroporus tartaricus* LeConte, 1850

*Hydroporus tartaricus* LeConte, 1850: 215. (Type locality — Lake Superior.) Melsheimer 1853: 32. — LeConte 1855: 292.

— LeConte 1863a: 16. — Gemminger and Harold 1868: 441. — Crotch 1873: 395. — Sharp 1882: 470. — Zaitzev 1907: 22. — Zimmermann 1919: 161. — Carr 1920: 4. — Leng 1920: 78. — Zimmermann 1920: 103. — Fall 1923: 86. — Fall 1926: 138. — Brown 1937: 109. — Hatch 1953: 208. — Zaitzev 1953: 162. — Wallis 1973: 105.

*Diagnosis.* — The combination of pale genae which contrast in color with the slightly darker gula, the coarsely punctate frons, and the anteriorly narrowing lateral margin of the pronotum distinguish adults of this species from others of *Hydroporus*.

*Description.* — Measurements of 16 Alberta specimens are: TL — 3.28 to 3.56 mm ( $\bar{X} = 3.40 \pm 0.07$  mm); MW — 1.68 to 1.84 mm ( $\bar{X} = 1.76 \pm 0.05$  mm); TL/MW — 1.89 to 1.95 ( $\bar{X} = 1.93 \pm 0.02$ ).

Head dark rufous to black except frontal bar between eyes, and anterior margin, rufous; ventral surface with genae testaceous to pale rufous, gula slightly darker in color; antenna with articles 1 to 2 or 3 testaceous, outer articles darker, largely piceous but with at least extreme base of each article rufous; palpi rufous with terminal article of each palpus infuscate. Pronotum piceous to black, anterior angle pale rufous, lateral margin pale anteriorly, becoming dark rufous to piceous posteriorly. Elytron brown laterally and basally, darker medially and posteriorly; epipleuron brown to rufous. Ventral surface piceous to black, most specimens with prosternum and process, metasternum medially, metacoxal process, sternum 2 medially, and sterna 3 to 6 laterally and apically, rufous. Legs dark rufous to piceous with at least trochanters and apex of femora paler.

Dorsal surface reticulate, similar in both sexes; sculpture irregular and somewhat effaced on ventral sclerites of body. Head strongly and coarsely punctate: frontal impressions with punctures more or less longitudinal and linear in arrangement. Pronotum marginally densely punctate; disc with punctures smaller and sparser. Elytron conspicuously punctate, punctures separated by two or more times their own diameters. Punctures of pronotum and elytron each with pale brown seta, equal to or slightly longer than distance between elytral punctures. Metasternal wing, metacoxa and sterna 1 and 2 with conspicuous punctures, slightly less dense than those of *H. sp. near despectus*: sterna 3 to 6 finely and sparsely punctate.

Body broadly oval to almost subparallel medially, maximum width near middle; somewhat depressed. Antenna with article 2 conical, maximum width near apex. Pronotum evenly rounded laterally, on most specimens in form of smooth continuous curve with lateral margin of elytron; maximum width at hind angles; lateral bead narrow, well defined posteriorly, but narrowed anteriorly and on many specimens disappeared externally near laterally inflated margin of front angle. Prosternum with file and prominence weakly developed on some specimens; process narrow, strongly convex, sparsely setose, narrowly margined laterally. Elytron with lateral margin shortly but distinctly ascending to humeral angle, epipleuron disappearing posterior to

shoulders.

Male pro- and mesotarsal articles narrow but distinctly dilated, articles 3 elongate oval; articles 1 each with two and articles 2 each with one pair of small, oval scales on ventral surface. Protarsal claws subequal, anterior claw slightly more robust than posterior. Aedeagus simple, slender.

*Taxonomic notes.* — Although this species resembles *H. sp.* near *despectus* in general appearance, the two may not be closely related, as suggested by the slight differences in outline of the aedeagus. However, adults of species in this section of the genus *Hydroporus* are so similar to one another that it is difficult to determine their relationships.

*Natural history notes.* — Adults of *H. tartaricus* were found in *Carex* marshes in the parkland or mixed forest zones of the province. Some were associated with *Sphagnum*.

*Distribution.* — This species has been recorded from New England to British Columbia and Alaska, and from northern Europe and Siberia. I examined 14 specimens from Alberta localities (map, Fig. 380).

#### *Hydroporus elegans* (Panzer, 1794)

*Dytiscus elegans* Panzer, 1794: 5. (Type locality — unknown, type lost (Anderson, 1962).) North American references only.

— J. Balfour-Browne 1948: 160. — Hatch 1953: 211. — Zaitsev 1953: 202. — Anderson 1962: 61. — Wallis 1973: 106.

*Hydroporus depressus* auctorum, not Fabricius, 1775. — Wickham 1895a: 74. — Fall 1923: 109. — Leng 1920: 78. — Zimmermann 1920: 124. — Brown 1932b: 201. — Gordon and Post 1965: 18.

*Hydroporus rotundatus* LeConte, 1863b: 21. (Type locality — Toronto, Ontario.) — Crotch 1873: 392.

*Diagnosis.* — Adults of this and the following species, *H. depressus* Fabricius, are characterized by the rounded pronotum with maximum width anterior to the hind angles, maculate elytra, and the small subapical tooth on the lateral margin of the elytra. Additionally, males of *H. depressus* and *H. elegans* are distinguished by shape of the protarsal claws and aedeagus.

*Description.* — Measurements of 20 specimens from central Alberta are: TL — 4.92 to 5.54 mm ( $\bar{X} = 5.17 \pm 0.17$  mm); MW — 2.56 to 2.84 mm ( $\bar{X} = 2.68 \pm 0.07$  mm); TL/MW — 1.86 to 2.01 ( $\bar{X} = 1.93 \pm 0.03$ ).

Body testaceous to pale rufous. Head with posterior margin of frons narrowly piceous; antennal articles 5 or 6 to 11 infuscate apically; apex of terminal article of each palpus infuscate. Pronotum with anterior and posterior margins narrowly black; disc with pair of spots on posterior third, broadly contiguous with posterior margin. Disc of elytron with sutural margin and seven to eight distinct longitudinal vittae, black; or vittae more or less expanded and coalescent, but even darkest individuals with basomedial pale area, irregularly shaped pale lateral margin, and several short longitudinal pale vittae on disc. Ventral surface dark rufous to piceous. Legs rufous with tarsi infuscate.

Dorsal surface of body densely punctate, punctures of pronotum and elytron with very short pale setae; head and pronotum dull; elytron with sculpture lightly impressed, more shiny. Ventral surface uniformly and densely punctate, more or less granular; metatibia with ventral face densely punctate.

Pronotum broadly rounded laterally, greatest width before broadly rounded and very obtuse hind angles; lateral bead narrow but well defined. Elytron of both sexes with small, acute, subapical marginal tooth. Prosternum without medial file; prosternal process broad and more or less flat, slightly raised medially. Metacoxal lines divergent anteriorly. Sternum 6 unmodified.

Male with articles 1 to 3 of protarsus dilated, without distinct adhesive scales beneath; protarsal claws (Fig. 85) elongate and broadened, anterior claw conspicuously longer than posterior and more or less evenly arcuate from side. Aedeagus in ventral view (Fig. 76) with sides tapered toward narrowly rounded apex; parameres lightly sclerotized.

*Taxonomic notes.* — F. Balfour-Browne (1940) has shown that in the British Isles, the forms *depressus* and *elegans* represent the northern and southern ends, respectively, of a cline. Both of these forms occur in Alberta, where they appear to be largely allopatric. No morphologically intermediate specimens have been seen. The dividing line between the two is at about 55° to 56°N, an area in which there does not appear to be any marked climatic or geographical change. However, *H. elegans* is represented north of this line at Lake Claire. Perhaps more extensive collecting in central and northern Alberta will yield intermediate populations. Nonetheless, on the basis of the present observations, I regard these two groups as vicarious species.

Zaitsev's (1953) descriptions of *H. elegans* and *H. depressus* have the protarsal characters confused.

*Natural history notes.* — Warm, slow, sand- or gravel-bottomed streams and the bare gravel

or sandy shores of warm lakes are the usual habitats of this species. I collected specimens from permanent creeks with large deposits of crustose salts along their banks, but not from distinctly saline lakes. Thus, this is probably a fresh water species. Teneral specimens have been collected from August 8 to September 14.

*Distribution.* — *H. elegans* is transcontinental in southern Canada, ranging south to North Dakota and Utah. In Alberta, the species occurs north to Lesser Slave Lake and is perhaps isolated in the Athabasca delta. I examined 209 specimens from Alberta localities (map, Fig. 382).

*Hydroporus depressus* (Fabricius, 1775)

*Dytiscus depressus* Fabricius, 1775: 233. (Type locality -- unknown to me.) F. Balfour-Browne 1940: 228. — J. Balfour-Browne 1948: 160. — Zaitsev 1953: 201.

*Diagnosis.* — Only males of this species are reliably distinguished from those of *H. elegans*, by differences in protarsal claws and aedeagus.

*Description.* — Measurements of 20 specimens from northern Alberta are: TL — 4.56 to 5.48 mm ( $\bar{X} = 4.94 \pm 0.22$  mm); MW — 2.28 to 2.84 mm ( $\bar{X} = 2.51 \pm 0.16$  mm); TL/MW — 1.80 to 2.14 ( $\bar{X} = 1.97 \pm 0.09$ ).

Specimens tend to be slightly shorter than those of *H. elegans*, but the standard deviation associated with this measurement is relatively large. Also, most specimens of *H. depressus* are darker in color than those of *H. elegans* but this character is subject to a great deal of variation. Microsculpture and punctation are similar in both species.

Pronotum tending to be less strongly rounded laterally and with maximum width more posteriorly than in *H. elegans* specimens. Male with protarsal claws (Fig. 86) elongate and broadened, claws subequal: anterior claw strongly arcuate towards apex. Aedeagus (Fig. 77) with apex broad and broadly rounded.

*Taxonomic notes.* — See above under *H. elegans*.

*Natural history notes.* — Specimens collected from a small creek 2 mi S Indian Cabins, Alta were swimming over a bottom of pale clay in a light current near a culvert. A single specimen was found in a clay-bottomed borrow-pit near Grimshaw, Alta.

*Distribution.* — According to J. Balfour-Browne (1948), this species is distributed in a “long narrow finger across the boreal palaeartic into Siberia”. Perhaps the species is also widely distributed in the boreal portions of the New World. I examined 28 North American specimens from the following localities (Fig. 318 indicates those in Alberta).

ALBERTA: Waterways (Brown, CNC); 5 mi N Grimshaw (UC); Hwy. 35, 2 mi S Indian Cabins (UC).  
NORTHWEST TERRITORIES: Hay River (Bryant, UASM); Aklavik (Bryant, UASM) (1 ♀).

*Hydroporus striatellus* LeConte, 1852

*Hydroporus striatellus* LeConte, 1852: 207. (Type locality — “San Francisco et San Diego”, California.) Melsheimer 1853: 32. — LeConte 1855: 295. — LeConte 1858: 30. — LeConte 1863a: 16. — Gemminger and Harold 1868: 441. — Crotch 1873: 392. — LeConte 1878b: 466. — Sharp 1882: 435. — Horn 1894: 314. — Zimmermann 1919: 187. — Leng 1920: 78. — Zimmermann 1920: 128. — Fall 1923: 106. — Hatch 1933b: 10. — Leech 1945b: 110. — Leech 1948b: 399. — LaRivers 1951: 401. — Hatch 1953: 212. — Leech and Chandler 1956: 319. — Anderson 1962: 61. — Wallis 1973: 106.

*Hydroporus pulcher* Motschoulsky 1859: 163. (Type locality — not given), not LeConte, 1855. Sharp 1882: 808.

*Diagnosis.* — Included are maculate specimens of small size, broadly oval in outline, each elytron with one or more longitudinally impressed striae on disc.

*Description.* — Measurements of 20 specimens from Jasper National Park, are: TL — 3.80 to 4.32 mm ( $\bar{X} = 4.06 \pm 0.13$  mm); MW — 2.02 to 2.36 mm ( $\bar{X} = 2.18 \pm 0.09$  mm); TL/MW — 1.76 to 1.92 ( $\bar{X} = 1.86 \pm 0.04$ ).

Head black except transverse fascia on posterior margin of frons, and small medial anterior spot (on some specimens, these pale areas expanded and confluent along midline), rufous; clypeus pale on some specimens; antenna with articles 1 to 3 or 4 testaceous, outer articles darkly infuscate, at least apically: palpi testaceous, except terminal article of each palpus piceous, penultimate article infuscate on some specimens. Pronotum with color various: some specimens entirely black, or usually with post-medial longitudinal pale spot and pale area laterally on disc medial to piceous lateral bead. Elytron with color various, from almost entirely black (even darkest individuals with testaceous spot at base medial to shoulder) to lateral margin pale and disc with pale vittae, variously broken or transversely confluent; palest specimens with elytron more or less evenly testaceous to pale brown, but at least sutural margin piceous. Epipleuron testaceous to black. Ventral surface piceous to black. Legs piceous with apex of femora, and tibiae somewhat paler on most specimens.

Dorsal surface of pronotum and elytron grayish, with short pale brown or golden setae; specimen appears unusually dark if pubescence completely or partially removed.

Head with more or less evenly spaced irregular sized, coarse, punctures: interspaces coarsely reticulate. Pronotum medially with numerous small but deep setiferous punctures, interspaces shiny, with sculpture more or less effaced. Elytron densely and confluent punctate, interspaces shiny or with rudimentary sculpture. Ventral surface, including ventral face of meta-femur, densely and more or less confluent punctate.

Pronotum broad, short; sides various, evenly rounded to almost straight; hind angles obtuse; lateral bead narrow but well defined. Elytron short, broad, broadly rounded laterally; with evidently impressed sutural stria and most specimens with one or two additional discal striae (on some specimens as many as five longitudinal discal striae). Prosternal process broadly triangular in cross section, more or less flat dorsally with narrow medial carina. Metacoxal processes with hind margin incised medially. Sternum 6 not modified. Male with protarsal claws slender and somewhat elongate but not conspicuously modified. Aedeagus as in Figure 78.

*Taxonomic notes.* — This species varies markedly in both color and body outline, but no geographical pattern is evident within the province.

*Natural history notes.* — Specimens are in running water, such as small pools near sources of cold springs, pools in intermittent prairie creeks, beaver ponds, and in pools and eddies of larger rivers. Also, many specimens were collected from shallow water along shorelines of cold mountain lakes, often swimming over, or burrowing in, soft black organic silt. In rivers where the bottom is well scoured, and clean lake shores, they are on a bottom of clean gravel or clay. The beetles remain active throughout winter, in springs that do not freeze. Teneral specimens were collected from July 10 to August 4.

*Distribution.* — This species ranges widely in western North America, from Western Texas and Mexico north to at least the southern Yukon Territory (Mile 627 Alaska Hwy., CARR), and east to northern Manitoba. I examined more than 280 specimens from Alberta localities (map, Fig. 383).

#### *Hydroporus griseostriatus* (DeGeer, 1774)

*Dytiscus griseostriatus* DeGeer, 1774: 403. (Type locality — Sweden.) Aubé 1836: 258. — Aubé 1838: 541. — Mannerheim 1843: 220. — LeConte 1863a: 16. — Gemminger and Harold 1868: 434. — Crotch 1873: 393. — LeConte 1877: 108. — Sharp 1882: 434. — Wickham 1895a: 74. — Zimmermann 1919: 187. — Carr 1920: 3. — Leng 1920: 78. — Zimmermann 1920: 126. — Fall 1923: 107. — Brown 1930b: 236. — Hatch 1933b: 10. — Hatch 1938: 146. — LaRivers 1951: 401. — Hatch 1953: 211. — Zaitsev 1953: 195. — Leech and Chandler 1956: 319. — Anderson 1962: 61. — Gordon and Post 1965: 18. — Wallis 1973: 106.

*Hydroporus catascopium* Say 1823b: 103. (Type locality — not stated, type lost.) Melsheimer 1853: 32. — LeConte 1855: 291. — LeConte 1859a: 36. — LeConte 1863a: 16.

*Hydroporus parallelus* Say, 1823a: 153. (Type locality — Missouri, type lost.) Melsheimer 1853: 32.

*Hydroporus interruptus* Say, 1834: 445. (Type locality — Pennsylvania, type lost.) (From LeConte 1859b: 560.)

*Deronectes suffusus* Sharp, 1882: 434. (Type locality — “North America”), not Fall 1917: 175.

*Deronectes prosternalis* Sharp, 1882: 434. (Type locality — “North America”).

*Hydroporus coloradensis* Fall, 1923: 108. (Type locality — Copeland Res., Boulder Co., Colorado.) NEW SYNONYMY. — Leng and Mutchler 1927: 16. — Anderson 1962: 61.

*Hydroporus mathiasi* Hatch, 1933a: 22. (Type locality — Austin Pass L., Mt. Baker, Washington.) Blackwelder 1939: 16. — Hatch 1953: 211.

*Diagnosis.* — The elongate body, vittate maculations of elytron, absence of impressed longitudinal striae on elytron, lack of lateral subapical elytral tooth, the anteriorly diverging metacoxal lines and densely punctate ventral surface of the body characterize this species. In the field, specimens of *griseostriatus* can usually be recognized on the basis of the sickly sweet odor they produce when they are picked up.

*Description.* — Measurements of 20 Alberta specimens are: TL — 4.30 to 5.20 mm ( $\bar{X}$  = 4.86 ± 0.31 mm); MW — 2.08 to 2.68 mm ( $\bar{X}$  = 2.43 ± 0.17 mm); TL/MW — 1.91 to 2.06 ( $\bar{X}$  = 2.00 ± 0.03).

Head black except transverse bar on frons between posterior margins of eyes, and v-shaped area on clypeus and antero-medial portion of frons, testaceous to bright rufous (these pale areas continuous along midline of frons on most specimens, on some broadly so); antenna testaceous except articles 5 to 11 infusate; palpi testaceous except terminal article of each palpus infusate. Pronotum testaceous to rufotestaceous except anterior and posterior borders narrowly piceous and disc with pair of large piceous spots on basomedial region, spots on most specimens extended to hind margin and on some specimens,

spots contiguous along mid-line and extended anteriorly to front margin. Elytron on palest specimens with sutural margin and eight narrow longitudinal vittae on disc, black; most specimens with vittae broadened and variously contiguous, pale areas restricted to humeral and lateral regions, and several discontinuous longitudinal pale vittae or some specimens with entire disc piceous or almost so. Ventral surface mainly black. Legs rufous with pro- and mesotarsi and apex of metatarsal articles infuscate; some specimens with base of femora darkened.

Pronotum and elytra densely covered with short, decumbent, pale setae. Disc of pronotum and elytron densely punctate, interspaces with lightly impressed microsculpture; some specimens somewhat shiny. Ventral surface of body and ventral surface of metafemur densely and contiguously punctate; microsculpture coarse and granular.

Pronotum with lateral bead narrow, well defined internally, of more or less equal width throughout, or slightly narrowed anteriorly; lateral margin slightly but more or less evenly arcuate, greatest width at prominent but slightly obtuse hind angles. Elytron without subapical lateral tooth; epipleuron disappearing behind lateral margin posterior to humeral angle. Metacoxal lines divergent anteriorly (Fig. 44). Abdominal sternum 6 not modified. Male with protarsal articles 1 to 3 slightly broadened, without small adhesive scales beneath; protarsal claws very slightly broadened and elongated, otherwise not modified. Aedeagus as in Figure 79.

*Taxonomic notes.* — Specimens exhibit marked variation in color and size. A tendency is indicated toward development of geographical races.

LeConte (1855) regarded Say's species *H. parallelus* and *H. interruptus* to be conspecific with *H. catascopium* Say. Zimmermann (1919) treated *H. catascopium* as a variety of the species *H. griseostriatus* DeGeer. Zimmermann (1919) listed both of Sharp's names, *H. suffusus* and *H. prosternalis*, as junior synonyms of the name *H. griseostriatus*, and this synonymy was confirmed by Fall (1923). Hatch (1953) listed *H. mathiasi* Hatch as a variety of *H. griseostriatus*. I have tentatively placed the name *H. coloradensis* Fall as a junior synonym of *H. griseostriatus*, because specimens whose character states approach Fall's description of *H. coloradensis* occur in mixed populations with more typical specimens of *H. griseostriatus* and with intermediate forms. However, I have not examined the type, and Anderson (1962) treats *H. coloradensis* as a valid species.

*Natural history notes.* — Specimens live in a wide variety of aquatic habitats, from small barren pools along margins of ice fields and shores of cold alpine lakes, to gravel and clay shore lines of foothill and prairie rivers and warm prairie ponds, but not usually in dense *Carex* marshes or cold *Sphagnum* bogs. The common denominator in the various habitats appears to be an at least partially clear inorganic clay or gravel bottom not densely covered with rooted plants or plant debris. Many specimens were collected in flight from April 5 to May 30, and during this period, specimens may turn up in almost any body of water. These beetles are among the first dytiscids to become active in the spring, and specimens are often found along margins of rivers during early stages of breakup. They are frequently found swimming in the shallow layer of melt water that forms in the early spring over the still frozen ponds, and were collected from beneath 30 inches of ice on Chestermere L. in March (UC).

Sisula (1971) studied the ecology of this species in small temporary, rain-water rock pools on islands in the northern Baltic sea. In this area, the species was univoltine. The first larvae appeared in the pools by the end of May, and each of the three larval instars lasted one to two weeks. The larvae pupated on land. Pupal stage lasted three weeks after which the adult beetle returned to the pools for the rest of the summer. Adults overwintered on land in litter, and returned to the pools in the spring. In Alberta, outside the mountains, teneral specimens have been collected from June 7 to July 8, hence if overwintering by adult beetles is the rule, the larval stages are passed rather rapidly in the early spring.

The larva has been described by various authors including Xambeu (1891) and Bertrand (1928), and F. Balfour-Browne (1940) presents a photograph.

*Distribution.* — This species has a circumpolar distribution. In North America, it occurs from Labrador to Alaska and south to New Jersey, Arizona and California. The species is probably throughout Alberta for it has been taken in Great Slave Lake, Northwest Territories. However, it is probably uncommon in the boreal region of northern Alberta and I have not seen Alberta specimens collected north of about 56°N. I examined more than 400 specimens

from Alberta localities (map, Fig. 384).

*Hydroporus spenceri* (Leech, 1945)

*Deronectes spenceri* Leech, 1945b: 105. (Type – male, 13 Mile Lake, Dog Creek Road, NW of Clinton, B.C., in CNC.) Hatch 1953: 211.

*Diagnosis.* – Specimens are superficially very similar to those of *H. griseostriatus* DeGeer, but can be recognized by much larger size and metacoxal lines narrowly separated and more or less parallel anteriorly.

*Description.* – Measurements of 18 Alberta specimens are: TL – 5.44 to 5.96 mm ( $\bar{X}$  = 5.69 ± 0.16 mm); MW – 2.60 to 3.00 mm ( $\bar{X}$  = 2.80 ± 0.11 mm); TL/MW – 1.94 to 2.10 ( $\bar{X}$  = 2.03 ± 0.04).

Head testaceous except frons piceous along frontal fovea, medial to and behind eye, and along hind margin; antenna pale with articles 5 or 6 to 11 infuscate, at least apically; palpi pale, terminal article of each palpus infuscate. Pronotum pale except posterior margin and pair of triangular spots on disc, piceous to black; elytron testaceous with sutural margin and eight elongate vittae, piceous or black; vittae on most specimens separate and easily distinguishable but more or less fused in some specimens. Ventral surface mainly black. Legs pale with pro- and mesotarsi infuscate.

Disc of pronotum and elytron clothed with fine golden setae. Head with dual punctuation of numerous shallow umbilicate punctures, and large sparse deep punctures along frontal fovea and posterior margin of frons, interspaces finely sculptured. Pronotum and elytron with deep punctures smaller and denser than on head; interspaces with microsculpture finer. Ventral surface coarsely and more or less confluent punctate.

Epipleuron of elytron visible to humeral angle when examined in lateral view. Metacoxal lines (Fig. 45) close, more or less parallel with interspace punctate and setose. Metacoxal processes with posterior margin emarginate medially.

Male with sternum 6 concave medioapically, apex pointed and shortly deflected (female with evident or suggested modification but not so strong as that of male). Male metatrochanters ventrally, and metafemora ventrally and posterior, with long pale setae. Male protarsal claws slightly elongate, anterior claw slightly broader and more arcuate than posterior. Aedeagus (Fig. 80) more or less straight apically: apex broad and narrowly emarginate in dorsal view, grooved apically on ventral surface.

*Natural history notes.* – Few specimens and no long series of this species were collected in Alberta. Several teneral specimens (Aug. 2 to Sept. 17) indicate that the species breeds in Alberta and is not just a migrant from the west. Most specimens were in shallow foothill ponds, and do not appear to prefer saline water. However, Scudder (1969) calls this a “high salinity species” and records it from lakes on the Fraser Plateau of British Columbia with surface conductivities of 1,100 to 20,000 micromhos/cm.

*Distribution.* – This species ranges from south central British Columbia to southern Alberta, and north to the southern Yukon (Watson L, CARR, UASM). It is widespread in southern Alberta and is perhaps isolated in the Peace River area. I examined 24 specimens from Alberta localities (map, Fig. 385).

*Hydroporus quadrimaculatus* Horn, 1883

*Hydroporus quadrimaculatus* Horn, 1883: 284. (Type locality – western Nevada.) Leng 1920: 78. – Zimmermann 1920: 132. – Fall 1923: 117. – Fall 1932: 145. – LaRivers 1951: 401. – Hatch 1953: 210. – Leech and Chandler 1956: 319.

*Hydroporus brodei* Gellerman, 1928: 63. (Type locality – Walla Walla, Washington.) Hatch 1953: 210.

*Diagnosis.* – The characters presented in the key to species coupled with color are sufficient to permit the recognition of this distinctive species.

*Description.* – Measurements of 20 Alberta specimens from Beaver Creek, Alberta are: TL – 3.64 to 3.96 mm ( $\bar{X}$  = 3.80 ± 0.08 mm); MW – 2.12 to 2.32 mm ( $\bar{X}$  = 2.20 ± 0.05 mm); TL/MW – 1.70 to 1.76 ( $\bar{X}$  = 1.73 ± 0.02).

Head rufotestaceous; antenna and palpi testaceous, without apical infuscation. Disc of pronotum rufous; basal and apical borders broadly piceous, lateral border narrowly piceous on some specimens. Elytron dark brown to piceous except lateral margin, large humeral spots on basal third, slightly smaller subapical spot, and small apical spot, pale rufous; epipleuron testaceous. Ventral surface dark rufous with metasternal wings, metacoxal plates and basolateral areas of abdominal sterna, piceous. Legs rufous.

Dorsal surface glabrous. Elytron with shallow large punctures basally, obsolete apically and laterally; interspaces with numerous small micropunctures located at intersections of lines of very fine microsculpture. Metacoxal plates with few large irregularly situated punctures; ventral surface including epipleuron, densely micropunctate.

Pronotum with posterolateral angle somewhat produced behind, acute; lateral bead well defined, narrowed toward front

angle: disc mediolaterally with lightly impressed longitudinal groove suggesting specimens of following seven species (*Oreodytes*): base broadly and slightly produced medially. Prosternum without ridge and file; process short, very broad, more or less flat with a slight longitudinal medial convexity. Metacoxal processes with hind margin conjointly sinuate (Fig. 43); metacoxal lines slightly divergent anteriorly, interspace densely punctate, glabrous. Epipleuron visible to humeral angle in lateral view. Female with abdominal sternum 6 produced posteromedially into narrow elongate apically rounded lobe; posterior margin fringed with short setae; male sternum 6 unmodified. Metafemur with small sparse punctures, without linear arrangement of medioventral punctures. Metatibia with group of slender erect setae on inner apical margin, best developed on male.

Male with articles 1 to 3 of protarsus slightly dilated, article 1 with four round adhesive scales beneath; protarsal claws relatively long and slender but otherwise unmodified. Aedeagus (Fig. 75) robust basally, relatively short.

*Taxonomic notes.* — Fall (1932) treated the name *H. brodei* Gellerman as a synonym of *H. quadrimaculatus* Horn. Hatch (1953) gave it subspecific ranking but does not present any characters for separating *H. brodei* from the nominate subspecies.

The taxonomic position of this species is enigmatic. Various authors have placed it in the subgenus *Deronectes* but many characters including glabrous dorsal surface of the body, punctuation of the metafemur and ventral surface, shape of the metacoxal process, and peculiar elytral punctuation mitigate against this. Perhaps it is more closely related to the subgenus *Oreodytes* as was suggested by Fall (1932). Habitus, shape of pronotum, sublateral pronotal impression, and modified 6th abdominal sternum of the female, lend credence to this. Perhaps the species comprises a separate subgenus.

*Natural history notes.* — F. S. Carr collected several long series of this species from Beaver Creek, Alberta, probably in the Castle River watershed, approximately 15 miles SW of Pincher Creek. Beaver Creek is a small, low-gradient foothills stream with overhanging grassy banks and the occasional bar or shoreline of gravel and clay. The single specimen that I collected was under a stone on a gravel-clay bank of a slow warm stream (Groat Ck, 20 mi S Whitecourt).

*Distribution.* — This species ranges from western Nevada and northern California to south-eastern British Columbia and Alberta. In Alberta, it is in the southwest foothills and is perhaps isolated in the foothills of the northern Rocky Mountains. I examined 22 specimens from Alberta localities (map, Fig. 386).

#### *Hydroporus snoqualmie* Hatch, 1933

*Hydroporus snoqualmie* Hatch, 1933a: 26. (Type locality — North Bend, Washington.) Hatch 1953: 214.

*Diagnosis.* — Combination of the following characters defines this species: elytral epipleuron visible to humeral angle, broad pronotum, elongate shape, and usually brownish elytral markings.

*Description.* — Measurements and ratios of 20 specimens from southwestern Alberta are: TL — 3.44 to 3.84 mm ( $\bar{X} = 3.60 \pm 0.11$  mm); MW — 1.84 to 2.12 mm ( $\bar{X} = 1.95 \pm 0.08$  mm); TL/MW — 1.79 to 1.91 ( $\bar{X} = 1.85 \pm 0.03$ ).

Basic color of dorsal surface testaceous to pale brown. Head with elongate spot medial to each eye produced posteriorly and internally, spots confluent basomedially; area behind each eye brown to piceous; antenna testaceous with articles 4 or 5 to 11 infusate apically; palpi testaceous with terminal article of each palpus infusate apically. Pronotum with anterior and posterior margins narrowly brown to piceous; disc with two transverse maculations, each narrowly broken medially on most specimens but longitudinally confluent laterally on many specimens. Elytron with sutural margin narrowly darkened; disc with five or six discal vittae (vittae may be more or less confluent on many specimens) and two to three spots lateral to these; color of vittae various, brown on most specimens but pale brown and barely contrasting with ground color of disc, to piceous or very rarely black; epipleuron testaceous to piceous. Ventral surface brown to piceous or black. Legs piceous or brown with femora apically, tibiae, and metatarsi mainly testaceous.

Punctuation various: elytron very densely micropunctate, otherwise some specimens almost impunctate dorsally, others with conspicuous dorsal punctures. Metacoxal plates with sculpture coarse and obscuring shallow punctures.

Pronotum at widest point broader than elytra across base (Fig. 120); sides broadly and evenly rounded, constricted shortly before hind angle; hind angle varied, ranging from produced and more or less acute on some specimens to narrowly rounded and slightly obtuse on others; lateral bead narrow and weakly delimited from disc. Elytron broadly rounded laterally with maximum width about middle; lateral margin not produced into tooth; epipleuron visible to humeral angle in lateral view (Fig. 118). Metacoxal lines evenly and gradually divergent: hind margin of metacoxal processes conjointly incised medially. Protibia evenly widened towards apex, margins not or only slightly sinuate. Metatarsal article 1 with internal apical angle produced.

Male anterior protarsal claw not modified; articles 1 of pro- and mesotarsal articles each with four small oval scales on ventral



surface. Aedeagus as in Figure 125.

*Taxonomic notes.* — Although closely resembling the species *scitulus* in habitus, structure of the elytral epipleuron, metatarsal articles and male genitalia suggest that *H. snoqualmie* is more closely related to *H. laevis*.

*Natural history notes.* — This species is often abundant along gravel or rocky shorelines of subalpine lakes in southwestern Alberta. Long series were collected from Bertha Lake (5900'), and Upper and Lower Twin Lakes (ca 6500') in Waterton National Park. At lower elevations in the mountains, these beetles are usually found over gravel or silt bottoms of pools in clear cool creeks and rivers. This species is confined primarily to the mountains and the headwaters of rivers draining this area. In the lower foothills and adjacent prairies, *H. snoqualmie* is replaced by *H. scitulus* LeConte which appears to be more tolerant of warmer turbid water and clay-gravel substrates. Teneral specimens were collected from Aug. 9 to Aug. 27.

*Distribution.* — *H. snoqualmie* occurs in Washington, northern Idaho, southern British Columbia and western Alberta north to the Athabasca drainage. I examined 208 specimens from Alberta localities (map, Fig. 387).

#### *Hydroporus laevis* Kirby, 1837

*Hydroporus laevis* Kirby, 1837: 67. (Type — male in BMNH labelled as follows: type: N. Amer. ♂ 5768a: *Hydroporus laevis* Kirby, N. Amer. 5768, Rev. W. Kirby). LeConte 1850: 215. — Melsheimer 1853: 31. — LeConte 1855: 295. — LeConte 1863a: 16. — Zimmermann 1920: 131. — Hatch 1933a: 25. — Hatch 1953: 25.

*Hydroporus duodecimlineatus* LeConte, 1850: 214. (Type locality — Les Eerits, Lake Superior.) Melsheimer 1853: 32. — LeConte 1855: 295. — LeConte 1863a: 16. — Gemminger and Harold 1868: 432. — Sharp 1882: 448. — Wickham 1895a: 75. — Zimmermann 1919: 190. — Leng 1920: 132. — Zimmermann 1920: 132. — Fall 1923: 113. — Fall 1926: 138. — Hatch 1933a: 25. — Hatch 1953: 214. — Wallis 1973: 106.

*Hydroporus alpinus* Crotch, 1873: 391, not Paykull, 1798.

*Hydroporus semiclarus* Fall, 1923: 113. (Type locality — Georgetown, Colorado.) — Fall 1926: 139. — Hatch 1933a: 27. — Leng and Mutchler 1927: 17. — Leech and Chandler 1956: 319. — Anderson 1962: 65.

*Hydroporus yukonensis* Fall, 1926: 138. (Type locality — Dawson, Yukon Territories.) Hatch 1928: 221. — Leng and Mutchler 1933: 15.

*Hydroporus relicticollis* Hatch, 1928: 220, not Fall, 1926.

*Hydroporus hortense* Hatch, 1933a: 27. (Type locality — North Bend, Washington.) NEW SYNONYMY. Hatch 1953: 214.

*Diagnosis.* — Specimens are recognized readily on the basis of key characters.

*Description.* — Measurements of two Alberta population samples are: Waterton National Park (N = 20): TL — 4.08 to 4.64 mm ( $\bar{X} = 4.45 \pm 0.12$  mm); MW — 2.12 to 2.44 mm ( $\bar{X} = 2.28 \pm 0.06$  mm); TL/MW — 1.89 to 2.00 ( $\bar{X} = 1.95 \pm 0.03$ ). Canmore Alberta (N = 20): TL — 4.48 to 4.88 mm ( $\bar{X} = 4.74 \pm 0.09$  mm); MW — 2.24 to 2.52 mm ( $\bar{X} = 2.41 \pm 0.08$  mm); TL/MW — 1.90 to 2.09 ( $\bar{X} = 1.97 \pm 0.04$ ).

Dorsal surface of body pale yellow to testaceous. Head with large piceous spot medial to each eye, spots prolonged posteriorly and medially on head and joined medially near hind margin in form of V-shaped mark; antennae testaceous, articles 5 to 11 infusate; palpi testaceous except terminal article of each palpus infusate apically. Pronotum with anterior margin slightly darkened, posterior margin narrowly piceous: disc with median transverse mark in basal third, mark extended to lateral grooves and on many specimens narrowly broken medially at mid-line; lateral grooves darkened on many specimens in form of longitudinal markings. Elytron with sutural margin piceous, disc with six longitudinal black vittae: vittae 1 and 3 and 4 to 6 connected apically on many specimens; most specimens with vittae 1 and 2 joined by small spot at about basal third; area lateral to vitta 6 with two elongate spots and sublateral depigmented line; epipleuron pale. Ventral surface piceous to black. Legs testaceous with coxae, trochanters, basal two thirds of femora, extreme apex of tibia, and tarsi, brown to light piceous.

Punctuation highly varied among specimens.

Outline of body as in Figure 121. Shape of pronotum various: in some specimens, narrower at base than elytra across humeral angles hence lateral margin strongly discontinuous; other specimens with pronotal base and base of elytra equally wide; side margin of pronotum evenly rounded laterally or in some specimens almost straight along basal half: hind angles prominent, right angled to acute; lateral bead of uniform width or on some specimens slightly broadened toward base. Elytron with lateral margin strongly ascendent to humeral angle, epipleuron visible to humeral angle in lateral view; female elytron with subapical lateral tooth, various in shape, from short and blunt to slender and acutely pointed (the complete range of forms may be found in a given population sample); apex of elytron sinuate inside tooth. Protibia (Fig. 123) gradually and evenly broadened from base to apex, inner margin more or less straight. Metacoxal lines strongly divergent. Metatarsal article 1 with internal apical angle strongly produced. Abdomen not inflated, not extended below plane of metasternum in lateral view; sterna not appreciably

modified in either sex.

Male with protarsal claws slightly lengthened, broader than mesotarsal claws: articles 1 of pro- and mesotarsi each with four small oval scales on ventral apical surface. Aedeagus as in Figure 126.

*Taxonomic notes.* — Variation is exhibited in the following characters: body outline (related to width and degree of pronotum), size, color, punctation and development of the elytral tooth on the female. Because of this, a large number of names have been proposed for the various forms. I have not examined enough specimens to determine if any of this variation shows a geographical basis.

The male type of *H. laevis* Kirby is like Alberta specimens. However, I have not examined type material of the other names listed above as synonyms of *H. laevis*. In his revision of *Hydroporus*, Fall (1923) did not include the name *H. laevis* Kirby although he recognized *H. duodecimlineatus* LeConte from which he separated *H. semiclarius* Fall on the basis of length of male protarsal claws. Fall (1926) described *H. yukonensis* as very similar to *H. duodecimlineatus*. Hatch (1933a) recognized the variation in this species and synonymized *H. yukonensis* with *H. semiclarius*, and later (1953) placed the name *H. duodecimlineatus* as a junior synonym of *H. laevis*. Hatch (1933a) originally recognized the species *H. hortense* on punctuation (an extremely variable character) and size. However, later (1953) he gave the length of *hortense* as 4.2 to 4.7 mm which is exactly within the size range of Alberta specimens. As the species *H. hortense* is not characterized by any distinctive characters, I consider the name to be a junior synonym of *H. laevis*.

*Natural history notes.* — Specimens that I collected were from cool or cold, silt- or gravel-bottomed pools adjacent to cold, usually swift creeks and rivers. Many were collected from quiet stretches along the shorelines of such streams. The species is frequently associated with silt-laden water of glacial melt streams and bottoms of pools in which specimens occur are often covered with glacial silt.

*Distribution.* — The known range of *H. laevis* is from Colorado and California to Great Slave Lake (UC) and Alaska, and from Lake Superior to the Pacific. In Alberta, the species was collected from the Rocky Mountains, Swan Hills and perhaps may occur in the northeast in the Canadian Shield as it has been found in the adjacent portion of the Northwest Territories. I examined 200 specimens from Alberta localities (map, Fig. 388).

#### *Hydroporus alaskanus* Fall, 1926

*Hydroporus alaskanus* Fall, 1926: 139. (Type locality — Skagway, Alaska.) Hatch 1928: 221. — Hatch 1933a: 25. — Leng and Mutchler 1933: 15. — Hatch 1953: 214.

*Hydroporus recticollis* Fall, 1926: 140. (Type locality — Seward, Alaska.) NEW SYNONYMY. — Leng and Mutchler 1933: 15.

*Hydroporus rainieri* Hatch, 1928: 220. (Type locality — Mount Rainier, Washington.) NEW SYNONYMY. — Leng and Mutchler 1933: 15. — Hatch 1933a: 27. — Hatch 1953: 214.

*Hydroporus kincaidi* Hatch, 1928: 221. (Type locality — Mount Rainier, Washington.) Leng and Mutchler 1933: 15.

*Hydroporus productotruncatus* Hatch, 1944: 46. (Type locality — Fairmont, B.C.) NEW SYNONYMY. — Hatch 1953: 215.

*Diagnosis.* — In addition to characters given in the key to species, the inflated abdomen, male genitalia and modified female sternum 6, characterize this species.

*Description.* — Measurements of 20 specimens from Crowsnest Summit, Alberta, are: TL — 4.80 to 5.40 mm ( $\bar{X}$  = 5.15 ± 0.15 mm); MW — 2.32 to 2.60 mm ( $\bar{X}$  = 2.49 ± 0.07 mm); TL/MW — 2.03 to 2.14 ( $\bar{X}$  = 2.07 ± 0.03).

Body testaceous. Head with black inverted V on frons, and laterally behind eyes; antenna with outer articles infuscate; terminal article of each palpus infuscate apically. Pronotum with anterior and posterior borders narrowly margined with piceous; disc with two transverse fasciae, on many specimens each fascia broken medially but fasciae continuous with each other laterally. Elytron with sutural margin narrowly piceous; disc with six distinct longitudinal black vittae and two shorter less distinct vittae mediolateral to these; vittae 1 and 2 on most specimens united by a black spot at basal third; epipleuron piceous to black. Ventral surface mainly black. Legs testaceous: coxae, basal half to two thirds of femora, apex of tibia, and tarsi infuscated.

Male with frons and disc of pronotum finely and shallowly reticulate; punctation of dorsal surface fine and sparse. Female

with sculpture coarser, finely granulate; frons coarsely punctate between eyes. Elytral punctation coarser on female than on male.

Outline of body as in Figure 122. Pronotum with lateral margin rounded in anterior half, more or less straight and parallel sided in basal half or on some specimens slightly sinuate before right angled or more or less acute posterolateral angle. Elytra elongate, parallel sided, maximum width at or before middle, strongly narrowed in apical third; male with apex rounded or in some specimens subtruncate; female with side strongly sinuate shortly before apex and produced into more or less right angled tooth; apex truncate; margin steeply ascendent to humeral angle; epipleuron visible to humeral angle in side view. Metacoxal lines strongly divergent medially, less so anteriorly. Abdomen inflated ventrally, extended to below plane of metasternum when viewed from side; sterna 4 and 5 narrowly and shortly lobed medially; male sternum 6 slightly flattened medially; female with sternum 6 emarginate medially when viewed from behind, apex narrowly produced and deflected downwards. Protibia (Fig. 124) broadly expanded in distal half, inner margin strongly arcuate, outer margin more or less straight (best developed in male). Inner apical angle of metatarsal article 1 not or only slightly produced. Aedeagus (Fig. 127) laterally expanded towards apex.

*Taxonomic notes.* — Hatch (1933) synonymized the names *H. kincaidi* Hatch and *H. rainieri* Hatch, and later (1953) suggested that *H. productotruncatus* Hatch may also be a synonym. Fall's descriptions of *H. alaskanus* and *H. recticollis* are incomplete but both seem to apply to the present species. Hatch (1928) separated *H. rainieri* from *H. alaskanus* on the basis of characters not listed by Fall, and on other characters within the range of variation shown by specimens of this species. Hatch (1933) states that *H. dauricus* Motschulsky (1860: 100) appears to be very similar and differs primarily in the depth of the impression of the serial punctures of the elytra. If these are conspecific, the name *H. dauricus* has priority.

The females of this species vary in degree to which abdominal sternum 6 is modified and in shape of the elytral tooth. A female from Glacier, B.C. (CARR) has this very short and broadly rounded, hence the elytra are not truncate apically.

*Natural history notes.* — Adults of *H. alaskanus* are usually in clear, often cold, water over a gravel bottom. Most were collected in pools in gravel pits where the bottom was gravel and silt but lacked conspicuous vegetation. I also found specimens in quiet shallow pools of small creeks and in seepage-fed pools along margins of larger creeks and rivers. Teneral specimens were collected on October 4 (CARR).

*Distribution.* — This species ranges from Alaska south to at least Washington and Alberta. In Alberta, specimens were collected from the Rocky Mountains and adjacent foothills. I examined 131 specimens from Alberta localities (map, Fig. 389).

#### *Hydroporus scitulus* LeConte, 1855

*Hydroporus scitulus* LeConte, 1855: 295. (Type locality — Eagle Harbor, Lake Superior.) LeConte 1863a: 16. — Gemminger and Harold 1868: 440. — Crotch 1873: 392. — Zimmermann 1919: 190. — Zimmermann 1920: 133. — Guignot, 1933: 429. — Hatch 1933a: 26. — Hatch 1953: 212. — Wallis 1973: 106.

*Hydroporus septentrionalis* auctorum not Gyllenhal, 1827. — Leng 1920: 78. — Fall 1923: 114. — Brown 1932b: 201. — Anderson 1962: 65.

*Diagnosis.* — Adults of this species closely resemble those of *H. snoqualmie* Hatch but differ in the following ways: marks on frons inside of eyes separate throughout length and not convergent and joined posteriorly; elytral vittae piceous or black in color; epipleuron disappearing behind lateral margin of elytron posterior to level of humeral angle; and shape of male genitalia different.

*Description.* — Measurements of 20 Alberta specimens are: TL — 3.32 to 3.88 mm ( $\bar{X}$  = 3.62 ± 0.11 mm); MW — 1.72 to 2.08 mm ( $\bar{X}$  = 1.92 ± 0.07 mm); TL/MW — 1.86 to 1.94 ( $\bar{X}$  = 1.89 ± 0.02).

Dorsal surface testaceous to pale brown. Head with longitudinal piceous spot inside each eye, spots parallel and not convergent posteriorly on frons; margin of eye and posterior margin of head, narrowly piceous; antenna testaceous with articles 5 to 11 infusate apically; palpi testaceous, terminal article of each palpus infusate apically. Pronotum with anterior and posterior margins narrowly piceous, disc with two transverse fasciae on many specimens continuous with each other along lateral impression. Elytron with sutural margin and about eight longitudinal vittae, piceous or black; vittae 1 to 5 distinct, outer three vittae irregular, fused or broken on many specimens; epipleuron piceous, paler inside humeral angle. Ventral surface piceous to black. Legs pale with base of femora, apex of tibiae, and tarsal articles variously infusate.

Dorsal surface with fine granular microsculpture. Elytron densely micropunctate, punctures conspicuous on most specimens, larger punctures various in development. Metacoxal plate with deep conspicuous punctures internally, punctures smaller and more irregularly spaced externally. Intralineal space of metacoxa densely punctate.

Pronotum with sides evenly rounded, about as wide at base as elytra across humeral angles; posterolateral angle obtuse; lateral bead very fine and shallowly delimited from disc. Prosternum without prominence and file. Epipleuron disappearing behind lateral margin of elytron posterior to humeral angle when observed from side (Fig. 119). Metacoxal lines slightly divergent anteriorly; processes conjointly with hind margin incised medially. Abdominal sterna not modified. Protibia evenly widened toward apex. Male with anterior protarsal claw unmodified; protarsal articles slightly dilated, article 1 with four small scales on ventral surface. Aedeagus as in Figure 128.

*Taxonomic notes.* — Because populations exhibit variation in maculation and punctuation, characters that have been used for separating Nearctic *H. scitulus* from Palearctic *H. septentrionalis*, the taxonomic distinctiveness of these two forms has been questioned. Guignot (1933: 429) states that the genitalia differ, but did not state in what way. The aedeagus of a male of *H. septentrionalis* (Cornwall, England (UC)), was slightly more arcuate and narrowed apically, but was certainly very similar to that of Alberta specimens. For the present, I am treating these two as separate species although additional study is required both to confirm the taxonomic status of these forms and to determine the variation pattern of populations of *H. scitulus*.

*Natural history notes.* — Most specimens were in flowing water, especially in warm foothill creeks and rivers. The beetles are found in the Rocky Mountains in Waterton Lakes National Park, along lower lakes and slow, warmer streams. In general, *H. snoqualmie* replaces *H. scitulus* in mountainous areas. Specimens are occasionally found in prairie rivers over silty gravel bottoms, but not over extensive clay bottoms.

Matheson (1914) described the life history and larva.

*Distribution.* — This species is transcontinental in distribution. In Alberta, it is represented in the foothills and adjacent prairies. I examined 280 specimens from Alberta localities (map, Fig. 390).

#### *Hydroporus rivalis* Gyllenhal, 1827

*Hydroporus rivalis* Gyllenhal, 1827: 385. (Type locality — unknown to me.) Gemminger and Harold 1868: 440. — Zimmermann 1919: 191. — Leng 1920: 78. — Fall 1923: 119. — Hatch 1933a: 24. — Balfour-Browne 1940: 249. — Hatch 1953: 213. — Zaitsev 1953: 186.

*Diagnosis.* — (Fig. 5). Small size, oval shape and vittate elytra characterize this and the following three species of *Hydroporus*. However, separation within this group is extremely difficult and is based almost entirely on differences in punctuation and color. The key to species summarizes the important diagnostic features.

*Description.* — Measurements of 20 Alberta specimens are: TL — 2.80 to 3.08 mm ( $\bar{X} = 2.95 \pm 0.08$  mm); MW — 1.64 to 1.84 mm ( $\bar{X} = 1.76 \pm 0.06$  mm); TL/MW — 1.61 to 1.72 ( $\bar{X} = 1.68 \pm 0.02$ ).

Dorsal surface testaceous. Head with frons posteriorly and medially to each eye of many specimens, pale brown; eye very narrowly ringed with brown or piceous; antenna testaceous except outer articles darkly infusate; palpi testaceous with apical article of each palpus infusate. Pronotum with anterior border along medial emargination, posterior border medially, and single medial transverse fascia, dark brown to piceous. Elytron with sutural margin and six or seven longitudinal vittae, piceous; vittae 1 to 4 long and more or less complete but not extended to either basal or apical margins; vittae 5 to 7 short, 5 broken on many specimens to form anterior and posterior spot, 6 and 7 short medial lines or spots, or may be fused; medial portions of vittae 4, 5 and 6 expanded and more or less fused on many specimens. Ventral surface piceous to black. Legs testaceous to brown with at least apex of femora and tibiae medially, testaceous.

Dorsal surface finely punctate, elytral punctures conspicuously smaller than those forming serial lines on disc, and on most specimens barely visible at 50 magnifications. Ventral surface relatively lightly punctate; metacoxa with punctures small, shallow and inconspicuous against coarse sculpture of metacoxal plate, smaller than largest punctures along posterior lateral portions of metasternal wings.

Body short and broad, oval in outline (Fig. 5). Lateral bead of pronotum very narrow and not conspicuously widened at hind angle. Aedeagus as in Figure 129.

*Taxonomic notes.* — Forms that appear to be valid species in this group are very poorly separated from one another primarily on slight differences in color and punctuation. Also, certain species have wide ranges over which they show a tendency to form geographical races. These

factors together make it very difficult to define species limits and to correctly relate geographically separated populations. The problem of relationship between Palearctic and North American forms is similar to that shown by *H. scitulus*.

*Natural history notes.* — I collected adults of this species only from running water, in pools and eddies along banks of cool, clear, foothill and mountain streams, over bottoms of gravel, rock or hard clay. Teneral were collected Aug. 29 to Oct. 19.

*Distribution.* — In North America, this Holarctic species is restricted to the west where it has been recorded from Washington, Idaho and British Columbia. I examined 336 specimens from Alberta localities (map, Fig. 391).

#### *Hydroporus congruus* LeConte, 1878

*Hydroporus congruus* LeConte, 1878b: 452. (Type locality — Florissant, Colorado.) — Zimmermann 1919: 191. — Leng 1920: 78. — Zimmermann 1920: 132. — Fall 1923: 120. — Leng and Mutchler 1927: 17. — Hatch 1933a: 24. — Hatch 1953: 213. — Anderson 1962: 64.

*Diagnosis.* — Adults of this species closely resemble those of *H. rivalis* Gyllenhal, but differ primarily in smaller size, with elytral marks not extended as far anteriorly onto base, paler in color and with strong tendency toward lateral fusion.

*Description.* — Measurements of 20 Alberta specimens are: TL — 2.56 to 2.88 mm ( $\bar{X}$  = 2.71 ± 0.08 mm); MW — 1.52 to 1.72 mm ( $\bar{X}$  = 1.64 ± 0.05 mm); TL/MW — 1.62 to 1.71 ( $\bar{X}$  = 1.65 ± 0.03).

Head and pronotum with ground color rufotestaceous to brown, elytron testaceous. Pronotum with anterior margin narrowly piceous, lateral margins narrowly infuscate, disc with medial transverse piceous mark on some specimens, or more commonly, medial mark poorly defined and entire disc between lateral impressions nebulously darkened. Elytron with sutural margin narrowly piceous; discal vittae dark brown or rufopiceous, not piceous or black; origin of vittae well behind basal margin; vittae 1 to 4 distinguishable but in many specimens broadly expanded and fused both basally and near apex; vittae 5 and 6 broad and on most specimens fused at least apically. Ventral surface piceous to black but piceous areas more expanded than in related species; prosternal process, metepisternum, metacoxal process, and posterior margin of sterna 3 to 6, rufous to piceous.

Elytron, aside from serial punctures, and sparse row of fine punctures along sutural margin, virtually impunctate (minute sparse punctures visible at 50X on some specimens). Entire face of metacoxal plate with small but conspicuous punctures of more or less equal size, sculpture of metacoxal plate shallow.

Lateral margin of pronotum narrow and of equal width throughout length, not thickened at hind angle. Aedeagus as in Figure 130.

*Taxonomic notes.* — Zimmermann (1919) placed *H. congruus* LeConte as a synonym of *H. rivalis* Gyllenhal. Fall (1923) regarded *H. congruus* as a variety of the more western and southern species *H. obesus* LeConte. I have not seen sufficient material from western North America to venture an opinion on the relationship between *H. congruus* and *H. obesus*. However, Hatch (1933, 1953) is certainly correct in considering this species to be distinct from *H. rivalis*.

*Natural history notes.* — Adults of this species are in pools and eddies of mountain and foothill creeks and rivers, generally at higher levels of a watershed where they are often in association with specimens of *H. rivalis*. However, *H. congruus* does not extend as far downstream into the foothills as *H. rivalis*. Teneral specimens were collected on August 26 (Lundbreck, UASM).

*Distribution.* — This species was recorded from Montana, Utah, Washington and British Columbia. I examined a few specimens from Colorado (Blue Mesa Res, CARR) and Wyoming (South Pass City, CARR), and 87 specimens from Alberta localities (map, Fig. 392).

#### *Hydroporus crassulus* Fall, 1923

*Hydroporus crassulus* Fall, 1923: 119. (Type locality — Western Montana.) Leng and Mutchler 1927: 17. — Hatch 1933a: 24. — Hatch 1953: 213. — Anderson 1962: 65.

*Diagnosis.* — Adults of this species are similar to those of *H. rivalis* but differ in thicker marks, coarse punctation, and inflated bead of posterior lateral angles of the pronotum.

*Description.* — Measurements of 14 Alberta specimens are: TL — 2.92 to 3.12 mm ( $\bar{X} = 3.04 \pm 0.07$  mm); MW — 1.72 to 1.88 mm ( $\bar{X} = 1.81 \pm 0.04$  mm); TL/MW — 1.65 to 1.70 ( $\bar{X} = 1.68 \pm 0.02$ ).

Color very similar to that of *H. rivalis* Gyllenhal, with ground color more brown and marks black and thicker. Pronotum with lateral margins narrowly piceous, some specimens with medial transverse maculation extended anteriorly and joined to anterior piceous border.

Elytron distinctly punctate, punctures subequal to or larger than serial punctures. Metacoxal plate strongly punctate, punctures of more or less equal size and only slightly smaller than those along hind margin of metasternal wing.

Pronotum with lateral bead broadened along basal half, distinctly inflated just anterior to posterolateral angle. Lateral margin of elytron relatively strongly ascending to humeral angle.

*Taxonomic notes.* — Geographical variation in pattern of maculation is exhibited. Alberta specimens generally possess distinct separated elytral vittae, but to the west (Oregon, Idaho and adjacent British Columbia) and to the south (Colorado) the vittae tend not to extend as far forward on the elytral base and are more or less expanded and laterally continuous near the middle of the elytron and again toward the apex, thereby producing two irregular transverse fasciae on each elytron. Two specimens from Creston, B.C. (CARR) are intermediate in elytral pattern. However, the punctation and the inflation of the posterior lateral angle of the pronotum remain stable over the range of specimens that I have examined.

*Natural history notes.* — Adults are in foothill creeks and rivers, in eddies and pools over gravel or hard clay bottoms, at lower levels of a drainage system than adults of *H. rivalis*. Probably populations of *H. crassulus* are in the Cypress Hills because of tolerance for warm and silty water.

*Distribution.* — This species occurs from Colorado (CARR!) and Utah to British Columbia and western Alberta. I examined 73 specimens from Alberta localities (map, Fig. 393).

#### *Hydroporus angustior* Hatch, 1928

*Hydroporus angustior* Hatch, 1928: 221. (Type locality — Renton, Washington.) Leng and Mutchler 1933: 15. — Hatch 1933a: 24. — Hatch 1933b: 15.

*Diagnosis.* — Adults of this species resemble those of the preceding three species but are characterized as follows: pronotum with apical and basal margins piceous; disc with short transverse subapical mark (narrowly separated from or continuous with front margin) and on many specimens medially divided posterior transverse mark continuous with hind margin. Elytron with origin of vittae posteriorly to basal quarter; vittae 1 and 2 broken medially; vittae with tendency towards lateral fusion. Elytral disc basally and medially with large coarse punctures, sparser and finer or even obsolete laterally and apically; metacoxal plate internally and anteriorly with large punctures, these smaller posteriorly and externally; pronotal bead narrow, not conspicuously broadened at hind angle.

*Taxonomic notes.* — Specimens of *H. angustior* have not yet been collected in Alberta. However, they have been collected at Elko, British Columbia (CARR) and hence may occur in the Crowsnest Pass area of Alberta.

#### Genus *Laccornis* Des Gozis, 1914

*Laccornis* Des Gozis, 1914: 111. (Type species — the European *Hydroporus oblongus* Stephens, by monotypy.)  
*Agaporus* Zimmermann, 1919: 192. (Type species — *Hydroporus oblongus* Stephens, by monotypy.)

The members of this small hydroporine genus possess a rather distinctive appearance clearly distinguishing them from members of *Hydroporus*. In spite of this, the species of *Laccornis* possess few unique features in common diagnostic of the genus. Leech (1940) concluded that the best character for separating members of this genus from those of *Hydroporus* is the relative position of the metacoxal lobes and the base of the metafemur. In *Laccornis*, the base of the metafemur attains the metacoxal lobe or almost so, while in specimens of *Hydroporus* the

metafemur is separated from the metacoxal lobe by a distinct gap. The following generic description refers to the two Alberta members of the genus.

*Description.* – Hydroporinae of relatively large size: body attenuate: ventral surface somewhat flattened, dorsal surface broadly convex. Clypeus with single anteromedial fovea or group of contiguous deep punctures. Pronotum with lateral bead well defined; mediobasal lobe short and broad. Prosternal process very broad, short and rounded apically, variously convex medially; lateral margins broadly margined behind procoxa, narrowed towards apex: prosternal prominence well developed, without file; prosternum with lateral portions broadly inflated in front of procoxae. Metasternum anteriorly shortly flattened. Elytron elongate; epipleuron more or less horizontal and largely hidden in side view. Metacoxal processes with hind margin conjointly sinuate, medial projection along midline not extended as far posteriorly as level of posterior lateral angle of coxal lobe. Metafemur extended to metacoxal lobe or only very narrowly separated from it.

Male with articles 3 to 7 of antenna dilated; article 3 triangular in shape, narrower than 4; 4 broad and more or less quadrate; 5 to 7 progressively narrower: 3 to 7 with ventral surface flattened or even partially concave and coarsely sculptured. Articles 1 to 3 of pro- and mesotarsus dilated, each bearing several elongate adhesive scales on ventral surface: anterior pro-tarsal claw modified (ventrally toothed in the two Alberta species). Mesotrochanter and mesofemur with hind margin fringed with elongate golden setae: metafemur with posterior dorsal margin bearing a row of shorter pale setae. Sternum 6 with medial longitudinal impression. Aedeagus with apex recurved or reflexed ventrally.

The members of this genus have a range which in aggregate is Holarctic. Two South American species have been assigned to this genus but their placement has to be confirmed.

Leech (1940) presented a key to the North American species of the genus and illustrated the male genitalia of four of the five included species. Watts (1970) described the larva of *L. conoideus* LeConte.

#### Key to Alberta species of *Laccornis* Des Gozis

- 1 Elytron with coarse, irregularly distributed punctures; punctures varied in size and interspaces with somewhat more numerous fine punctures; aedeagus as in Figure 131  
..... *L. conoideus* (LeConte), p. 326
- 1' Elytron with coarse punctures more or less evenly spaced and separated by about twice their own diameters; interspaces with about equally numerous fine punctures; aedeagus as in Figure 132. .... *L. pacificus* Leech, p. 327

#### *Laccornis conoideus* (LeConte, 1850)

*Hydroporus conoideus* LeConte, 1850: 216. (Type locality – Eagle Harbour, Lake Superior.) – Melsheimer 1853: 32. – LeConte 1863a: 16. – Gemminger and Harold 1868: 430. – Crotch 1873: 396. – Carr 1920: 4. – Leng 1920: 74. – Fall 1923: 122. – Leng and Mutchler 1927: 17. – Leech 1940: 124, 125. – Blackwelder 1948: 4. – Hatch 1953: 215. – Wallis 1973: 106.

*Hydroporus oblongus* Sharp, 1882: 485, not Stephens.

*Diagnosis.* – The diagnostic characters are presented in the key to species.

*Description.* – Measurements of 20 specimens collected 8 mi W Calgary, Alberta, are: TL – 4.56 to 5.08 mm ( $\bar{X}$  = 4.85 ± 0.14 mm); MW – 2.24 to 2.48 mm ( $\bar{X}$  = 2.37 ± 0.08 mm); TL/MW – 2.00 to 2.09 ( $\bar{X}$  = 2.04 ± 0.03).

Head rufous anteriorly, darkened to piceous towards posterior margin; antenna rufous with apex of articles 3 to 11 piceous; palpi rufous, terminal article of maxillary palpus infuscate apically. Pronotum with disc dark rufous to piceous or black, lateral and basal margins paler, rufous. Elytron pale brown to rufous laterally and basally, darkened toward apex. Ventral surface mainly black. Legs rufous, with femora medially slightly darkened.

Dorsal surface finely reticulate. Disc of pronotum and elytron with large punctures with only very short inconspicuous setae. Head finely punctate, punctures irregular in size and distribution. Pronotum marginally coarsely punctate, punctures smaller and irregular on disc. Elytron with coarse irregularly distributed punctures, varying in size; interspaces with somewhat more numerous fine punctures. Metacoxal plate with coarse irregular punctation, denser and more or less confluent externally. Abdominal sterna very finely and sparsely punctate, finely strigate.

Prosternal process short, broad, broadly rounded apically: surface lowly but broadly and evenly convex in cross section. Structural characters and male secondary sexual characters as in generic description. Aedeagus with reflexed apex broad and rounded, spatulate (Fig. 131).

*Natural history notes.* – This species is abundant in ponds in rolling moraine with dominant vegetation of the area aspen and willows and in the open areas, rough fescue grass. The ponds, generally dry by July or August of most years, are fed by snowmelt, and are in small basins ringed with aspen and usually completely filled with *Carex*.

The species is found throughout the parkland and boreal portions of the province, where specimens are in shallow bodies of water among dense stands of *Carex* or in *Carex-Sphagnum* bogs, often in heavily shaded water that remains very cold. Teneral specimens were collected from July 7 to August 29.

*Distribution.* – Leech (1940) records the range as New York and Massachusetts to Alberta. The southern and northern limits are unknown but the species is probably restricted mainly to the boreal portions of the continent. In Alberta, the species ranges throughout the forested portions of the north, and south along the mountains to the Old Man River. It has not been taken in the Cypress Hills. I examined more than 200 specimens from the Alberta localities indicated in Figure 394.

#### *Laccornis pacificus* Leech, 1940

*Laccornis pacificus* Leech, 1940: 123. (Type locality – Salmon Arm, B.C.) Blackwelder 1948: 4. – Hatch 1953: 215.

*Diagnosis.* – Specimens are very similar to those of *L. conoideus* but differ in the more regular punctuation of the elytron and narrower reflexed apex of the aedeagus.

*Description.* – Measurements of 4 specimens from southwestern Alberta, are: TL – 4.52 to 4.84 mm ( $\bar{X}$  = 4.66 mm); MW – 2.08 to 2.24 mm ( $\bar{X}$  = 2.18 mm); TL/MW – 2.09 to 2.19 ( $\bar{X}$  = 2.13).

Color as in *L. conoideus* or slightly paler; antennal articles not so distinctly infusate. Punctuation of body similar to that of *L. conoideus* adult with head and pronotum more densely and slightly more coarsely punctate: coarse punctures of elytron more numerous, more or less evenly spaced and separated by about twice their own diameters; interspaces with equally numerous small punctures. Aedeagus (Fig. 132) with reflexed apex relatively narrow, tongue-shaped and not spatulate.

*Taxonomic notes.* – This, and *L. conoideus*, are an east-west pair of vicarious species. Although the ranges of the two species very closely approach one another in southwestern Alberta there is no evidence of sympatry nor of intergradation in diagnostic characters.

*Natural history notes.* – I collected specimens among emergent *Carex* in small moss-ringed pools in an area densely forested with willow and the occasional spruce tree. Leech (1940) collected specimens commonly in a small weedy meadow pond.

*Distribution.* – The range of *L. pacificus* includes Washington, southern British Columbia, and extreme southwestern Alberta. I examined 10 specimens from Alberta localities (map, Fig. 395).

#### Subfamily Colymbetinae

This subfamily is a very diverse group of medium-sized dytiscids, distinguished from members of Laccophilinae and Hydroporinae, by the visible scutellum, and from members of the Dytiscinae by emargination of the anterior margin of the eye.

*Description.* – Size moderate, TL – 5.4 to 20.0 mm. Color and sculpture various. Body asetose. Eye with anterior margin emarginate above base of antenna. Mentum without acute medial tooth. Prosternum and its process in same plane, or apex of process slightly deflected upward behind procoxae. Scutellum visible. Metepisternum extended to mesocoxal cavity. Legs various, generally slenderer than those of members of Dytiscinae; metatibia of male with natatorial setae along posterior margin (except females of *Coptotomus longulus* and *Ilybius discedens*), with or without bifid setae; tarsi distinctly composed of five articles; male with articles 1 to 3 of protarsus dilated but not together in form of round palette. Male genitalia various: parameres not broadly united dorsally by membrane. Female with ovipositor various.

#### Genus *Agabus* Leach, 1817

*Agabus* Leach, 1817: 68. (Type species – *Dytiscus serricornis* Paykull, 1799, by monotypy.)

*Necticus* Hope, 1838: 168. (Type species – not designated.)

*Anisomera* LeConte, 1853: 226. (Type species – *A. cordata* LeConte by monotypy.) Not Brink.

*Acatodes* Thomson, 1860: 53. (Type species – *Dytiscus fuscipennis* Payk., 1798, by monotypy.)

*Eriglenus* Thomson, 1860: 55. (Type species – *Dytiscus labiatus* Brahm (Zaitsev, 1953: 284).)



- Gaurodytes* Thomson, 1860: 57. (Type species – *Dytiscus guttatus* Paykull, 1798 (Crotch, 1873: 414).)  
*Arctodytes* Thomson, 1874: 541. (Type species – *Dytiscus elongatus* Gyll., by monotypy.)  
*Ilybiosoma* Crotch, 1873: 413. (Type species – *Ilybius regularis* LeConte, original designation.)  
*Dichodytes* Thomson, 1886: x. (Type species not designated.)  
*Xanthodytes* Seidlitz, 1891: 89. (Type species not designated.)  
*Scytodytes* Seidlitz, 1891: 89. (Type species not designated.)  
*Heteronychus* Seidlitz, 1891: 89. (Type species – *Agabus coxalis* Sharp, by monotypy.)  
*Apator* Semenov, 1899: 512. (Type species – *Agabus kessleri* Hochhuth, 1871 (= *Colymbetes bifarius* Kirby) (Leech 1942, 358).)  
*Anagabus* Jakowlew, 1897: 38. (Type species not designated.)  
*Hydronebrius* Jakowlew, 1897: 39. (Type species – *Gaurodytes cordaticollis* Reitter, by monotypy.)  
*Asterus* Guignot, 1931: 203. (Type species – *Dytiscus chalconotus* Panzer, original designation.)  
*Agabinectes* Guignot, 1931: 203. (Type species – *Dytiscus brunneus* Fabricius, original designation.)  
*Parasternus* Guignot, 1936: 186. (Type species – *Agabus subtilis* Erichson, original designation.)  
*Nebriogabus* Guignot, 1936: 186. (Type species – *Agabus discicollis* Ancy, original designation.)  
*Dichonectes* Guignot, 1947: 171. (Not seen – from Zaitsev, 1953: 226.)

The genus *Agabus*, in its broadest sense is second in diversity only to *Hydroporus* in the Alberta dytiscid fauna. Its members are rather undistinguished dytiscids of a more or less uniform habitus, moderate size (5.4 to 11.1 mm), and usually somber color, although some specimens are maculate.

The Alberta species possess the following combination of characters in addition to those common to all members of the subfamily Colymbetinae: anterolateral fovea of clypeus elongate, in many specimens continuous along anterior margin of clypeus in form of very fine bead; palpi unmodified, terminal article of each palpus entire; pronotum margined laterally; metacoxal process lobed, lobe covering base of trochanter; metafemur ventrally bearing a short row of stout setae near posterior apical angle (Fig. 142); posterior (dorsal) face of metatibia without bifid setae; metatarsal articles not or only very slightly lobed at posterior external angle; metatarsal claws equal or if slightly unequal in length, claws very short; male articles 1 to 3 of pro- and mesotarsi moderately dilated or not, with glandular setae or small scales beneath; parameres symmetrical, setose apically but without suctorial setae, of various forms but not with long stylus-like apex; aedeagus various; female stylus rounded, short, relatively lightly sclerotized and setose, not adapted for piercing or cutting.

Determination of some *Agabus* adults, especially females, is very difficult because of the large number of included species, great similarity between certain ones and individual variation of certain characters. For example, identification of some species, especially those near *congener*, depends upon use of several characters, together, any one of which is subject to sufficient intra- or interpopulation variation to prohibit it alone from being a reliable diagnostic character. Because of this, recognition of certain species is a matter of personal opinion, when only structural characters of adults are used. Perhaps a detailed study of interpopulation variation and geographical relationships of the variants would help place definition of taxa on a more objective basis.

The single most important external character for species recognition is elytral microsculpture which varies throughout the genus in the following ways: depth of impression of lines; relative size and shape of adjacent meshes; punctation of lines and meshes; presence of secondary sculpture within larger and coarser meshes of the primary sculpture; and in orientation or stretching of meshes. Sculpture is sexually dimorphic (for example in the species *punctulatus*, *nectris*, *lutosus*, etc.), individually varying (*bifarius*) or very constant in a given species.

A character introduced here is presence or absence of a fine anterior marginal bead on the clypeus. Adults of most species of Dytiscids possess a small impression or fovea near the anterolateral angle of the clypeus. In most species of *Agabus*, this impression is located very near the anterior margin of the clypeus and is prolonged along this margin, separated from it by only a very narrow convex bead, which is either complete across the entire width of the clypeus or widely broken at the middle. On some specimens this character may be difficult to interpret either because of fineness of the bead or because it is unusually indistinctly developed. The clypeal groove is distinct and relatively broad laterally, and hence can be easily seen, thereby providing a refer-

ence point from which the bead can be traced toward the middle. In some species, in which the bead is usually complete, the line is broken irregularly but is almost always clearly traceable by a series of narrowly separated elongate punctures. In those species, in which the bead is considered to be broken medially, the width of the break is at least 1/3 the total width of the anterior clypeal margin.

Relative width of metacoxa to metasternum when measured along the same line (see Fig. 133 for position of measurement) at a point of closest approximation of metacoxa to mesocoxal plate is useful for recognition of certain species, but other species show a high degree of individual variation. Jackson (1956) showed that certain species are dimorphic in development of the metasternal wing, and in at least one species, *A. raffrayi* Sharp, metasternal wing width is related to development of flight muscles and in turn, to the ability to fly. Values for this ratio are presented in each species description.

Degree of convexity and length of the prosternal process, in addition to size and shape of the metasternal emargination of the anterior medial margin, provide valuable characters for species recognition. However, these characters tend to be gradational, and have been used sparingly. Similarly, another character used extensively by Fall (1922) and others, punctuation of the ventral posterior margin of the metatibia, is gradational and individually varying. However, in certain instances it is useful.

Male characters are decisive for recognition of most species. Useful ones are: dilation and ventral vestiture of pro- and mesotarsal articles 1 to 3; shape of protarsal article 5; protarsal claws; aedeagus, and shape and vestiture of the parameres. With few exceptions, the male genitalia appear to provide a good basis upon which to build a classification of the species of *Agabus*.

The last complete treatment of the North American fauna of *Agabus* was Fall's (1922) revision, excellent for the most part. However, the key is based mainly on gradational or individually varying characters (shape of prosternal process, punctuation of metatibia) and therefore requires considerable experience to use it successfully. Also, since Fall's revision, a number of additional species, primarily from western and northern North America, have been described, many of which are mentioned in the appropriate sections below, even if they have not been recorded from Alberta.

Diversity of *Agabus* and divergence of species included in it have led many taxonomists to attempt division into smaller more homogeneous groups of generic or subgeneric rank. Balfour-Browne (1950) describes the history of such attempts. Without a widely accepted classification, arrangement of species reflects my views on relationships within the genus.

Most species of *Agabus* live in shallow water along the margins of standing, often quite small and temporary, bodies of water where the emergent vegetation or detritus is very dense. However, certain species are almost exclusively restricted to running water, from small seepages and springs to margins of large creeks and rivers. At least one species is regularly found in emergent patches of *Carex* along lake shores where wave action is not too strong. These insects overwinter as eggs, larvae or adults, depending upon the species. The larvae of the following North American species have been described: *A. erichsoni* Gemminger and Harold (James, 1970); *A. antennatus* Leech, *A. bifarius* Kirby, *A. discolor* Harris and *A. ontarionis* Fall (Watts, 1970); *A. congener* Thunbg. (Bertrand, 1928; Guignot, 1933).

#### Key to Alberta species of *Agabus* Leach

- 1 Pronotum and elytron with aciculate sculpture (Fig. 322, 323, 324), i.e., more or less separated deeply impressed lines, in addition to fine isodiametric sculpture; lines longitudinal in orientation on pronotum and base of elytron, transverse on lateral

- and apical portions of elytron; wing of many specimens without reflexed apex . . .  
 . . . . . *A. bifarius* (Kirby), p. 367
- 1' Sculpture various but not aciculate, lines in form of definite meshes: wing full, with reflexed apex . . . . . 2
- 2 (1') Metacoxa large, anterior margin laterally extended to level of hind margin of mesocoxa; antenna of male clavate . . . . . 3
- 2' Metacoxa smaller, anterior margin not extended forward to level of hind margin of mesocoxa; antenna of male not clavate . . . . . 4
- 3 (2) Prosternal process triangular in cross section, produced medially into sharp longitudinal keel; ventral surface of male protrochanter and profemur with dense brush of setae; male protarsal article 5 straight ventrally: arctic species. . . . .  
 . . . . . *A. verus* Brown\*
- 3' Prosternal process markedly convex in cross section, narrowly but smoothly rounded and not in form of sharp keel: male protrochanter and femur without ventral brush of setae; male protarsal article 5 with small medial ventral tooth. . . . .  
 . . . . . *A. antennatus* Leech, p. 368
- 4 (2') Anterior margin of clypeus with complete although very narrow bead (Fig. 279) (if discontinuous, bead broken irregularly or shortly, usually near middle, and not discontinuous for more than 0.25 of its total length) . . . . . 14
- 4' Anterior clypeal bead restricted to lateral portion and broken medially by gap equal to at least 0.33 width of clypeus at anterior margin (Fig. 278) (on some specimens this space with several isolated punctures) . . . . . 5
- 5 (4') Pronotum subcordate (Fig. 134); maximum width near middle, side constricted towards base and sinuate before hind angle. . . . . *A. bjorkmanae* Hatch, p. 336
- 5' Maximum width of pronotum at or slightly before hind angle, or if near middle, hind angle broadly rounded and obtuse . . . . . 6
- 6 (5') Metatarsal articles 1 to 3 each with from one to three large punctures on dorsomedial surface; pronotum with lateral margin sinuate at front angle (Fig. 136); large, black . . . . . *A. erichsoni* G. & H., p. 340
- 6' Metatarsal articles impunctate dorsally or with numerous minute punctures; without above combination of characters . . . . . 7
- 7 (6') Pronotum with posterolateral angle broadly rounded and obtuse; metasternum between mesocoxae shortly impressed; prosternal process short, bluntly pointed and somewhat deflected upward behind procoxae . . . . . 8
- 7' Pronotum with posterolateral angle more or less right angled or only narrowly rounded at apex; metasternum between mesocoxae with distinct V- or U-shaped impression . . . . . 11
- 8 (7) TL greater than 7.5 mm . . . . . 9
- 8' TL less than 7.0 mm . . . . . 10
- 9 (8) Ratio WC/WS less than 1.90 (Pacific Coast). . . . . *A. confertus* LeConte\*
- 9' Ratio WC/WS greater than 2.20 . . . . . *A. pseudoconfertus* Wallis, p. 337
- 10 (8') Ratio WC/WS greater than 2.30; pronotum with sides rounded basally, more or less straight and convergent anteriorly . . . . . *A. kenaiensis* Fall, p. 338
- 10' Ratio WC/WS less than 1.90; pronotum with sides evenly rounded . . . . .  
 . . . . . *A. verisimilis* Brown, p. 339
- 11 (7') Lateral bead of pronotum broad, subequal in width to maximum width of antennal article 3 . . . . . 12

\* Species not known from Alberta: not treated further.

- 11' Lateral bead of pronotum narrow, about one half maximum width of antennal article 3 . . . . . 13
- 12(11) Pronotum with lateral bead abruptly truncate behind narrow, acutely protruding front angle (Fig. 137); body brown to piceous; male with anterior protarsal claw (Fig. 153) very broad with apex obliquely truncate . . . . .  
. . . . . *A. triton* Fall, in part, p. 343
- 12' Pronotum with lateral bead evenly produced on front angle: body black: male anterior protarsal claw with large ventral tooth . . . . .  
. . . . . *A. falli* (Zimmermann), in part, p. 342
- 13(11') Prosternal process long, apex sharply pointed: anteromedial metasternal impression well developed and extended posteriorly to level of inner posterior margin of mesocoxal cavity . . . . . *A. seriatus* (Say), p. 335
- 13' Prosternal process short, apex bluntly pointed; anterior metasternal impression between mesocoxae short and not extended to level of inner posterior margin of mesocoxal cavity . . . . . *A. hypomelas* Mannerheim, p. 339
- 14 (4) Elytron testaceous to pale brown with four or five black longitudinal vittae on disc . . . . . *A. disintegratus* (Crotch)\*
- 14' Color of elytron various but not pale with dark longitudinal vittae . . . . . 15
- 15(14') Prosternal process flat or slightly concave in basal half . . . . . 16
- 15' Prosternal process various but more or less convex in basal half . . . . . 17
- 16(15) Elytron with lines of sculpture deeply impressed, in form of coarse meshes of very unequal size and shape (Fig. 301); pronotum pale rufous with anterior and posterior margins bordered with black medially (on some specimens black marks expanded and confluent along midline of pronotum); male with protarsal article 5 straight ventrally . . . . . *A. arcticus* (Paykull), p. 351
- 16' Elytral sculpture of small rounded more or less equal sized meshes (Fig. 303); pronotum black with lateral bead narrowly rufous; male protarsal article 5 with ventral tooth . . . . . *A. elongatus* Gyllenhal, p. 355
- 17(15') Pronotum with lateral bead broad, abruptly truncate behind narrow acutely protruding front angle (Fig. 137); male with anterior protarsal claw very broad, apex obliquely truncate (Fig. 153) . . . . . *A. triton* Fall, (in part), p. 343
- 17' Lateral bead of pronotum and male protarsal claw not as above . . . . . 18
- 18(17') Metatibia with punctures along posteroventral margin confluent, in form of more or less continuous groove; lines of primary sculpture deeply impressed, meshes large and on most specimens longitudinally stretched on at least anteromedial portion of pronotum; meshes on elytron with at least suggested secondary reticulation (Fig. 298, 299, 300) . . . . . 19
- 18' Metatibia with posteroventral margin impunctate; if punctate, punctures separated from one another by distinct convexity and together not in form of continuous groove: sculpture various . . . . . 20
- 19(18) Pronotum brown with medial transverse piceous fascia (expanded or not over most of disc): epipleuron brown: ratio WC/WS 2.2 to 2.7. . . . . *A. tristis* Aubé, p. 349
- 19' Pronotum black with lateral bead rufous to piceous: epipleuron black with external humeral margin rufous: ratio WC/WS 1.8 to 2.1. . . . . *A. leptapsis* (LeConte), p. 350
- 20(18') Body black with at most lateral margins of pronotum and elytron narrowly piceous, elytron with pale sublateral medial vitta; elytral sculpture fine, meshes rounded and more or less isodiametric (Fig. 287); metasternum with anteromedial emargination

\* Species not known from Alberta: not treated further.

- short, not extended to level of hind margin of mesocoxa; male abdominal sternum 3 mediolaterally with series of oblique ridges, male anterior protarsal claw with ventral tooth . . . . . *A. semipunctatus* (Kirby), p. 341
- 20' Without above combination of characters: male without oblique ridges on sternum 3 . . . . . 21
- 21(20') Elytral sculpture more or less equal sized meshes small, rounded or hexagonal, (punctate meshes larger than adjacent nonpunctate ones); male with anterior protarsal claw without tooth . . . . . 22
- 21' Elytron with sculpture various, meshes irregular in size and shape; male anterior protarsal claw toothed or not . . . . . 29
- 22(21) Pronotum with anterolateral portion of disc flat or evenly and gradually convex medially to lateral bead; prosternal process strongly convex, more or less carinate or angulate . . . . . 23
- 22' Pronotum with anterolateral portion of disc inflated and distinctly convex medial to lateral bead; prosternal process evenly and smoothly convex in cross section . . . . . 26
- 23(22) Metacoxae with intralineal space scabrous, with numerous longitudinal rugae: metacoxal process (when viewed from behind) with hind margin slightly inflated medially to posterolateral emargination . . . . . *A. infuscatus* Aubé, p. 353
- 23' Metacoxae with intralineal space smooth or punctate, not longitudinally rugose or scabrous; metacoxal process with hind margin not swollen but convexly arched on some specimens . . . . . 24
- 24(23') Pronotum black with at most lateral margins narrowly rufous; sculpture of elytron very fine (Fig. 314); metatibia with ventral surface impunctate medially . . . . . *A. confinis* (Gyllenhal), p. 361
- 24' Pronotum rufous to dark brown, not black; elytron with sculpture coarser (Fig. 304); metatibia with ventral face micropunctate or with medial series of punctures . . . 25
- 25(24') Metacoxal process, in posterior aspect, with area medial to posterolateral emargination convexly arched; male with protarsal claws subequal, protarsal article 5 with large ventral tooth . . . . . *A. ajax* Fall, p. 352
- 25' Metacoxal process, with inner area flat in posterior aspect; male anterior protarsal claw shorter than posterior, protarsal article 5 without ventral tooth . . . . . *A. coxalis* Sharp\*
- 26(22') Lateral margin of pronotum internal to bead, broadly rufous; metatibia of many specimens with row of punctures along inner ventral margin . . . . . 27
- 26' Pronotum with lateral margin inside bead piceous or only narrowly rufous; inner ventral margin of metatibia impunctate or with few punctures along basal half . 28
- 27(26) Total length greater than 8.5 mm; legs dark rufous to piceous; aedeagus without subapical ventral spine . . . . . *A. audeni* Wallis, p. 358
- 27' Total length less than 8.0 mm; legs testaceous to pale rufous; aedeagus with prominent subapical ventral spine . . . . . *A. canadensis* Fall, p. 358
- 28(26') Disc of elytron dark piceous or black basomedially, concolorous with disc of pronotum; elytron with scattered very small and inconspicuous punctures (Fig. 313) . . . . . *A. bicolor* (Kirby), p. 360
- 28' Disc of elytron brown to pale piceous basomedially, contrasting in color with disc of pronotum; elytron with scattered conspicuous punctures, each centered in slightly

\* Species not known from Alberta: not treated further.

- enlarged sculpture mesh (Fig. 312) . . . . . *A. phaeopterus* (Kirby), p. 359
- 29(21') Lateral bead of pronotum broad, subequal in width to maximum width of antennal article 3 . . . . . 30
- 29' Lateral bead of pronotum narrower, in most specimens about 0.5 width of maximum width of antennal article 3 . . . . . 31
- 30(29) Total length less than 6.5 mm; male anterior protarsal claw with small broad medial tooth; aedeagus short, simple; paramere long, narrow and heavily sclerotized, with apical brush of very long black setae; stridulatory organ absent . . . . . *A. margareti* new species, p. 344
- 30' Total length greater than 6.5 mm: male anterior protarsal claw with large medial ventral tooth; aedeagus long with ventral apical ridge twisted to right at apex; parameres normal, fringed with pale setae along ventral margin; male with suture between abdominal sterna 2 and 3 raised mediolaterally as low sharp ridge, anterior dorsal margin of metafemur with series of fine transverse grooves . . . . . *A. falli* (Zimmermann) in part, p. 342
- 31(29') Dorsal surface of pronotum and elytron with at least faint aeneous sheen (except pale specimens of *A. colymbus*); elytral lines of sculpture with scattered punctures situated in at least some of intersections (very difficult to see on some coarsely sculptured females) (Fig. 291, 292, 293); male with anterior protarsal claw toothed; aedeagus with basal piece very large, apex strongly twisted to right, lacking subapical spine . . . . . 32
- 31' Dorsal surface without aeneous sheen, or if present, very faint and aedeagus with a subapical spine; intersections of lines of sculpture without punctures; male anterior protarsal claw toothed or not, if toothed aedeagus with subapical spine . . . . . 35
- 32(31) Suture between abdominal sterna 2 and 3 raised as low acute ridge lateral to midline; elytral sculpture similar for both sexes (Fig. 293): male with tooth of anterior protarsal claw more or less medial in position . . . . . *A. pisobius* Leech, p. 346
- 32' Suture between abdominal sterna 2 and 3 flat, not raised; female elytral sculpture with strong secondary reticulation (Fig. 292); male with tooth of anterior protarsal claw medial or subapical in position . . . . . 33
- 33(32') Lateral bead of pronotum of equal width throughout length or only gradually and slightly narrowed toward front angles . . . . . 34
- 33' Lateral bead of pronotum strongly narrowed near front angle; male protarsus relatively strongly dilated, width article 1/width article 4, 2.4 to 3.0: male anterior protarsal claw with ventral tooth right angled to obtuse apically: female with meshes of elytral sculpture small, not or only slightly longitudinal on basomedial portion of elytron: aedeagus as in Figure 190: arctic species . . . . . *A. colymbus* Leech\*
- 34(33) Aedeagus with dorsal groove twisted to right, covered in dorsal view by expanded left side; male anterior protarsal claw with ventral tooth more or less medial in position; only west of Rocky Mountains . . . . . *A. oblongulus* Fall\*
- 34' Aedeagus (Fig. 189) with dorsal groove open in dorsal view, not twisted to right; male anterior protarsal claw with ventral tooth subapical in position; transcontinental . . . . . *A. punctulatus* Aubé, p. 345
- 35(31') Elytron with lines deeply impressed, meshes (Fig. 295-300) large of irregular size and shape and with secondary system of fine isodiametric reticulations, partially effaced or not, toward base; male protarsal articles 1 to 3 beneath with both glandular

\* Species not known from Alberta: not treated further.

- setae and small oval scales . . . . . 36
- 35' Elytral sculpture various, if lines deeply impressed and meshes coarse, latter smooth and shiny, without secondary isodiametric microsculpture; male protarsus various, most specimens with either glandular setae or scales . . . . . 38
- 36(35) Epipleuron rufous: pronotum dark rufous with transverse medial piceous area expanded or not to cover most of disc but lateral margins broadly rufous . . . . .  
. . . . . *A. austinii* Sharp, in part, p. 346
- 36' Epipleuron black or piceous: pronotum black with lateral margins narrowly rufous . . . . . 37
- 37(36') TL 7.5 to 8.6 mm: metatibia with ventral face sparsely and finely punctate (punctures on some specimens highly reduced and almost invisible); prosternal process almost flat basally on some specimens, more convex toward apex, with sparse setiferous punctures . . . . . *A. ambiguus* (Say), p. 347
- 37' TL 6.0 to 7.4 mm; metatibia without micropunctuation; prosternal process more evenly convex, surface densely punctate and setose . . . . .  
. . . . . *A. strigulosus* Crotch, p. 348
- 38(35') Body black, some specimens with lateral margins of pronotum and elytron rufous; elytral sculpture of deep lines in form of coarse irregularly shaped meshes (Fig. 302); metafemur with posterior apical angle expanded posteriorly beneath femoral comb (best developed on male); male articles 1 to 3 of pro- and mesotarsi with very large round scales beneath . . . . . *A. anthracinus* Mannerheim, p. 352
- 38' Without above combination of characters: if body black and sculpture coarse, metafemur without external posterior angle produced . . . . . 39
- 39(38') Head and disc of pronotum rufous to piceous not black; if piceous, lateral margin of pronotum broadly rufous: elytral sculpture of large meshes visible at 6 to 10 X (Fig. 294); aedeagus without subapical spine . . . *A. austinii* Sharp, in part, p. 346
- 39' Frons and disc of pronotum black; sculpture various, meshes of elytron on most specimens small; aedeagus with subapical spine . . . . . 40
- 40(39') Total length 10.0 to 12.0 mm; prosternal process carinate or strongly and narrowly convex in cross section; metatibia with more or less complete row of punctures along inner ventral margin, ventral face micropunctate medially; male protarsal articles 1 to 3 broadly dilated with large oval scales beneath: male anterior protarsal claw long and slender, not toothed ventrally . . . . . *A. ontarionis* Fall, p. 354
- 40' TL less than 9.0 mm: without above combination of characters . . . . . 41
- 41(40') Epipleuron piceous or black, many specimens with external margin narrowly rufous, prosternal process broad, lower and on different plane than subangular medial convexity of prosternum; metatibia with ventral face densely micropunctate, also dorsal surface of metatarsal article 1 micropunctate . . . . . *A. nectris* Leech, p. 357
- 41' Epipleuron pale, testaceous to rufous, some specimens slightly infusate internally; prosternal process various: punctation of metatibia various . . . . . 42
- 42(41') Male anterior protarsal claw with large ventral tooth: female elytral sculpture coarse (Fig. 307), meshes longitudinal on basomedial portion of disc and on sublateral band on apical half; ventral face of metatibia densely micropunctate . . . . .  
. . . . . *A. lutosus* LeConte, p. 356
- 42' Male anterior protarsal claw not toothed; female elytral sculpture fine, meshes not stretched longitudinally; ventral face of metatibia without micropunctuation . . 43
- 43(42') Apical article of palpus piceous to black, only narrowly rufous at base; prosternal process evenly convex, bluntly pointed; metatibia with punctures along at least basal half of ventral posterior margin: arctic species . . . . .

- ..... *A. moestus* Curtis\*
- 43' Infuscation of apical article of palpus various, on most specimens restricted to apical 0.5 or 0.66 at most; prosternal process various, apex pointed to acuminate: punctation of metatibia various, on many specimens ventral posterior series of punctures restricted to basal one quarter or entirely absent . . . . . 44
- 44(43') Anterior margin of clypeus and lateral margin of pronotum inside bead, rufous; elytral sculpture very fine (Fig. 316); prosternal process only slightly and broadly convex laterally, with low but obvious medial convexity; many specimens with lateral portions of process densely setose, metasternal wings narrow, WC/WS 2.4 to 2.9 . . . . . *A. discolor* (Harris), p. 363
- 44' Anterior margin of clypeus and lateral margin of pronotum piceous or black, or at most lateral margins of pronotum narrowly rufous; elytral sculpture various; prosternal process various, from strongly carinate medially to broadly and evenly convex but without combination of broad convexity and low medial ridge; glabrous or sparsely setose laterally; metasternal wings broader, WC/WS 1.7 to 2.6 . . . . . 45
- 45(44') TL 6.1 to 7.2 mm: elytron with sculpture fine (Fig. 319, 320, 321) . . . . . *A. inscriptus* (Crotch), p. 365
- 45' TL 6.7 to 8.5 mm: elytron with sculpture coarser (Fig. 315, 317, 318) . . . . . 46
- 46(45') Prosternal process with low even convexity at base, more strongly convex apically but not distinctly tectiform or carinate; lines of sculpture fine, meshes large (Fig. 315): elytron of many specimens with a faint aeneous sheen; aedeagus slightly broadened at base of subapical spine (Fig. 209) . . . . . *A. congener* (Thunberg), p. 362
- 46' Prosternal process strongly convex, tectiform or carinate: elytron with meshes of sculpture finer (Fig. 317, 318); elytron lacking aeneous sheen; aedeagus not broadened at base of subapical spine (Fig. 210, 211) . . . . . 47
- 47(46') Prosternal process of most specimens more or less carinate; prairie and SW foothills . . . . . *A. approximatus* Fall, p. 364
- 47' Prosternal process tectiform: Rocky Mountains and adjacent foothills . . . . . *A. sp. nr. approximatus*, p. 365

*Agabus seriatus* (Say, 1823)

*Colymbetes seriatus* Say, 1823b: 97. (Neotype – ♂, North Lebanon, N. Y., MCZ, designated by Leech 1942c: 126.) Melsheimer 1853: 30. – Gemminger and Harold 1868: 456. – Crotch 1873: 420. – Sharp 1882: 498. – Wickham 1895b: 120. – Blatchley 1910: 226. – Zimmermann 1919: 208. – Carr 1920: 4. – Leng 1920: 79. – Zimmermann 1920: 172. – Fall 1922: 14. – Brown 1930b: 236. – Hatch 1933b: 10. – Leech 1942c: 128. – Balfour-Browne 1948: 164. – LaRivers 1951: 403. – Hatch 1953: 218. – Leech and Chandler 1956: 320. – Anderson 1962: 68. – Gordon and Post 1965: 19. – Wallis 1973: 106.

*Agabus striatus* Aubé, 1838: 305. (Type locality – North America.) LeConte 1850: 213.

*Agabus arctus* Melsheimer, 1844: 27. (Type locality – Philadelphia.) – Melsheimer 1853: 30.

*Agabus parallelus* LeConte, 1850: 213. (Type locality – Lake Superior.) Melsheimer 1853: 30. – LeConte 1863a: 17. – Gemminger and Harold 1868: 456. – Crotch 1873: 420.

*Gaurodytes intersectus* Crotch, 1873: 419. (Lectotype – ♀, California, MCZ, designated by Leech 1942c.) LeConte 1863a: 17. (nomen nudum). – LeConte 1878b: 466. – Sharp 1882: 495. – Seidletz 1887: 84. – Zimmermann 1920: 167. – Leech 1942c: 126. – Hatch 1953: 218. – Leech and Chandler 1956: 320.

**Diagnosis.** – Adults are shiny black and subparallel with incompletely margined clypeus, and elongate, acute prosternal process.

**Description.** – Measurements and ratios of 24 specimens from 10 mi SE Calgary, are: TL – 7.68 to 9.36 mm ( $\bar{X}$  = 8.60 ± 0.34 mm); MW – 3.84 to 4.64 mm ( $\bar{X}$  = 4.30 ± 0.16 mm); TL/MW – 1.90 to 2.04 ( $\bar{X}$  = 1.98 ± 0.03); WC/WS – 2.00 to 2.41 ( $\bar{X}$  = 2.19 ± 0.10).

\* Species not known from Alberta: not treated further.



Color black. Head with inconspicuous frontal spots or without them; antennal articles 1 and 2 rufous, articles 3 to 11 slightly darker and infuscate apically on most specimens; labrum and mouthparts rufous; maxillary and labial palpi dark rufous, terminal articles infuscate apically on some specimens. Pronotum with lateral and basal margins piceous. Posterior margin of abdominal sterna 3 to 6, and diffuse area on lateral portions of sterna 3 to 5 of some specimens, piceous. Legs dark rufous to piceous.

Head sculpture of finely impressed lines in form of irregularly shaped moderate sized meshes; lines with scattered deeper punctures mainly in intersections; meshes smooth and shiny, sparsely and finely punctate. Pronotal sculpture similar to that of head but meshes larger medially on disc and lines much deeper laterally. Elytron (Fig. 280) with meshes varied in size and shape but on average larger than those of head and pronotum; lines more deeply impressed apically, meshes smaller and more convex; lines with scattered punctures situated at some intersections; meshes smooth, with small sparse punctures.

Clypeus with anterior margin incomplete (Fig. 278), broadly broken medially. Pronotum with lateral margins slightly rounded laterally, almost parallel-sided toward base on some specimens. Prosternal process broad, slightly and evenly convex basally, more convex towards apex; smooth and glabrous. Anteromedial emargination of metasternum well developed, extended to level of hind margin of mesocoxae. Legs slender; metafemoral comb poorly developed; metatibia with more or less complete row of separated setiferous punctures along posteroventral margin; medioventral series of punctures well developed and extended into apical half of metatibia; metatarsus I glabrous beneath.

Male articles 1 to 3 of pro- and mesotarsi narrowly dilated, with numerous small adhesive scales beneath; anterior protarsal claw (Fig. 145) slightly longer and broader than posterior with broad poorly defined ventral tooth or expansion near base. Aedeagus (Fig. 178) simple, apex bent slightly to right.

*Taxonomic notes.* — Leech (1942c) wrote that the name *A. intersectus* (Crotch) applies to populations of this species from western North America. These populations are conspecific with those of *A. seriatus*, but the two groups are subspecifically distinct. Alberta specimens belong to the western subspecies, because the metasternal wing tends to be broader than in those from eastern Canada (WC/WS – 2.35 to 3.0 ( $\bar{X}$  = 2.7), N = 12). Leech considers Manitoba specimens intermediate between the two subspecies.

*Natural history notes.* — *Agabus seriatus* inhabits running water: most frequently, streams and springs with mixed clay and gravel substrates; also pools in intermittent creeks; but not very cold, swift mountain creeks and rivers. Newly emerged adults were collected in September, and a number of the specimens collected in April and May are slightly teneral. Overwintering appears to be in the adult stage. Records of flight are not available.

Several specimens collected from a small spring 10 miles south of Calgary (March 14, 1971) had in their crops pieces of head capsules of larval Trichoptera.

*Distribution.* — This species is transcontinental from Newfoundland to British Columbia and south to Washington, D.C., New Mexico, Arizona and California. The northern limits are unknown but I have seen specimens from Hay River, Northwest Territories (UC). I examined more than 210 specimens from Alberta localities (map, Fig. 396).

#### *Agabus bjorkmanae* Hatch, 1939

*Agabus bjorkmanae* Hatch, 1939: 104. (new name for *A. rectus* LeConte). Hatch 1953: 227. — Leech and Chandler 1956: 319. — Anderson 1962: 68.

*Anisomera recta* LeConte, 1869: 374. (Type locality – Vancouver Island.) Not Babington, 1840. — Crotch 1873: 424. — Sharp 1882: 756. — Leng 1920: 79. — Zimmermann 1920: 171. — Fall 1922: 9.

*Diagnosis.* — The basally constricted or subcordate pronotum is characteristic of this species.

*Description.* — Measurements of 20 specimens from southwestern Alberta are: TL – 9.29 to 10.64 mm ( $\bar{X}$  = 9.94 ± 0.32 mm); MW – 4.64 to 5.04 mm ( $\bar{X}$  = 4.81 ± 0.10 mm); TL/MW – 1.97 to 2.15 ( $\bar{X}$  = 2.07 ± 0.05); WC/WS – 1.90 to 2.50 ( $\bar{X}$  = 2.12 ± 0.17).

Body dark piceous to black; some specimens faintly aeneous. Head with frontal spots obscurely rufous; labrum, palpi and antenna dark rufous. Pronotum and elytron with lateral margins piceous. Sterna 3 to 6 with hind margins narrowly piceous. Legs piceous with tarsi and trochanters slightly paler.

Head with moderately coarse, irregular reticulation: meshes smooth medially with few fine punctures, laterally behind eyes with evident secondary microreticulation. Pronotum with sculpture similar to that of head, but lines more shallowly impressed medially on disc, and deeper with meshes smaller laterally. Elytron coarsely reticulate (Fig. 281), lines deeply impressed and meshes granular, smaller than those on disc of pronotum, irregular in shape but more or less equal sized or slightly smaller laterally and toward apex; meshes with obsolete secondary microreticulation.

Clypeus with narrow anterior bead broadly broken medially. Pronotum (Fig. 134) with sides constricted in basal half,

distinctly sinuate before hind angles; lateral bead clearly defined almost to front angles, indistinctly delimited from disc at base. Prosternal process more or less flattened to smoothly and evenly convex in cross section, broadly pointed apically. Metasternum with anteromedial emargination shallow, not or barely extended to hind margin of mesocoxal cavities. Legs relatively slender. Metafemoral comb indistinctly developed. Metatibia with more or less complete row of small separated punctures along inner ventral margin; ventral medial series of punctures extended almost to apex. Metatarsal article 1 glabrous dorsally and ventrally. Tarsal claws long and slender.

Male articles 1 to 3 of pro- and mesotarsi slightly dilated beneath, with dense coating of adhesive setae. Anterior protarsal claw simple, slender, similar in shape to posterior. Aedeagus (Fig. 179) simple, tapered evenly to apex; apex slightly twisted to right.

*Taxonomic notes.* — The species *A. cordatus* LeConte and *A. bjorkmanae* Hatch are vicarious, their combined range extending over much of the western United States. The species *A. cordatus* occupies the Great Basin and ranges east to New Mexico and Colorado, while *A. bjorkmanae* has a more northern distribution. The two species are very similar in most features including the male genitalia (Fig. 179, 180), and are separated primarily on color (*cordatus* is paler) and shape of the pronotum which is more strongly constricted basally in *A. cordatus* specimens (Fig. 135). I examined several hundred specimens of the two species, noted that color and shape of the pronotum vary, but have not detected a geographical pattern nor evidence of hybridization. However, I have not seen specimens of either species from Montana or Wyoming, a geographically intermediate area, and an area in which intergradation would be most likely to occur.

*Natural history notes.* — Specimens of *A. bjorkmanae* occur in shallow water along the margins of foothill and mountain streams and less commonly, along lake shores but then usually near inlet or outlet streams. The insects are most frequently found under loose stones on bare gravel and clay often at the water's edge. The strongly cordate pronotum and habit of occurring under rocks along the edges of streams gives the impression of a very hygrophilous *Nebria*. Teneral specimens have been collected from August 10 to 29.

*Distribution.* — This species ranges from northern California (Leech and Chandler, 1956) to British Columbia (Hatch, 1956) and western Alberta. I examined 95 specimens from Alberta localities (map, Fig. 397).

#### *Agabus pseudoconfertus* Wallis, 1926

*Agabus pseudoconfertus* Wallis, 1926: 90. (Holotype — male, Winnipeg, Manitoba, June 11, 1924, J. B. Wallis, CNC.) — Leng and Mutchler 1933: 15. — Fall 1934: 171. — Leech 1937: 149. — Hatch 1953: 226. — Wallis 1973: 108.

*Agabus gelidus* Fall, 1926: 142. (Holotype — male, Fairbanks Alaska, July 7, 1924, H. C. Fall, USNM.) Not U. Sahlberg 1906. Brown 1932a: 5. — Leng and Mutchler 1933: 15. — Fall 1934: 171. — Leech 1937: 149.

*Description.* — Measurements and ratios of 20 Alberta specimens are: TL — 7.52 to 8.48 mm ( $\bar{X}$  = 8.11 ± 0.14 mm); MW — 4.00 to 4.56 mm ( $\bar{X}$  = 4.29 ± 0.13 mm); TL/MW — 1.83 to 1.94 ( $\bar{X}$  = 1.89 ± 0.03); WC/WS — 2.33 to 2.68 ( $\bar{X}$  = 2.52 ± 0.09).

Color black except following. Head with frontal spots, anterior margin of clypeus, frons above base of antenna, and labrum, rufous; antenna and palpi rufous, outer articles of most specimens without apical infuscation. Pronotum with lateral bead rufous. Scutellum piceous. Lateral margin of elytron piceous in apical half. Metacoxal process and posterior margins of abdominal sterna 3 to 6, rufous. Legs dark rufous, most specimens with femora and metatibiae somewhat darker.

Elytral sculpture of males and many females (Fig. 282) fine but clearly impressed lines in form of meshes of irregular shape and size, although size of meshes generally of about same magnitude; each intersection of lines with small puncture; many larger meshes with single small puncture; meshes with secondary reticulation, somewhat effaced on some specimens. Some females (Fig. 283) with meshes of head and pronotum with secondary reticulation, meshes of pronotum and elytron longitudinally stretched; elytron with spaces between lines (distinct meshes absent on basal half) with dense, more or less granular, reticulation; sculpture normal apically. Head with frons between eyes with relatively large coarse punctures, each situated medially in mesh.

Anterior margin of clypeus incomplete, broadly broken medially. Lateral margin of pronotum rounded, sides convergent in apical third; hind angle broadly rounded and obtuse; lateral bead broad and well defined throughout length. Prosternal process short, bluntly pointed apically; convex in cross section; apex deflected upward behind procoxae. Metasternum with anterior margin between mesocoxae slightly flattened or impressed, without distinct V-shaped medial impression and flattened area not extended to level of hind margin of mesocoxal cavity. Metatibia with posterior ventral margin with varied number of large scattered punctures; ventral face without micropunctuation. Metatarsal article 1 glabrous beneath.

Male articles 1 to 3 of pro- and mesotarsi narrowly dilated and with numerous small adhesive scales beneath: protarsal claws (Fig. 146) slender, simple; anterior claw shorter than posterior, ventral margin shallowly sinuate beneath. Abdominal sternum 6 with posterior medial area flattened, sternum laterally with short longitudinal rugae. Aedeagus (Fig. 181) simple, slender, apex not twisted laterally.

*Taxonomic notes.* — The species *A. pseudoconfertus* Wallis, *A. confertus* LeConte, *A. kenaiensis* Fall, *A. verisimilis* Brown and *A. vandykei* Leech form a very homogeneous group of moderate sized, parallel sided, black species of *Agabus*. All members are characterized by the following features: clypeus incompletely margined; prosternal process short, blunt, medially convex, apex deflected upwards behind procoxae; metasternum with anteromedial emargination between mesocoxal cavities obsolete, not extended posteriorly as V-shaped impression to level of hind margin of mesocoxal cavities. Males are characterized as follows: parameres normal, aedeagus simple and not twisted laterally; protarsi little modified; elytral sculpture more or less of uniform type, i.e., lines fine, with punctures situated in intersections, meshes with secondary reticulation.

Two of these species, *A. pseudoconfertus* and *A. kenaiensis*, are probably transcontinental in the boreal regions while the remaining three are restricted to western North America.

*Natural history notes.* — The habitat is poorly known because I collected few specimens, mostly along margins of small woodland pools, usually in mats of *Calamagrostis canadensis* Michx. stalks, or in some other flooded grass, and usually not associated with *Carex*. No records of flight or teneral specimens are available.

*Distribution.* — This species is probably transcontinental in boreal North America. I have seen specimens from Massachusetts (UASM), Manitoba (UASM), and British Columbia (CARR), and the species has been recorded from British Columbia, Washington and Alaska. I examined 33 specimens from Alberta localities (map, Fig. 398).

#### *Agabus kenaiensis* Fall, 1926

*Agabus kenaiensis* Fall, 1926: 141. (Type locality — Anchorage, Alaska.) — Brown 1930b: 236. — Brown 1932a: 5. — Leng and Mutchler 1933: 15. — Fall 1934: 171. — Hatch 1953: 225. — Anderson 1962: 70. — James 1970: 94. — Wallis 1973: 108.

*Agabus palustris* Wallis, 1926: 92. (Type locality — Onah, Manitoba.) — Leng and Mutchler 1933: 15.

*Diagnosis.* — Specimens look very much like small ones of *A. pseudoconfertus*. Characters presented in the key permit recognition of this species.

*Description.* — Measurements of 25 Alberta specimens are: TL — 5.92 to 6.40 mm ( $\bar{X} = 6.11 \pm 0.14$  mm); MW — 3.04 to 3.44 mm ( $\bar{X} = 3.21 \pm 0.11$  mm); TL/MW — 1.81 to 2.03 ( $\bar{X} = 1.90 \pm 0.05$ ); WC/WS — 2.27 to 2.83 ( $\bar{X} = 2.54 \pm 0.13$ ).

Body black except following. Head with frontal spots, anterior margin of clypeus, labrum, antenna and palpi, rufous. Pronotum with lateral bead and hind margin piceous. Scutellum piceous. Lateral margin of elytron piceous, at least on apical half. Prosternal process, metacoxal process and hind margins of abdominal sterna 3 to 6, rufous to piceous. Legs dark rufous to piceous (older preserved specimens or specimens kept in alcohol for some time tend to be considerably paler than indicated above).

Sculpture similar to that of *A. pseudoconfertus* but finer. Lines on elytron fine (Fig. 284), in form of moderate sized meshes of unequal shape but of similar size; fine punctures at intersections of lines and, on some specimens, in meshes; latter with fine secondary reticulation.

Clypeus with anterior bead broadly broken medially. Pronotum broad, sides broadly rounded in basal half, more or less straight and convergent anteriorly; hind angle broadly rounded and obtuse; lateral bead of moderate width, clearly defined and more or less equal in width throughout length, or narrowed slightly towards anterior angle. Prosternal process short, apex broadly pointed, deflected upward behind procoxae; ventral face with medial longitudinal convexity; setose laterally. Metasternum with anteromedial portion concave, without distinct V-shaped impression. Metatibia of most specimens with irregular series of punctures along basal half of posteroventral margin. Male sternum 6 slightly flattened medially, with few shallow longitudinal striae laterally; female sternum 6 smooth laterally.

Male with articles 1 to 3 of pro- and mesotarsi very slightly broadened, each article ventrally with group of golden adhesive scales; protarsal claws (Fig. 147) subequal in length, similar in shape, with anterior claw slightly broader. Aedeagus as in Figure 182.

*Natural history notes.* — Most specimens of *A. kenaiensis* were collected from small pools of

water situated in *Carex-Sphagnum* bogs, but also from tufts of *Carex* in cool, woodland pools, where *Sphagnum* mats were not present.

*Distribution.* — The species ranges from Ontario to the Northwest Territories (Providence, UC!) and Alaska. Northern and southern limits of its range are unknown but it is probably boreal for the most part. I examined 29 specimens from Alberta localities (map, Fig. 399).

*Agabus verisimilis* Brown, 1932

*Agabus verisimilis* Brown, 1932a: 4. (Holotype — ♂, Creston, British Columbia, April 21, 1930, G. Stace Smith No. 3237 CNC.) Leech 1942c: 130. — Hatch 1953: 226. — Anderson 1962: 70.

*Diagnosis.* — Small size, incomplete clypeal bead, short prosternal process and relatively low value for the ratio WC/WS characterize this species.

*Description.* — Measurements of 20 Alberta specimens are: TL — 5.84 to 7.04 mm ( $\bar{X} = 6.39 \pm 0.30$  mm); MW — 2.88 to 3.44 mm ( $\bar{X} = 3.31 \pm 0.17$  mm); TL/MW — 1.88 to 2.00 ( $\bar{X} = 1.93 \pm 0.03$ ); WC/WS — 1.63 to 1.96 ( $\bar{X} = 1.72 \pm 0.07$ ).

Color black except as follows. Head with frontal spots, frons above base of antenna, anterior margin of clypeus, labrum, antenna and palpi, rufous. Pronotum with lateral bead and disc narrowly inside of bead, rufous. Scutellum piceous. Lateral margin of elytron along lateral bead, piceous; epipleuron black internally, paler along outer margin. Prosternal process, metacoxal process and posterior margin of abdominal sterna 3 to 6, dark rufous. Legs rufous with pro- and mesocoxae basally, femora medially and dorsally, and metatibia, piceous to black.

Sculpture of elytron (Fig. 285) of fine lines in form of small meshes of irregular size and shape; lines with small punctures at many of the intersections; some meshes with small medial puncture; secondary reticulation on many specimens somewhat effaced on basal and medial portions of elytral disc.

Anterior margin of clypeus incomplete, broadly broken medially. Pronotum with side slightly but evenly arcuate throughout length, hind angle broadly rounded and obtuse. Elytra more or less parallel sided with greatest width behind middle. Prosternal process short, bluntly pointed, angularly convex in cross section. Metasternum slightly flattened between mesocoxal cavities but lacking distinct V-shaped impression for reception of apex of prosternal process. Metatibia posteroventral margin with one to several coarse punctures near middle and on some specimens few additional fine punctures near base and middle.

Male with articles 1 to 3 of pro- and mesotarsi feebly dilated; each with golden scales beneath. Protarsal claws (Fig. 148) slender, equal in length; anterior claw gradually and evenly narrowed to apex, posterior claw with slight ventral sinuation. Abdominal sternum 6 slightly flattened medially; laterally with few fine longitudinal striae. Male genitalia (Fig. 183) with paramere normal; aedeagus simple, slender, not twisted laterally.

*Taxonomic notes.* — This species is closely related to *A. vandykei* Leech (1942c, 129), which occurs in California and Oregon.

*Natural history notes.* — I collected adults from only two localities, both situated in coniferous forests of the subalpine zone of southwestern Alberta, from stands of *Carex* in shallow water of small spring-fed pools, partially shaded by willow and with bottoms of clay and soft organic silt.

*Distribution.* — The species *A. verisimilis* occurs in the Rocky Mountains from southeastern British Columbia and southwestern Alberta, south to Colorado (Gore Pass, CARR!) and Utah. I examined 20 specimens from Alberta localities (map, Fig. 400).

*Agabus hypomelas* Mannerheim, 1843

*Agabus hypomelas* Mannerheim, 1843: 221. (Type locality — Sitka, Alaska.) — Melsheimer 1853: 30. — LeConte 1863a: 17. — Gemminger and Harold 1868: 455. — Crotch 1873: 423. — Sharp 1882: 496. — Horn 1883: 281. — Leng 1920: 79. — Zimmermann 1920: 166. — Fall 1922: 13. — Fall 1926: 141. — Leech 1937: 148. — Leech 1942c: 130. — Leech 1945a: 78. — Hatch 1953: 218. — Anderson 1962: 68.

*Agabus irregularis* Mannerheim, 1853: 159. (Type locality — Kenai Peninsula.) — LeConte 1863a: 17. — Gemminger and Harold 1868: 455. — Sharp 1882: 753. — Leech 1937: 149. — Hatch 1938: 146. — Leech 1942c: 130. — Leech 1945a: 78.

*Diagnosis.* — The incomplete clypeal bead, almost right angled hind angles of the pronotum, short prosternal process, and characteristic elytral sculpture define this species.

*Description.* — Measurements of six Alberta specimens are: TL — 6.48 to 6.96 mm ( $\bar{X} = 6.79 \pm 0.19$  mm); MW — 3.36 to 3.76 mm ( $\bar{X} = 3.58 \pm 0.14$  mm); TL/MW — 1.85 to 1.93 ( $\bar{X} = 1.90 \pm 0.03$ ); WC/WS — 1.83 to 2.25 ( $\bar{X} = 2.09 \pm 0.15$ ).

Dorsal surface piceous to black, some specimens with faint metallic or brassy sheen. Head with frontal spots, frons above base of antennae, anterior half of clypeus, labrum, and palpi, rufous; antenna rufous with articles 9 or 10 to 11 infuscate

apically. Pronotum with lateral bead and disc broadly inside of bead, rufous; hind angle dark, pale area extended inwards on disc anteriorly and front angle entirely pale. Elytron with lateral bead and outer margin of epipleuron rufous, darkened dorsally on disc. Ventral surface black with prosternal process, metacoxal process and posterior margins of sterna 3 to 6, rufous. Legs rufous with femora, at least medially, and coxae basally, piceous or black.

Elytron with lines of sculpture fine, numerous and in form of small irregular sized and shaped meshes; intersections of many lines with small deep punctures clearly visible. Meshes with suggested rugosity but without definite secondary reticulation.

Clypeus with anterior bead broadly interrupted medially. Head very broad, almost as wide as pronotum. Pronotum with lateral margin slightly arcuate anteriorly, almost straight with sides more or less parallel posteriorly; hind angle with apex narrowly rounded but more or less right angled; lateral bead narrow but well defined. Prosternal process short, with apex broadly pointed; smoothly convex in cross section without definite medial longitudinal ridge; smooth and shiny, sparsely punctate laterally; in more or less same plane as prosternum. Metasternum with short rounded depression between mesocoxae, hind margin of depression not extended to level of hind margin of mesocoxal cavities. Metatibia with irregular series of coarse punctures along posteroventral margin.

Male with articles 1 to 3 of pro- and mesotarsi slightly broadened, each article ventrally with golden adhesive scales. Pro-tarsal claws (Fig. 149) similar in shape, anterior claw very slightly longer and broader. Sternum 6 not or slightly flattened medially, with number of short irregular longitudinal striae along hind margin. Aedeagus and paramere as in Figure 184.

*Taxonomic notes.* — Leech (1937) recognized two subspecies of *A. hypomelas*: *A. h. irregularis* Mannerheim, ranging in the Aleutian Islands and along the Alaskan coast south to Yakutat Bay; and *A. h. hypomelas* which ranges from the southern end of the distribution of *A. irregularis* to Washington, the southern interior of British Columbia and Utah. Alberta specimens belong to the southern, nominate subspecies.

The Pacific Coast species, *A. vancouverensis* Leech, is similar to *A. hypomelas* but differs in larger size, metasternal sulcus more rudimentary, and in form of the male genitalia and ovipositor.

*Natural history notes.* — J. Carr collected this species in two Alberta localities, in subalpine coniferous forests. Teneral specimens have been collected on Aug. 13.

*Distribution.* — (see above under Taxonomic notes.) In Alberta the species is known only from the southwestern portion of the province. I examined six specimens (map, Fig. 401).

#### *Agabus erichsoni* Gemminger and Harold, 1868

*Agabus erichsoni* Gemminger and Harold, 1868: 454. (New name for *nigroaeneus* Erichson.) Wickham 1895b: 120. — Poppius 1910: 348. — Zimmermann 1919: 212. — Leech 1939: 218. — J. Balfour-Browne 1948: 160. — Hatch 1953: 227. — Anderson 1962: 69. — James 1970: 93. — Wallis 1973: 108.

*Agabus nigroaeneus* Erichson, 1837: 157. (Type locality — Berlin.) Not Marsham, 1802. Sharp 1882: 529. — Horn 1883: 279. — Carr 1920: 4. — Leng 1920: 79. — Zimmermann 1920: 169. — Fall 1922: 32. — Fall 1924: 141. — Brown 1930b: 236. — Brown 1931: 116. — Zimmermann 1934: 189. — Leech 1938a: 127. — P. Zaitsev 1953: 236.

*Gaurodytes lutosus* Crotch, 1873: 419. (Type locality — not designated.) Not LeConte, 1853. Sharp 1882: 776.

*Diagnosis.* — Large size, sinuate anterior lateral angles of the pronotum and presence of coarse punctures on the dorsomedial surface of the basal three metatarsal articles permit the ready recognition of this species.

*Description.* — Measurements of 20 specimens from Kananaskis Lakes, Alberta, are: TL — 8.88 to 10.56 mm ( $\bar{X}$  = 10.23 ± 0.46 mm); MW — 4.72 to 5.76 mm ( $\bar{X}$  = 5.45 ± 0.72 mm); TL/MW — 1.81 to 1.92 ( $\bar{X}$  = 1.88 ± 0.03); WC/WS — 1.81 to 2.18 ( $\bar{X}$  = 1.97 ± 0.13). The species shows some geographical variation in size, with northern specimens tending to be slightly larger than those from the southwestern portion of the province. For example, TL for 20 specimens from Rycroft (ten of each sex) is: 10.24 to 11.04 mm ( $\bar{X}$  = 10.54 ± 0.24 mm).

Color black except as follows. Head with two small spots on frons between eyes, anterior margin of clypeus, labrum, antenna and palpi, rufous. Pronotum with lateral margin rufous to piceous, basal margin piceous. Elytron with lateral margin rufous to piceous; epipleuron dark internally, paler piceous to rufous externally. Abdominal sterna with apical margins piceous. Front and middle legs rufous with femora, and on many specimens also tibiae, piceous, at least medially; hind legs piceous to black with apex of femur and tibia, trochanter and tarsal articles, rufopiceous.

Elytron with sculpture (Fig. 286) similar in both sexes, of clearly impressed lines in form of small irregularly shaped meshes; with fine rugosity or microreticulation on basomedial area of disc with some tendency towards longitudinal stretching, less pronounced laterally and apically.

Clypeus with narrow anterior margin at sides only, broadly interrupted medially. Pronotum (Fig. 136) with lateral bead well defined throughout most of length, but ended behind front angle; front angle with lateral sinuation. Prosternal process strongly but smoothly convex in cross section, not carinate medially. Metasternal wing broad. Metatibia with more or less

complete row of punctures along inner ventral margin; medioventral face with series of smaller punctures extended entire length. Metatarsal articles 1 to 3 or 4 broadly concave along outer dorsal surface in male, less distinctly so in female; articles 1 and 2 and on some specimens also 3 and 4, each with one or two large mediodorsal setiferous punctures. Metatarsal claws very short (about one quarter length of metatarsal article 5), subequal in length or inner claw slightly broader and less arcuate. Sternum 6 of male longitudinally striate: obscurely rugose on female.

Male with anterior protarsal claw (Fig. 150) swollen basally, posterior basal margin with distinct ventral sinus, slightly longer than narrow, sinuate posterior claw; articles 1 to 3 of pro- and mesotarsus narrowly dilated, with, in total, eight to ten irregular transverse rows of small elongate scales on ventral surface. Male genitalia with aedeagus and paramere as in Fig. 186.

*Natural history notes.* — This is one of the most common species of *Agabus* in the forested portions of the province. Almost every collection made in emergent *Carex* or flooded grasses along margins of both temporary or permanent ponds, yielded adults. Many teneral specimens have been collected from July 7 to August 3 while all specimens collected in the spring have been mature, indicating that they have overwintered as adults. However, James (1970) records eggs of this species overwintering in Ontario, and provides a very detailed description of the larva.

*Distribution.* — This species has a wide range across the northern portions of Europe, Asia and North America. Specimens have been collected throughout the forested portions of Alberta with the exception of the Cypress Hills. I examined more than 500 specimens (map, Fig. 402).

#### *Agabus semipunctatus* (Kirby, 1837)

*Colymbetes semipunctatus* Kirby, 1837: 69. (Type — male in BMNH labelled as follows: Type H.T.; ♂; N. Amer. ♀, 5772a; *A. semipunctatus* Kirby.) LeConte 1850: 214. — Mannerheim 1853: 158. — Melsheimer 1853: 30. — LeConte 1863a: 17. — Gemminger and Harold 1868: 456. — Crotch 1873: 417. — Horn 1883: 282. — Wickham 1895b: 120. — Blatchley 1910: 227. — Carr 1920: 4. — Zimmermann 1920: 171. — Fall 1922: 18. — Brown 1937: 109. — Leech 1939: 220. — Hatch 1953: 220. — Wallis 1973: 108.

*Agabus stridulator* Sharp, 1882: 509. (Type locality — Hudson Bay, Canada.) Wickham 1895b: 120. — Fall 1922: 18. — Leech 1939: 220.

*Agabus stridulatus* Zimmermann, 1920: 173.

*Diagnosis.* — A small black species characterized by elytral sculpture of small rounded more or less equal sized meshes, short prosternal process, toothed anterior protarsal claw of the male, and a “stridulatory file” on sternum 3 of the male.

*Description.* — Measurements of 20 specimens from Winchell Coulee near Water Valley, Alberta, are: TL — 5.84 to 6.80 mm ( $\bar{X} = 6.37 \pm 0.22$  mm); MW — 3.00 to 3.44 mm ( $\bar{X} = 3.25 \pm 0.12$  mm); TL/MW — 1.88 to 2.00 ( $\bar{X} = 1.96 \pm 0.03$ ); WC/WS — 2.27 to 2.65 ( $\bar{X} = 2.47 \pm 0.09$ ).

Body black except as follows. Head with frontal spots and labrum, dark rufous; antenna rufous, articles 4 or 5 to 11 lightly infuscate on many specimens, apical half of article 11 piceous; palpi rufous, apical half of terminal article of each palpus, piceous. Pronotum, and on some specimens also elytron, with lateral margin, piceous; epipleuron black; clytron with medial sublateral and subapical depigmented spot (on many specimens spots visible only when elytron is raised). Apex of metacoxal process and apical margins of abdominal sterna 3 to 6, piceous. Legs piceous to black except trochanters, at least apices of femora and tibia, and tarsi, rufous.

Sculpture of head and pronotum small meshes irregular in size and shape; meshes smooth or with suggestion of obsolete secondary reticulation, best seen laterally on pronotum; many intersections of lines with small punctures. Elytron with sculpture fine (Fig. 287), meshes irregular in size and shape basomedially, laterally and apically finer, more or less rounded and generally of equal size but interspaced with some larger more or less rectangular meshes; some intersection of lines with punctures.

Clypeus with anterior margin complete. Lateral bead of pronotum moderate in width, about 0.66 to 0.75 width of apex of antennal article 3, narrowing gradually towards front angles. Prosternal process short, strongly but smoothly and evenly convex in cross section. Metasternum with anteromedial emargination short, not extended to level of hind margin of mesocoxae. Metatibia with punctures along posteroventral margin, punctures on basal 0.5 to 0.66 or on some specimens reaching almost to apex; ventral face of metatibia without micropunctation. Metatarsal article 1 glabrous beneath or occasional specimen with 1 or 2 setae. Tarsal claws short.

Male with pro- and mesotarsal articles 1 to 3 slightly dilated (ratio protarsal article 1/article 4 — 1.5 to 1.8); anterior protarsal claw (Fig. 151) with large ventral tooth. Sternum 3 mediolaterally with series of short closely spaced curved longitudinal ridges (presumably file of stridulatory organ with plectrum represented by sharp anterior dorsal margin of metafemur). Paramere normal; aedeagus (Fig. 185) ridged along ventral apical margin.

*Taxonomic notes.* — Males of three Old World species, *A. biguttulus* Thomson, *A. affinis* Paykull and *A. unguicularis* Thomson and the Nearctic species *A. velox* Leech, have the same form of stridulatory organ as *A. semipunctatus*. In the Alberta fauna, *A. falli* is probably the most closely related species.

Variation is exhibited by this species. The only specimens seen with setae on the ventral surface of metatarsal article 1 were collected in southwestern Alberta. A single specimen from Waterton National Park (a female) possesses coarser, more irregular elytral sculpture than does any other specimen seen by me, and also lacks the preapical depigmented elytral spot.

*Natural history notes.* — This species lives in cold *Carex*-choked water in the forested parts of the province, often in, but not restricted to, *Sphagnum* bogs. I have seen a single teneral specimen (July 7).

*Distribution.* — The species *A. semipunctatus* is transcontinental in the forested northern portion of North America. The southern and northern limits are unknown. Blatchley (1910) recorded it from Indiana and I have seen specimens from Deep Bay, Great Slave Lake (UC). In Alberta, this species occurs throughout much of the forested area with the exception of the Cypress Hills and higher elevations in the Rocky Mountains. I examined more than 290 specimens from Alberta localities (map, Fig. 403).

#### *Agabus falli* (Zimmermann, 1934)

*Gaurodytes falli* Zimmermann, 1934: 186. (New name for *A. sharpi* Fall, not Jakobs.) Hatch 1953: 220. — Carr and Leech 1966: 546. — Wallis 1973: 107.

*Agabus sharpi* Fall, 1922: 19. (Type locality — Winnipeg, Manitoba.) Not Jakobs., 1908. Leng and Mutchler 1927: 17. — James 1970: 93.

*Agabus semipunctatus* Sharp, 1882: 507, not Kirby, 1837.

*Diagnosis.* — Adults are moderate sized, and convex, black in color with distinctive elytral sculpture, and very broad pronotal bead. The male is characterized by a toothed anterior protarsal claw and “stridulatory organ” consisting of a ridge along the suture between sterna 2 and 3 and a file on the anterodorsal margin of the metafemur (Larson and Pritchard, 1974).

*Description.* — Measurements and ratios on 20 Alberta specimens are: TL — 6.56 to 7.60 mm ( $\bar{X} = 7.17 \pm 0.25$  mm); MW — 3.28 to 3.88 mm ( $\bar{X} = 3.65 \pm 0.14$  mm); TL/MW — 1.91 to 2.00 ( $\bar{X} = 1.97 \pm 0.03$ ); WC/WS — 2.20 to 2.90 ( $\bar{X} = 2.50 \pm 0.15$ ).

Color piceous to black. Head with frontal spots, anterior margin of clypeus, and labrum, rufous; antenna light rufous, articles 4 or 5 to 10 infusate apically on most specimens, article 11 with apical half piceous to black; palpi rufous. Pronotum with lateral bead and margin inside of bead, rufous. Elytron with lateral margin rufous to piceous, epipleuron piceous. Ventral surface of body black; prosternal process, metacoxal process and hind margins of sterna 3 to 6, piceous. Legs dark rufous, except femora and metatibiae somewhat darker.

Sculpture of head of very irregular small to moderate sized meshes with scattered punctures both in lines and on interspaces, otherwise meshes smooth and shiny. Pronotum with lines of sculpture less dense than on head, meshes larger but very irregular in size and shape medially, smaller and more regular laterally. Scattered small punctures usually at intersections of lines; meshes smooth or with indication of obsolete secondary sculpture. Elytron (Fig. 288) with meshes of small to moderate size, irregular in shape, on many specimens smallest laterally and apically; meshes smooth; small punctures present, usually situated at intersections of lines.

Clypeus with anterior margin variously developed, complete or in some specimens broken at middle. Lateral bead of pronotum very broad, subequal in width to apex of antennal article 3. Prosternal process broad, evenly to subangularly convex; bluntly pointed apically; sparsely setose laterally. Anteromedial metasternal emargination almost or extended to hind margin of mesocoxal cavities. Metatibia with large punctures along posteroventral margin, extended to or almost to apex; medioventral face smooth, with basal series of punctures reduced. Metatarsal article 1 glabrous ventrally.

Male with articles 1 to 3 of front and middle tarsi dilated (width protarsal article 1/width article 4 — 1.6 to 2.0 ( $\bar{X} = 1.8$ )), with small oval scales beneath; protarsal claws subequal, short; anterior claw (Fig. 152) with a ventral tooth. Male with posterior margin of meso- and metafemora with sparse brush of short, erect, golden setae. Abdominal sternum 3 without stridulatory organ, segment 2 excavate laterally and produced into low but sharp ridge along posterior margin; anterior dorsal edge of metafemur with file comprised of series of shallow closely spaced transverse striae. Aedeagus (Fig. 187) simple, apex slightly bent to right with short longitudinal ventral ridge.

*Taxonomic notes.* — In the Alberta fauna, *A. falli* most closely resembles the species *semipunctatus*

in habitus, and in the structure of the male protarsus. However, the male stridulatory organ, aedeagus and setae on the ventral margin of the pro- and mesofemora indicate a relationship with the eastern species *aeruginosus* and *punctatus*.

*Natural history notes.* — A description of a habitat in which specimens of *A. falli* have been collected, is given by Carr and Leech (1966). James (1970) includes *A. falli* in his list of woodland species. I collected specimens from temporary ponds located in both aspen parkland and fescue grassland.

*Distribution.* — This species occurs from Ontario to northeastern British Columbia. The northern and southern limits are unknown. In Alberta, it has been taken from the United States border north to the Peace River area. I examined 42 specimens from Alberta localities (map, Fig. 404).

#### *Agabus triton* Fall, 1922

*Agabus triton* Fall, 1922: 17. (Type locality — Edmonton, Alberta.) Leng and Mutchler 1927: 17. — Carr and Leech 1966: 546. — Wallis 1973: 106.

*Diagnosis.* — Broadly oval shape, broad lateral bead of the pronotum abruptly truncated near the anterior angle, and spatulate anterior protarsal claw of the male, make this one of the most distinctive species of *Agabus* in the Alberta fauna.

*Description.* — Measurements and ratios of 20 specimens collected eight miles west of Calgary, are: TL — 6.56 to 7.60 mm ( $\bar{X} = 7.15 \pm 0.25$  mm); MW — 3.68 to 4.08 mm ( $\bar{X} = 4.04 \pm 0.15$  mm); TL/MW — 1.73 to 1.80 ( $\bar{X} = 1.77 \pm 0.02$ ); WC/WS — 1.90 to 2.17 ( $\bar{X} = 2.04 \pm 0.08$ ).

Head piceous; clypeus and frontal spots rufous; antenna pale with at least apex of article 11 infuscate; palpi rufous, terminal article of each palpus infuscate. Pronotum with disc piceous, lateral margin broadly rufous. Elytron brown, disc darkened medially; epipleuron piceous with outer basal margin rufous. Legs rufous except meso- and metafemora of some specimens somewhat darker.

Elytron with sculpture as in Figure 289: lines shallowly but distinctly impressed, in form of moderate sized meshes of unequal sizes and various shapes; small punctures at intersections of lines and, less frequently, medially on meshes.

Anterior bead of clypeus complete or broken medially. Lateral bead of pronotum very broad, slightly narrowed anteriorly and ended shortly behind anterolateral angle, abruptly sinuate at front angle (Fig. 137). Prosternal process strongly convex, sparsely setose. Metatibia with series of large punctures along posteroventral margin extended into at least apical half and on many specimens extending entire length of metatibia.

Male articles 1 to 3 of pro- and mesotarsi dilated, and with small oval scales on ventral surface. Anterior protarsal claw (Fig. 153) subequal in length to posterior, broadly dilated ventrally, apex obliquely truncate. Aedeagus (Fig. 188) very long and slender, apex twisted to right.

*Taxonomic notes.* — This and the preceding species (*A. falli*) differ from most of the others by marked intraspecific variation in development of the anterior bead of the clypeus. The bead varies from complete development and traceable across the entire anterior margin of the clypeus, to widely discontinuous medially.

*Natural history notes.* — Specimens of *A. triton* are common in a series of small aspen- and willow-ringed temporary ponds situated in rolling moraine about eight miles west of Calgary. These ponds are, for the most part, less than 18 inches deep following snowmelt, and are usually dry by mid-summer. Much of the surface area is covered by mats of decaying *Carex* and grass stalks in the early spring, followed later by dense emergent growth. Adult beetles are active very early in the spring, and were collected before the ice on the ponds has completely melted and while melting snowbanks were still feeding the ponds. Wallis (1973) also records *A. triton* as an early spring species in Manitoba.

Although ponds fitting the above description are common in the area west of Calgary, specimens of *A. triton* have been collected only from the relatively few undisturbed by overgrazing of livestock.

Teneral specimens were collected June 13 and 25 in Alberta, and June 26 in Manitoba, suggesting that the life cycle is completed by late spring or early summer.



*Distribution.* — This species is known only from Alberta and Manitoba. Alberta localities, from which 103 specimens have been collected, are indicated in Figure 405.

*Agabus margareti* new species

Holotype male and allotype female, ¼ mile south Little Fish Lake Provincial Park, Hand Hills, Alberta; May 2, 1971; D. & M. Larson (CNC).

Paratypes — all other specimens of this species examined are so designated (see below for list of localities). (CARR, CAS, CNC and UASM).

*Description.* — Measurements of eight specimens (5 males, 3 females) are: TL — 5.44 to 6.00 mm ( $\bar{X} = 5.70 \pm 0.16$  mm); MW — 3.04 to 3.44 mm ( $\bar{X} = 3.15 \pm 0.13$  mm); TL/MW — 1.73 to 1.87 ( $\bar{X} = 1.81 \pm 0.05$ ); WC/WS — 1.91 to 3.31 ( $\bar{X} = 2.10 \pm 0.12$ ).

Color black except following. Head with frontal spots, anterior margin of clypeus, and labrum, rufous; antenna testaceous with outer articles infusate on some specimens; palpi testaceous. Pronotum with lateral margin broadly rufous to piceous, posterior margin piceous. Elytron with lateral margin and epipleuron dark rufous to piceous; disc without defined pale spots. Prosternal process, metacoxal process and hind margin of sterna 3 to 6, dark rufous to piceous (in some specimens, elytron, metasternal wings and sternum 1, piceous). Legs dark rufous except meso- and metafemora somewhat infusate on some specimens.

Sculpture of head of fine lines in form of meshes very irregular in size and shape (some specimens with lines shallowly impressed and partially effaced medially on frons); punctation varied, some specimens almost impunctate, others with distinct though small punctures situated mainly on intersections of lines: meshes smooth and shiny. Pronotum with sculpture similar but lines finer with punctation more distinct. Elytron (Fig. 290) with meshes irregular in size and shape, largest basally, smaller toward apex; meshes smooth and shiny, slightly larger on male than on female but otherwise similar on both sexes; punctures limited to intersections of lines.

Clypeus with anterior bead complete but fine. Pronotum with lateral bead broad, at widest point subequal in width to width of apex of antennal article 3. Prosternum broadly angulate medially; prosternal process strongly convex but rounded in cross section; smooth and glabrous medially. Metasternum with anteromedial emargination narrow, not or barely extended to level of posterior margin of mesocoxal cavities. Metatibia with row (in some irregular) of large punctures along posteroventral margin: medioventral face with punctures in basal 1/2 to 2/3, otherwise ventral face smooth, without micropunctation. Metatarsal article 1 glabrous ventrally. Tarsal claws very short, those of mesotarsus subequal in length to mesotarsal article 4. Stridulatory organs absent.

Male with articles 1 to 3 of pro- and mesotarsus very slightly dilated; extreme apex of articles 1 and articles 2 and 3 with few scattered small oval scales; protarsal article 5 with anterior ventral margin slightly produced, in form of small external apical ridge; anterior protarsal claw (Fig. 154) slightly longer than posterior, with small, very blunt, ventral tooth. Male genitalia as in Figure 192: aedeagus short, basal piece very large, apex slender and straight; paramere strongly sclerotized, rod-like, with dense brush of long black setae at apex.

*Taxonomic notes.* — On the basis of habitus, microsculpture and weakly toothed anterior protarsal claw of males, this species shows affinities with both *A. punctulatus* and *A. semipunctatus*. However, the short aedeagus and the peculiar paramere is totally unlike anything found in other species of the genus. Because of this, the species appears to occupy a rather isolated position.

*Etymology.* — The trivial epithet is based on the given name of my wife, Margaret, who collected the holotype.

*Natural history notes.* — Specimens were collected only in the early spring, when they were found uncommonly in flooded and emergent vegetation along margins of small temporary prairie ponds, usually in association with the much more abundant species *A. punctulatus* and are generally identified as small dark colored males of that species. These insects are most frequently in water on undisturbed prairie and the presence of cattle and their associated effects of trampling, removal of vegetation and deposition of manure in the water, appear inimical to this species. The scarcity of this species in collections may reflect scarcity of prairie ponds undisturbed by livestock. All specimens examined have been collected between April 18 and June 3. None are teneral.

*Distribution.* — The species is known only from Alberta (Fig. 406). Specimens from the following localities have been labelled as paratypes.

Onefour Research Station (male, May 12, 1972, UC); 5 mi W Onefour Research Station (female, May 12, 1972, UC); Tp. 6 Rge. 2 W 4 (male, May 12, 1972, UC); Tp. 9 Rge 3 W 4 (male, May 19, 1970, CARR); Medicine Hat (male, April 18, 1925,

F. Carr, UASM); Medicine Hat (female, June 3, 1956, CARR); Hwy. 41, 10 mi N Medicine Hat (male, May 24, 1970, UC); 12 mi SW Empress (male, May 24, 1970, UC); 18 mi S Magrath (female, May 9, 1970, UC).

*Agabus punctulatus* Aubé, 1838

*Agabus punctulatus* Aubé, 1838: 332. (Type locality – "l'Amerique du Nord"). Melsheimer 1853: 30. – LeConte 1863a: 17. – Gemminger and Harold 1868: 456. – Zimmermann 1920: 171. – Fall 1922: 17. – Brown 1932b: 201. – Leech 1938a: 126. – Leech 1949a: 247. – Hatch 1953: 219. – Anderson 1962: 68. – Gordon and Post 1965: 19. – Wallis 1973: 106.

*Gaurodytes aeneolus* Crotch, 1873: 421. (Type locality – not specified, specimens from Pennsylvania and Newfoundland.) Sharp 1882: 507. – Zimmermann 1920: 155.

**Diagnosis.** – The combination of small size, aeneous sheen of the dorsal surface and toothed anterior protarsal claw of the male, separates this species from all other Alberta species of *Agabus* except for *A. pisobius*. On specimens of the latter, the suture between abdominal sterna 2 and 3 is raised into a fine carina, a modification absent from specimens of *A. punctulatus*.

**Description.** – Measurements of 30 specimens from Southern Alberta, are: TL – 5.60 to 6.40 mm ( $\bar{X}$  = 6.04 ± 0.19 mm); MW – 3.04 to 3.52 mm ( $\bar{X}$  = 3.30 ± 0.14 mm); TL/MW – 1.73 to 1.89 ( $\bar{X}$  = 1.82 ± 0.04); WC/WS – 2.45 to 1.89 ( $\bar{X}$  = 2.68 ± 0.09).

Color of dorsal surface dark rufous to piceous, almost black in some males; most specimens with faint aeneous sheen. Head with frontal spots, anterior portion of clypeus and labrum, rufous; antenna testaceous basally, outer articles light rufous and infusate apically; palpi testaceous, terminal article of each palpus infusate apically; ventral surface of head rufous to rufopiceous. Pronotum with lateral margins rufous. Elytron with epipleuron and lateral margin rufous, disc darkened medially. Ventral surface piceous with prosternum and its process, metasternum medially, metacoxal process and posterior margin of abdominal sterna 3 to 6, rufous. Legs rufous.

Sculpture of frons medially of meshes irregular in shape and size, more even in size laterally, smooth or with very fine sparse punctation; lines with small punctures situated primarily in intersections. Pronotum with sculpture similar to that of head but lines lightly impressed medially on disc, deepened laterally; punctation in lines more conspicuous than on head. Elytron of male (Fig. 291) with meshes slightly smaller than those on pronotum, irregular in size and shape and without definite pattern of orientation; meshes smaller and more regular laterally and apically, finely punctate basomedially, smooth or on some specimens with suggestion of obsolete secondary reticulation; lines with deep conspicuous punctures in intersections. Female (Fig. 292) with some meshes in basomedial area longitudinally oriented, laterally and apically more rounded and irregular; meshes on most specimens with secondary microreticulation; lines of primary sculpture with scattered punctures at intersections, punctures somewhat inconspicuous on coarsely sculptured individuals. (Degree of longitudinal stretching of primary meshes varies considerably; however, almost all specimens show some tendency towards longitudinal arrangement of meshes on basomedial portion of the elytron.)

Clypeus with fine but complete anterior margin. Pronotum with lateral bead of moderate width, about 0.5 maximum width of antennal article 3: complete but slightly narrowed toward front angle. Mesotarsal claws longer than mesotarsal article 4. Metatibia with irregular row of setiferous punctures along at least basal 1/2 to 2/3 of posteroventral margin; ventral face with numerous small shallow punctures, almost indiscernible on some specimens. Inner metatibial spur subequal in length to metatarsal article 1. Metatarsal article 1 with from 1 to 5 or 6 inner ventral setae.

Male with articles 1 to 3 of pro- and mesotarsus distinctly dilated, ventral surface of apical half of articles 1, and articles 2 and 3, with numerous small oval scales; article 5 unmodified. Anterior protarsal claw (Fig. 155) slightly longer than posterior, with acute more or less distally directed tooth. Aedeagus (Fig. 189) with basal piece very large; apex strongly twisted to right; median groove open for entire length in ventral view, not covered near middle by extension of left side of aedeagus: paramere normal, fringed apically with golden setae.

**Taxonomic notes.** – Alberta specimens vary considerably in color, sculpture and development of setae on the metatibia, but a geographical pattern is not evident.

**Natural history notes.** – These beetles are common in temporary prairie melt ponds among flooded grasses or emergent vegetation and also in shallow areas of larger permanent ponds where vegetation is dense. This is one of the first species of dytiscids to be found in the spring, and specimens copulated in the shallow layer of water covering the ice of a still frozen roadside pond on April 4, 1971. Teneral specimens were collected from June 16 to August 8, with the majority being taken during July.

**Distribution.** – This species ranges from New England to Arizona and Colorado, and north to Alberta. Hatch (1953) records *A. punctulatus* from northeastern Washington, but it is largely replaced by *A. oblongulus* Fall and *A. pisobius* Leech west of the Rocky Mountains. The species

occurs throughout the prairie and southern parkland areas of Alberta and is perhaps isolated in the Peace River area. I examined 346 specimens from Alberta localities (map, Fig. 407).

*Agabus pisobius* Leech, 1949

*Agabus pisobius* Leech, 1949a: 246. (Type locality – Creston, B. C., 2000 feet, Holotype in CAS, No. 6153 (type not seen.) Hatch 1953: 219.

*Diagnosis.* – Similar to *A. punctulatus* but the elytral microsculpture does not show sexual dimorphism, and both sexes possess a “stridulatory organ” formed from sterna 2 and 3 and the anterodorsal margin of the metafemur (Larson and Pritchard, 1974).

*Description.* – Measurements of 12 Alberta specimens (six of each sex) are: TL – 5.68 to 6.32 mm ( $\bar{X} = 6.04 \pm 0.16$  mm); MW – 3.04 to 3.28 mm ( $\bar{X} = 3.15 \pm 0.08$  mm); TL/MW – 1.87 to 1.97 ( $\bar{X} = 1.92 \pm 0.04$ ); WC/WS – 2.55 to 2.94 ( $\bar{X} = 2.72 \pm 0.12$ ).

Color piceous to black with dorsal surface faintly aeneous. Head with anterior margin and frontal spots (indistinct in many specimens), rufous: antenna pale rufous, outer articles lightly infuscate apically; palpi pale rufous with apex of terminal article of each palpus, lightly infuscated. Pronotum and elytron with lateral margin rufous. Epipleuron rufous. Elytron with small subapical depigmented spot (on some specimens visible only when elytron is lifted). Prosternum, prosternal process, metasternum medially, metacoxal process and the posterior margins of sterna 3 to 6, rufous. Legs rufous except femora more or less infuscate medially.

Head with sculpture of meshes irregular in size and shape; meshes with small sparse punctures, otherwise smooth and shiny; scattered somewhat obscure punctures in lines, primarily at intersections. Pronotum with lines finely impressed, meshes largest medially on disc, smaller laterally, with strong longitudinal orientation basomedially, irregular elsewhere on disc. Elytron with sculpture (Fig. 293) similar to pronotum but lines more deeply impressed, punctures at intersections of lines distinct; meshes irregular in size and shape, without definite orientation, or on some females with slight tendency for longitudinal arrangement of larger meshes in basomedial region of elytron; meshes smooth, without secondary reticulation, or at most with secondary sculpture suggested towards apex.

Clypeus with anterior margin finely and completely margined. Pronotum with lateral bead narrow, about 0.5 width of apex of antennal article 3, not or only slightly narrowed toward front angle. Prosternal process narrow, strongly and evenly convex; sparsely setose laterally. Metafemur with posteroapical angle somewhat produced. Metatibia with posteroventral series of punctures extended to at least middle, and on many specimens, almost to apex, medioventral face smooth or with sparse very shallow micropunctuation. Metatarsal article 1 glabrous beneath. Suture between sterna 2 and 3 raised laterally into low sharp ridge; metafemur with anterior dorsal margin cut by numerous small transverse grooves in form of file.

Male with articles 1 to 3 of pro- and mesotarsus moderately dilated (ratio width article 1/width article 4 = 1.50 to 1.75), with small oval scales beneath. Anterior protarsal claw (Fig. 156) with ventral tooth, located more basally than that of *punctulatus* Aubé; apex of tooth directed at an angle away from the longitudinal axis of the claw. Aedeagus (Fig. 191) with basal piece large, apex strongly twisted to right, ventral groove covered dorsally near middle by extension of left side.

*Natural history notes.* – In a locality 4 miles north of Lundbreck, adults were collected from a small reservoir formed by damming of a runoff creek. They were in shallow warm water at the point where the stream entered the pond in water four inches deep and choked with emergent or flooded grasses, *Juncus* sp., *Sagittaria* sp. and detritus. The closely related species, *A. punctulatus*, though widely distributed in southwestern Alberta, was not taken from this pond. Teneral specimens were collected July 6 and 12.

*Distribution.* – Leech (1949) recorded *A. pisobius* from southeastern British Columbia, eastern Washington and Idaho. In Alberta, *A. pisobius* is known only from the vicinity of the Crowsnest Pass. I examined 14 specimens from Alberta localities (map, Fig. 408).

*Agabus austinii* Sharp, 1882

*Agabus austinii* Sharp, 1882: 516. (Lectotype (here selected), male in BMNH labelled as follows: *Agabus austinii* ♂ Crotch fide LeConte, Utah 792: Sharp Coll. 1905 – 313; Type 792 *Agabus austinii*.) – Fall 1922: 20. – Hatch 1933b: 11. – LaRivers 1951: 403. – Hatch 1953: 221. – Leech and Chandler 1956: 320. – Anderson 1962: 69.

*Gaurodytes austinii* LeConte, 1878: 466, (nomen nudum).

*Description.* – Measurements of 20 specimens from localities in the Crowsnest Pass, Alberta, are: TL – 7.92 to 9.04 mm ( $\bar{X} = 8.53 \pm 0.28$  mm); MW – 4.08 to 4.72 mm ( $\bar{X} = 4.41 \pm 0.16$  mm); TL/MW – 1.88 to 1.96 ( $\bar{X} = 1.94 \pm 0.02$ ); WC/WS – 3.09 to 3.80 ( $\bar{X} = 3.44 \pm 0.18$ ).

Color of dorsal surface, brown to piceous. Anterior margin of head, frontal spots, lateral margins of pronotum and elytron,

and epipleuron, testaceous to pale brown. Labrum and mouthparts rufous. Antenna testaceous, article 11 and in some specimens also article 10 infuscated apically. Palpi testaceous, apex of terminal article of each palpus lightly infuscated. Ventral surface, piceous to black; proepisternum testaceous to light rufous; prosternal process, posteromedial portion of metasternum, metacoxal process, metacoxa internally, and hind margins of abdominal sterna 3 to 6, rufous. Front and middle legs rufous, hind legs slightly darker.

Sculpture slightly sexually dimorphic. Male pronotum with large meshes, on many specimens longitudinally oriented medially, smooth or laterally on disc with lightly impressed secondary microreticulation; elytron (Fig. 294) with meshes longitudinal basomedially, laterally and apically irregular or slightly transverse, smooth and shiny or with obsolete secondary sculpture medially on disc, secondary sculpture stronger toward apex; with sparse very fine punctures. Female with sculpture similar to that of male but meshes on pronotum more strongly stretched; meshes of elytron (Fig. 295) on most specimens with strong secondary reticulation, on many specimens more lightly impressed laterally and apically.

Clypeus finely but completely margined. Prosternal process strongly convex, rounded in cross section; smooth and almost completely glabrous; apex sharply pointed. Metasternum with anterior medial emargination extended to level of hind margin of mesocoxal cavities. Metatibia with punctures of posteroventral margin restricted to basal 0.25 to 0.33 on most specimens: entire ventral face with sparse very fine punctures on most specimens. Metatarsal article 1 glabrous ventrally.

Male with articles 1 to 3 of pro- and mesotarsus narrowly dilated; ventral surface of article 1 with dense adhesive setae, articles 2 and 3 with four to six small oval scales in addition to adhesive setae. Protarsal claw (Fig. 157) very slender; anterior claw slightly narrower and shorter than posterior, with outer margin slightly arcuate, inner margin almost straight, base ventrally with a small obtuse tooth. Aedeagus (Fig. 193) simple, slender: basal piece small: apex with very slight bend to right.

*Taxonomic notes.* — Sharp (1882) placed this species in group 10 of *Agabus* — an obviously heterogeneous assemblage which contained species such as *A. congener* (Payk.), *A. ambiguus* (Say), *A. anthracinus* Mann., *A. subfuscatus* Sharp, *A. austinii* Sharp and *A. strigulosus* (Crotch). However, the association of *A. austinii* with *A. ambiguus* and *A. strigulosus* suggested by Fall (1922) in his arrangement of species, may be satisfactory. These species share the following characters: primary elytral sculpture coarse, meshes large bearing secondary reticulation; antero-medial metasternal sulcus well developed; male with protarsal articles 1 to 3 together bearing glandular pubescence and oval scales beneath, protarsal claws simple and slender; aedeagus simple and slender, apex not or only slightly twisted to right; parameres triangular in shape. The eastern North American species *A. erythropterus* (Say) probably belongs to this group, for the peculiarly modified male protarsal claws and laterally flanged aedeagus are already suggested in the corresponding structures of *ambiguus*.

*Natural history notes.* — Adults are usually found in shallow, cool *Carex*-choked waters associated with beaver ponds and small springs. The bottom in these areas is usually composed largely of soft black organic mud. Most specimens were collected in forested areas, but there are several records of this species from springs along the eastern edge of the southwestern foothills. Mature larvae and pupae were collected in mid-June (June 17-19, T.G. Leischner) from beaver ponds along Lusk Creek, Kananaskis Experimental Forest, Alberta, and third instar larvae of *Agabus* sp., probably belonging to *A. austinii*, were collected from this site during winter months, demonstrating that larval overwintering occurs. A brief description of this habitat is given by Pritchard and Hall (1971). Teneral adults were collected from June 19 to August 30. No records of flight are available.

*Distribution.* — This species is widespread in western North America, from New Mexico and California north to at least the southern Yukon Territory (mile 450, Alaska Highway, CARR!) and east to Alberta. In Alberta, the species is common throughout the western mountains, sporadic in west central Alberta and apparently isolated in the Cypress Hills. I examined more than 200 Alberta specimens (map, Fig. 409).

#### *Agabus ambiguus* (Say, 1823b)

*Colymbetes ambiguus* Say, 1823b: 96. (Type locality — not stated, interpreted by Fall (1922) as eastern Pennsylvania.) — LeConte 1850: 214. — Melsheimer 1853: 30. — LeConte 1859b: 510. — Gemminger and Harold 1868: 453. — Sharp 1882: 513. Horn 1883: 278. — Leng 1920: 79. — Zimmermann 1920: 71. — Fall 1922: 21. — Leng and Mutchler 1927: 17. — Brown 1932b: 201. — Leech 1938a: 127. — J. Balfour-Browne 1948: 160, 164. — Hatch 1953: 221. — Gordon and Post 1965: 20. — MacKay 1969: 1157. — Wallis 1973: 107.

*Agabus reticulatus* Aubé, 1838: 355. (Type locality – North America), not Kirby, 1837. – LeConte 1863a: 17. – Sharp 1882: 522. – Horn 1883: 282. – Wickham 1895b: 121.

*Agabus fimbriatus* LeConte, 1850: 214. (New name for *A. reticulatus* Aubé.). – Melsheimer 1853: 30. – Crotch 1873: 214.

**Diagnosis.** – The coarse primary sculpture and well-developed secondary sculpture separate specimens of this species from most others in the province. In addition to this, the combination of large size, basally flattened prosternal process, and micropunctuation of the metatibia, distinguish *A. ambiguus* from specimens of *A. strigulosus*, the only similar species in the fauna.

**Description.** – Measurements of 20 specimens from ten miles south of Lethbridge, Alberta, are: TL – 7.84 to 8.56 mm ( $\bar{X}$  = 8.16 ± 0.16 mm); MW – 3.96 to 4.32 mm ( $\bar{X}$  = 4.16 ± 0.10 mm); TL/MW – 1.89 to 2.04 ( $\bar{X}$  = 1.96 ± 0.04); WC/WS – 2.78 to 3.33 ( $\bar{X}$  = 3.05 ± 0.13).

Head black except frontal spots, anterior margin of clypeus, and labrum, rufous; antenna light rufous, outer articles infuscate apically; palpi pale except apex of terminal article of each palpus, lightly infuscate. Pronotum black except lateral bead and margin narrowly inside of bead, rufous and posterior margin narrowly piceous. Scutellum piceous. Elytron with lateral and basal margins light brown, disc dark brown to piceous; epipleuron piceous to black, narrowly rufous along outer margin. Ventral surface black except apex of metacoxal process and hind margins of abdominal sterna 3 to 6, rufous to piceous. Legs rufous except metafemur and tibiae dark rufous or piceous, at least medially and ventrally; some specimens with pro- and mesofemora infuscate medially.

Sculpture of head of large irregular meshes; secondary reticulation, more or less effaced medially on frons but evident at least laterally and posteriorly; punctuation of meshes sparse and fine. Pronotum with sculpture similar to that of head although lines slightly deeper and meshes on disc lateral to medial line with longitudinal orientation on some specimens; meshes smooth and shiny medially, microreticulate laterally. Elytron (Fig. 296) with large irregular meshes, partially oriented longitudinally basomedially (best developed on female); meshes with isodiametric secondary microreticulation, somewhat effaced on some males and stronger on females than on males.

Clypeus with anterior bead complete. Pronotum with lateral bead of moderate width, well defined almost to front angle. Prosternal process broad, flat or slightly convex basally, strongly convex toward apex; smooth and only sparsely punctate: apex acuminate. Metasternum with anterior medial emargination extended to level of hind margin of mesocoxal cavities. Metatibia with scattered punctures along posteroventral margin, extended on distal half on some specimens; medioventral series of punctures small, restricted to basal third; ventral face with very small somewhat longitudinally shaped punctures scattered over surface; on some specimens punctures very small and sparse. Metatarsal article 1 glabrous beneath.

Male with articles 1 to 3 of pro- and mesotarsus distinctly dilated; articles 1 with glandular setae basally and a single row of oval scales along apical margin, articles 2 and 3 with scales only. Anterior protarsal claw (Fig. 158) long and slender slightly sinuate beneath; posterior claw slightly longer, dorsal-ventrally flattened and somewhat expanded laterally. Male genitalia (Fig. 194) with aedeagus simple, apex flanged laterally; not at all twisted: parameres normal for genus.

**Taxonomic notes.** – Although the type specimen is lost, Fall (1922) makes a very good case for applying the name *ambiguus* to the present species.

**Natural history notes.** – On the prairies, this species is an inhabitant of springs and small creeks. However, in the forested northern portion of the province, specimens were taken in streams, beaver ponds and *Carex* marshes (usually with running water in the vicinity).

**Distribution.** – This species occurs from the Maritime Provinces to British Columbia, and south to Virginia in the east. In the west, I have specimens from as far south as Oregon (Dry Falls L., O. Edwards, UASM), and north to the southern Yukon (Mile 627, Alaska Hwy., CARR). I examined more than 200 specimens from Alberta localities (map, Fig. 410).

#### *Agabus strigulosus* (Crotch, 1873)

*Gaurodytes strigulosus* Crotch, 1873: 422. – (Type locality – Lake Tahoe, California.) – Sharp 1882: 517. – Zimmermann 1920: 173. – Fall 1922: 20. – Hatch 1933b: 11. – Leech 1938a: 127. – Leech 1942a: 78. – LaRivers 1951: 403. – Hatch 1953: 221. – Leech and Chandler 1956: 320. – Anderson 1962: 69.

*Gaurodytes namus* LeConte, 1878b: 452. (Type locality – Florissant, Colo., 8000<sup>+</sup>.) – Zimmermann 1920: 173.

**Diagnosis.** – Similar to *A. ambiguus* but smaller and differing in the characters given in the key to species and listed in the diagnosis of *A. ambiguus*.

**Description.** – Measurements and ratios of 20 specimens from Allison Lake, near Coleman, Alberta, are: TL – 6.08 to 6.96 mm ( $\bar{X}$  = 6.49 ± 0.27 mm); MW – 3.04 to 3.52 mm ( $\bar{X}$  = 3.27 ± 0.17 mm); TL/MW – 1.93 to 2.05 ( $\bar{X}$  = 1.99 ± 0.04); WC/WS – 2.61 to 3.05 ( $\bar{X}$  = 2.82 ± 0.12).

Color of head black except frontal spots, and on some specimens anterior margin of clypeus, rufous; labrum rufous; antenna testaceous with articles 4 or 5 to 11 infuscate apically; palpi testaceous except terminal article of each palpus infuscate apically.

Pronotum black except lateral margin narrowly rufous. Elytron dark brown to piceous, except lateral margin, especially in humeral region, rufous to brown; epipleuron piceous or black. Ventral surface black except metacoxal process and posterior margins of abdominal sternites 3 to 6, rufous. Legs rufous except coxae and femora basally and medially, infusate.

Sculpture of head of large irregular meshes with fine secondary reticulation, best developed laterally behind eye and on most specimens more or less obsolete medially. Pronotum with sculpture similar but lines more deeply impressed, meshes somewhat longitudinal in arrangement medially, and secondary sculpture usually absent from disc, somewhat effaced laterally. Elytron (Fig. 297) with large irregular meshes; longitudinal basomedially on many specimens, with fine isodiametric secondary reticulation: serial punctures centered on meshes of primary sculpture.

Clypeus with anterior bead complete. Pronotum with lateral bead complete but narrow. Prosternal process broad, smoothly convex to obtusely angulate medially, densely punctate and setose, apex sharply pointed. Metasternum with anteromedial emargination extended to level of hind margin of mesocoxae. Metatibia with punctation of posteroventral margin highly varied, from one or two punctures on some specimens to almost complete line of distinct but narrowly separated punctures on basal half on other specimens; ventromedial series of punctures on basal 1/3 to 1/2 of metatibia, otherwise metatibia smooth and impunctate. Metatarsal article 1 glabrous ventrally.

Male with articles 1 to 3 of pro- and mesotarsus narrowly but distinctly dilated; articles 1 with glandular setae basally and a row of small oval scales apically; articles 2 and 3 with small scales and adhesive setae beneath. Protarsal claws (Fig. 159) narrow, relatively unmodified: anterior claw slightly longer than posterior. Aedeagus (Fig. 197) simple, evenly narrowed toward apex and not bent laterally.

*Natural history notes.* – This is the most common species of dytiscid in *Carex* marshes in the mountainous parts of the province. Specimens of *strigulosus* are found amid *Carex* stalks in shallow water, usually over a bottom of soft organic mud. Teneral specimens were collected during July and August.

*Distribution.* – This is a western species, known from Colorado and California, north to Alberta and at least the southern Yukon (Mile 627, Alaska Hwy., CARR!). I examined more than 600 specimens from Alberta localities (map, Fig. 411).

#### *Agabus tristis* Aubé, 1838

*Agabus tristis* Aubé, 1838: 356. (Type locality – “Amerique septentrionale”.) – Mannerheim 1843: 220. – Melsheimer 1853: 30. – LeConte 1857: 11. – Gemminger and Harold 1868: 457. – Crotch 1873: 422. – Sharp 1882: 531. – Wickham 1895b: 121. – Kincaid 1900: 371. – Schwarz 1900: 175. – Zaitzev 1905: 212. – Poppius 1910: 348. – Zimmermann 1919: 208. – Leng 1920: 79. – Zimmermann 1920: 174. – Fall 1922: 33. – Fall 1926: 143. – Brown 1930b: 236. – Zimmermann 1934: 182. – LaRivers 1951: 403. – Hatch 1953: 225. – Zaitzev 1953: 235. – Leech and Chandler 1956: 320. – Anderson 1962: 69.

*Agabus dubius* Mannerheim, 1843: 221. (Type locality – Sitkha.)

*Agabus atratus* Mannerheim, 1853: 157. (Type locality – “Ad ostia fl. Kaktnu peninsulae Kenai”.)

*Agabus subopacus* Mannerheim, 1853: 157. (Type locality – Kadjak Island.)

*Agabus crotchii* Zaitzev, 1905: 212. (Type locality – “Nord-California”.)

*Agabus picea* Zaitzev, 1905: 212. (Type locality – “Miedny, Kommandor’sche Inseln”.) Not Jakowlew, 1897.

*Agabus piceolus* Zaitzev, 1907: 123. (New name for *A. piceus* Zaitzev, 1905, not Jakowl. 1897.)

*Diagnosis.* – The complete row of contiguous punctures along the posteroventral margin of the metatibia, the elongate fusiform shape of the body, the coarse sculpture and the color, characterize this species.

*Description.* – This species varies markedly in size and in the ratio WC/WS over its range. Measurements of 20 specimens from the junction of the Forestry Trunk Road and James River, Alberta, are: TL – 9.20 to 10.32 mm ( $\bar{X} = 9.84 \pm 0.26$  mm); MW – 4.64 to 5.28 mm ( $\bar{X} = 5.02 \pm 0.14$  mm); TL/MW – 1.89 to 2.00 ( $\bar{X} = 1.96 \pm 0.03$ ); WC/WS – 2.23 to 2.69 ( $\bar{X} = 2.42 \pm 0.12$ ).

Dorsal surface generally dark rufous to rufopiceous. Head piceous, except frontal spots, anterior margin of clypeus, gena medial to eye, and mouthparts, rufous; clypeus testaceous; antenna rufous except outer 2 to 6 articles infusate apically; palpi rufous with terminal article of each palpus infusate apically. Pronotum rufous with medial transverse piceous band, on most specimens poorly limited posteriorly and continuous with posterior margin, rarely clearly delimited on all sides, or, on some specimens broadly expanded and extended over disc except anterolateral margins. Elytron with epipleuron, lateral margin in basal two thirds, base, and narrow band along suture, rufous: disc medially and apically darker, dark brown to piceous. Ventral surface piceous or black, with proepisternum, prosternum of most specimens, metacoxal processes, abdominal sternum 1 medially and the posterior margin of sterna 2 to 6, rufous; some specimens with pale areas expanded and ventral surface of body largely rufous. Legs rufous with bases of femora, especially metafemora, infusate.

Sculpture sexually dimorphic. Male head with deeply impressed lines in form of large meshes irregular in shape, with very fine sparse punctation; pronotum with sculpture similar but meshes with an evident longitudinal or oblique arrangement, at

least medially on disc; elytron (Fig. 298) with large irregular meshes, sparsely punctate, with fine secondary isodiametric reticulation somewhat effaced basally but stronger and more or less continuous towards apex. Female with meshes on disc of pronotum narrower, more strongly longitudinal in arrangement; elytron (Fig. 299) with lines lightly impressed, meshes on base strongly stretched obliquely, more irregular in shape and orientation toward apex, with strong microreticulation. Pattern of sculpturing subject to some variation, some females very closely approaching male condition.

Clypeus with anterior margin complete or only narrowly and irregularly broken near middle. Pronotum with lateral margin complete, anterior angles acute with anterolateral margin slightly sinuate on many individuals. Prosternum broadly angulate medially; process dilated behind procoxae and moderately and smoothly convex; apex sharply pointed. Metafemur clavate, evenly dilated toward apex. Metatibia with complete row of confluent punctures along posteroventral margin; ventral face punctate on basal half. Metatarsal articles glabrous ventrally.

Male with articles 1 to 3 of front and middle tarsi dilated, together with dense covering of adhesive hairs ventrally; scales absent. Protarsal article 5 unmodified; anterior protarsal claw (Fig. 160) with ventral basal tooth. Aedeagus and paramere as in Fig. 195.

*Taxonomic notes.* – Leech (1938b) concluded that variation in convexity and form has no geographical basis in this species. Although color varies within a population sample, specimens from the California Sierras tend to be darker (many specimens entirely black dorsally) than those from other North American localities. If the Sierra specimens are judged to be subspecifically distinct, the name *A. crotchi* Zaitzev is available.

*Natural history notes.* – Although this is one of the most abundant species of *Agabus* in the Rocky Mountains, it is increasingly uncommon in the northern and eastern portions of the province. Most specimens were found among sedges along margins of beaver ponds, small lakes, backwaters of small creeks and in springs, often where the water is quite cold. The species was also taken regularly along rocky banks of alpine lakes. T. Leischner collected mature larvae from a beaver pond on Lusk Creek, Kananaskis Research Forest, between April 4 and May 4, 1971. Teneral specimens were found as early in the spring as May 17 (James R.), but the majority of tenerals were collected from June 20 to August 27. As adults were collected throughout May, and as late in the fall as November 15, it appears that the species overwinters as either a third instar larva or adult.

*Distribution.* – This species ranges from Labrador westward to Siberia. East of the Rocky Mountains it is mainly northern, extending south into the mountains of New Hampshire. In the west *A. tristis* ranges south to New Mexico, Arizona and California. In Alberta, the species is in the Rocky Mountains, and in the northern and eastern portions of the province, and is apparently isolated in the Cypress Hills. I examined more than 300 specimens from Alberta localities (map, Fig. 412).

#### *Agabus leptapsis* (LeConte, 1878)

*Gaurodytes leptapsis* LeConte, 1878: 596. (Type locality – Marquette, Michigan.) – Sharp 1882: 776. – Zimmermann 1920: 167. – Fall 1922: 34. – Leng and Mutchler 1927: 18. – Brown 1930b: 236. – Hatch 1953: 225.

*Agabus leptapsis* Leng 1920: 79.

*Diagnosis.* – This large, black, fusiform species, closely resembles dark specimens of *A. tristis* or a species of *Ilybius*.

*Description.* – Measurements of three males from Alberta are: TL – 9.68 to 10.00 mm ( $\bar{X}$  = 9.84 mm); MW – 5.12 to 5.20 mm ( $\bar{X}$  = 5.15 mm); TL/MW – 1.89 to 1.95 ( $\bar{X}$  = 1.91); WC/WS – 1.86 to 2.02 ( $\bar{X}$  = 1.94).

Color black except following. Head with frontal spots and labrum, rufous; antenna with articles 1 and 2 testaceous, outer articles progressively darker, rufous or infusate apically; palpi rufous, terminal article of each palpus infusate apically. Pronotum with lateral margin narrowly piceous, posterior margin piceous. Elytron with shoulder and epipleuron, piceous. Metacoxal process and posterior margins of abdominal sterna 3 to 6, piceous. Legs dark rufous to piceous.

Sculpture of head of deeply impressed lines in form of large irregularly shaped meshes, smooth with sparse fine punctures. Pronotum with lines slightly deeper, meshes large, medially with strong longitudinal arrangement, less so laterally; secondary reticulation well developed laterally but more or less effaced medially. Elytron (Fig. 300) with coarse meshes longitudinal in orientation basomedially on disc, more or less oblique in humeral area, irregularly oriented apically; with secondary reticulation.

Structure similar to *A. tristis* Aubé but differing as follows: body larger and broader, more convex dorsally; prosternum

broadly angulate medially; process convex but rounded, sharply pointed: metatarsal article 1 with ventral lateral row of setae extending almost entire length: male anterior protarsal claw (Fig. 161) without basal tooth; more strongly arcuate and narrower apically: aedeagus (Fig. 196) similar in the two species.

*Natural history notes.* – The normal habitat of this species is unknown. The three Alberta specimens were taken from among submerged *Carex* and *Calamagrostis* stalks along the margin of a small brownwater stream draining a spruce-*Sphagnum* bog.

*Distribution.* – *A. leptapsis* has been recorded from Michigan, Quebec, Ontario and south-eastern British Columbia. This species is probably widespread in the boreal portions of North America. I have seen three specimens from the locality indicated in Figure 413.

#### *Agabus arcticus* (Paykull, 1798)

*Dytiscus arcticus* Paykull, 1798: 201. (Type locality – “Habitat in aquis Lapponiae Tornoenfis”) – Gemminger and Harold 1868: 453. – Crotch 1873: 422. – Sharp 1882: 526. – Leng 1920: 79. – Zimmermann 1920: 30. – Fall 1922: 30. – Hatch 1928: 222. – Brown 1930b: 236. – Zimmermann 1934: 195. – F. Balfour-Browne 1950: 93. – Zaitsev 1953: 245. – Wallis 1973: 108.

*Colymbetes reticulatus* Kirby 1837: 71. (Type – male in BMNH labelled: Type H.T.; N. Amer. ♂ 5776 a; *Colymb. reticulatus* Kirby; N. Amer. 5776, Rev. Wm. Kirby.). Not Aubé, 1838. – Gemminger and Harold 1868: 456. – Horn 1883: 282.

*Agabus subfasciatus* LeConte 1863: 17. (nomen nudum). (European synonymy and references omitted.)

*Diagnosis.* – The combination of medially pale pronotum (of most specimens), coarse elytral sculpture, flat or slightly longitudinally concave prosternal process, and sinuate lateral margin of pronotum of female, is characteristic of this species.

*Description.* – Measurements of 20 specimens from Lawrence Lake near Smith, Alberta, are: TL – 7.44 to 8.00 mm ( $\bar{X}$  = 7.71 ± 0.16 mm); MW – 3.84 to 4.16 mm ( $\bar{X}$  = 4.03 ± 0.09 mm); TL/MW – 1.87 to 2.00 ( $\bar{X}$  = 1.91 ± 0.03); WC/WS – 2.33 to 2.80 ( $\bar{X}$  = 2.59 ± 0.12).

Head black with frontal spots, clypeus, labrum and mouthparts, testaceous; antenna testaceous except articles 3 or 4 to 11 infusate, palpi testaceous except terminal article of each palpus infusate apically. Pronotum testaceous to pale rufous except basal and apical margins broadly bordered with black medially (some specimens with anterior and posterior black margins continuous medially on disc but such specimens not seen from Alberta). Elytron brown medially, paler basally and laterally. Ventral surface largely black. Legs rufous.

Elytron with sculpture (Fig. 301) consisting of deeply impressed lines in form of coarse meshes irregular in size and shape; without definite pattern of orientation, or on some specimens, somewhat transverse posterolaterally, more or less smooth but some specimens with obsolete secondary reticulation.

Clypeus with anterior bead, slightly broadened and narrowly interrupted medially on some specimens, usually complete. Pronotum of male (Fig. 138) with narrow but complete lateral bead: female (Fig. 139) with bead on basal half only, pronotal margin sinuate towards front angle. Prosternum angularly convex medially; prosternal process flat or slightly concave basally; apex acuminate. Metasternum with anteromedial impression extended to level of hind margin of mesocoxae. Metafemur very broad apically. Metatibia with complete row of separated setiferous punctures along posteroventral margin.

Male with articles 1 to 3 of pro- and mesotarsi dilated, together with four transverse rows of large circular scales and row of very small scales on basal portion of article 1; anterior protarsal claw (Fig. 162) shorter than posterior, with broad ventral tooth in basal half; posterior claw sinuate basally. Male genitalia as in Figure 198: aedeagus with basal piece very large; apex twisted to right.

*Taxonomic notes.* – This species varies individually in extent of dark maculations of the pronotum. Specimens from Alberta and the southern Northwest Territories are considerably larger than are specimens from some other portions of the species' range (7.44 to 8.00 mm). Both F. Balfour-Browne (1950) and Fall (1922) give the range of length as 6 to 7.5 mm for specimens from Britain and Labrador respectively, while Zaitsev (1953) gives a size range of 7 to 7.5 mm for specimens from the USSR.

*Natural history notes.* – This species appears to be an inhabitant of sheltered margins of larger clear lakes, especially in situations where the bottom is clean and firm and some emergent vegetation is present. Teneral specimens were collected from August 29 to September 30, in various localities around Great Slave Lake.

*Distribution.* – This species has a circumpolar distribution, occurring in Ireland and Scotland, and across northern Europe and Asia, generally north of 60° N latitude (F. Balfour-Browne, 1950). In North America, *A. arcticus* ranges from Alaska to Labrador in the boreal and arctic



regions, north to Aklavik (Bryant, UASM). I examined more than 40 specimens from Alberta localities (map, Fig. 414).

*Agabus anthracinus* Mannerheim, 1852

*Agabus anthracinus* Mannerheim, 1852: 304. (Type locality – “Nov. Archangelsk insulae Sitkhae”). – Sharp 1882: 514. – Horn 1883: 281. – Wickham 1895b: 120. – Blatchley 1910: 226. – Carr 1920: 4. – Leng 1920: 79. – Zimmermann 1920: 171. – Fall 1922: 31. – Fall 1926: 141. – Brown 1930b: 236. – Brown 1932b: 201. – Leech 1938a: 127. – J. Balfour-Browne 1948: 160. – Hatch 1953: 225. – Anderson 1962: 69. – Gordon and Post 1965: 21. – James 1970: 94. – Wallis 1973: 108.

*Agabus scapularis* Mannerheim, 1852: 303. (Type locality – as above.). – LeConte 1863a: 17. – Gemminger and Harold 1868: 456. – Sharp 1882: 755.

**Diagnosis.** – (Fig. 6). A moderate sized, mainly black species with very coarse elytral sculpture. The metafemur of the male, and to a lesser extent, the female, has the posteroapical angle below the femoral comb produced posteriorly.

**Description.** – Measurements of 20 specimens from the vicinity of Manning, Alberta, are: TL – 7.20 to 8.10 mm ( $\bar{X}$  = 7.55 ± 0.24 mm); MW – 3.76 to 4.16 mm ( $\bar{X}$  = 3.90 ± 0.10 mm); TL/MW – 1.88 to 2.00 ( $\bar{X}$  = 1.94 ± 0.03); WC/WS – 2.53 to 2.88 ( $\bar{X}$  = 2.70 ± 0.10).

Body black except as noted, more or less shiny. Head with frontal spots and anterior margin of clypeus, dark rufous to piceous; labrum testaceous; antenna testaceous basally, articles 4 to 11 infusate apically; palpi testaceous with terminal article of each palpus infusate apically. Pronotum with lateral bead, and on some specimens disc narrowly internally to bead, rufous. Elytron with rufous or piceous area on shoulder, prolonged posteriorly inside lateral margin of elytron but indistinct toward middle; epipleuron piceous to black. Ventral surface mainly black. Legs with trochanters, apex of femur, pro- and mesotibia and tarsi, and to a lesser extent metatibia and tarsus, rufous; natatorial setae of legs dark brown.

Elytron with sculpture (Fig. 302) very coarse, lines deeply and broadly impressed and forming large irregular meshes, smooth or with obsolete secondary rugosity, without micropunctuation; serial punctures medially on meshes.

Clypeus with anterior bead complete, thickened at middle. Pronotum with lateral bead of moderate width, complete. Prosternum angularly convex; prosternal process on slightly lower plane, slightly and smoothly convex basally, more convex toward acuminate apex. Metasternum with anteromedial margin deeply impressed. Metafemur (Fig. 142) with posteroapical angle strongly produced below femoral comb, less developed on female. Metatibia with posteroventral margin with more or less continuous row of separated punctures along basal half, only few scattered punctures along apical half; medioventral face finely micropunctate.

Male with articles 1 to 3 of pro- and mesotarsi dilated, together with 10 to 12 large round scales beneath: anterior protarsal claw (Fig. 163) long and narrow, outer margin slightly and evenly rounded, inner margin almost straight, apex acute and slightly arcuate; posterior claw slightly shorter than anterior and about 0.5 its width. Aedeagus as in Figure 199: basal piece large, apex bent to right.

**Taxonomic notes.** – Although the correct application of the name *A. scapularis* Mannerheim is not known with certainty, most authors regard it as a synonym of *A. anthracinus*.

In the North American fauna, this species is quite distinct. Structure of the male genitalia, coarse sculpture, male protarsal characters and medial thickening of the clypeal bead on many specimens, suggest a relationship with the species *A. arcticus*.

**Natural history notes.** – Members of this very common species are found in a wide variety of shallow-water habitats in parkland and forested portions of the province, most commonly in *Carex* marshes, but also in almost every lotic or slow-flowing water collection site in which dense emergent vegetation or mats of plant debris occur. Most prairie records refer to single specimens taken in the fall, a major dispersal period for many dytiscids, and hence may represent stray specimens rather than actual breeding populations. Teneral specimens were collected during the latter half of July and August.

**Distribution.** – This species ranges from Newfoundland to Alaska, and south to Massachusetts, Michigan and Utah. I examined more than 1,100 specimens from Alberta localities (map, Fig. 415).

*Agabus ajax* Fall, 1922

*Agabus ajax* Fall, 1922: 30. (Type locality – Waghorn, Alberta.). – Leng and Mutchler 1927: 17. – Brown 1932b: 201. –

Hatch 1953: 224. — Anderson 1962: 69. — Carr and Leech 1966: 545. — Wallis 1973: 108.

*Diagnosis.* — This species is characterized by large broad form, pale color, relatively coarse rounded or hexagonal meshes of the elytral sculpture, and structure of the metacoxae.

*Description.* — Measurements and ratios of 20 Alberta specimens are: TL — 8.80 to 10.24 mm ( $\bar{X} = 9.62 \pm 0.41$  mm); MW — 5.12 to 5.92 mm ( $\bar{X} = 5.62 \pm 0.21$  mm); TL/MW — 1.65 to 1.78 ( $\bar{X} = 1.71 \pm 0.03$ ); WC/WS — 3.00 to 4.20 ( $\bar{X} = 3.53 \pm 0.34$ ).

Body brown with head basally and disc of pronotum medially, dark rufous to piceous; elytron dark brown with lateral, basal and scutellar margins paler; ventral surface rufous to rufopiceous. Antenna entirely testaceous. Palpi testaceous with terminal article of each palpus infusate apically. Legs rufous.

Elytron with sculpture (Fig. 304) of rounded or hexagonal, more or less isodiametric, meshes; without secondary sculpture, meshes smooth and shiny.

Clypeus with anterior bead fine but complete. Pronotum with lateral bead narrow, poorly defined; disc more or less flat internally to bead. Prosternal process strongly convex in cross section, with narrowly rounded medial keel; process with apex slightly deflected upwards behind procoxae and not exactly in same plane as prosternum. Metacoxa with intralineal space not scabrous or rugose; metacoxal process with hind margin medial to posterolateral emargination convexly arched. Metatibia with sparse irregular row of setae along posteroventral margin; medioventral face with small scattered punctures.

Male with articles 1 to 3 of protarsus broadly dilated (ratio width article 1/width article 4 — 2.4 to 3.0) (Fig. 175), together with about 20 large oval scales on ventral surface; protarsal article 5 with ventral tooth (Fig. 166); protarsal claws elongate, slender and more or less straight; anterior claw slightly sinuate along ventral margin. Aedeagus (Fig. 200) with subapical spine.

*Taxonomic notes.* — I have not been able to locate the type locality, Waghorn, on any map of Alberta or in the Gazetteer of Alberta Place Names. Presumably, Waghorn is located in the vicinity of Edmonton, as this is the area in which F. S. Carr did most of his collecting prior to 1922.

*Natural history notes.* — This species is most common in the parkland and mixed forest zones of the province, usually amid emergent vegetation in shallow water along warm, exposed margins of permanent ponds. Unlike most species of *Agabus*, I have not found specimens of *A. ajax* earlier in the spring than June 20, and most specimens collected in June and the first two weeks of July were teneral. It appears as though this species overwinters in an immature stage and adult overwintering does not occur.

J. Carr collected a single male from a snowbank at about 8,000' (Tp. 35 Rge. 18 W 5) on July 19, 1973, and also obtained a long series from a small roadside pool located on the northern portion of the Livingstone Range on August 20, 1973. The presence of beetles in both of these sites was no doubt due to recent flight.

*Distribution.* — The species ranges from Newfoundland to British Columbia and from northern Utah to at least Great Slave Lake (Hay River!). I examined 116 specimens from the localities indicated in Fig. 417.

#### *Agabus infuscatus* Aubé, 1838

*Agabus infuscatus* Aubé, 1838: 330. (Type locality — "Amérique Septentrionale"). — LeConte 1850: 214. — LeConte 1863a: 17. — Gemminger and Harold 1868: 453. — Crotch 1873: 420. — Sharp 1882: 520. — Wickham 1895b: 120. — Leng 1920: 79. — Zimmermann 1920: 167. — Fall 1922: 29. — Fall 1926: 141. — Brown 1932b: 201. — Zimmermann 1934: 198. — Hatch 1938: 146. — Hatch 1953: 223. — Zaitsev 1953: 257. — Gordon and Post 1965: 20. — Wallis 1973: 107.

*Diagnosis.* — Specimens resemble small ones of *A. ajax* Fall but can be recognized on the basis of dark head and pronotum, rugosity of the intralineal space of the metacoxae, and differences in the male protarsus.

*Description.* — Measurements of six specimens from Yukon Territories (2), Alberta (2), and Manitoba (2), are: TL — 7.68 to 8.56 mm ( $\bar{X} = 8.29 \pm 0.29$  mm); MW — 4.24 to 4.72 mm ( $\bar{X} = 4.57 \pm 0.18$  mm); TL/MW — 1.75 to 1.89 ( $\bar{X} = 1.81 \pm 0.04$ ); WC/WS — 2.32 to 2.89 ( $\bar{X} = 2.55 \pm 0.19$ ).

Head black; frontal spots, anterior margin of clypeus and labrum rufous; antenna testaceous, outer articles lightly infusate on some specimens; palpi testaceous, terminal article of each palpus lightly infusate apically. Pronotum with disc black, lateral margin rufous. Scutellum piceous. Elytron with lateral margin and epipleuron testaceous, disc dark brown to piceous medially and apically. Ventral surface black except apex of prosternal process, metacoxal process and hind margins of abdominal sterna 3 to 6, dark rufous to piceous. Legs rufous except coxae, femora and metatrochanters darker.

*Quaest. Ent.*, 1975, 11 (3)

Elytron with sculpture of small rounded more or less isodiametric flat, smooth and shining meshes.

Clypeus with very narrow but complete anterior bead. Lateral bead of pronotum narrow, clearly delimited from disc. Prosternal process strongly convex, in form of narrow medially rounded keel. Metasternum with anteromedial emargination well developed. Intralineal space of metacoxa coarsely rugose, with several confluent longitudinal punctures. Metatibia of most specimens with three to four widely spaced punctures along posteroventral margin, otherwise smooth and without micropunctuation. Metatarsal article 1 glabrous ventrally.

Male antennae subserrate, with articles 5 to 8 each with anteroapical angle slightly produced. Articles 1 to 3 of protarsus (Fig. 176) dilated, together with 15 to 16 small oval scales beneath; protarsal article 5 (Fig. 167) without ventral tooth; anterior protarsal claw slightly longer than posterior, both claws elongate, straight medially with apex arcuate, slightly sinuate along ventral margin. Aedeagus (Fig. 201) with subapical ventral spine; parameres normal.

*Taxonomic notes.* — Specimens from Yukon Territory, Alberta, and Manitoba are readily separated from those from Quebec, Labrador and Newfoundland on the basis of size, and shape of pronotum (Manitoba specimens are somewhat intermediate). Western specimens are larger ( $\bar{X} = 8.29 \pm 0.29$  mm ( $n = 6$ )) than are eastern (Quebec — Newfoundland) specimens (TL — 6.88 to 8.08 mm ( $\bar{X} = 7.49 \pm 0.40$  mm) ( $n = 13$ )). Also, the pronotum differs in shape: on western specimens, the pronotum (Fig. 140) is straight or little rounded laterally and the front angles are relatively sharp. Those from eastern Canada have the pronotum more strongly rounded laterally (Fig. 141) and the anterior lateral angles are blunt or almost truncate in some specimens.

*Natural history notes.* — The single specimen that I collected was in a small *Sphagnum*-ringed pool shaded by *Carex* and situated in a black spruce-*Sphagnum* bog.

*Distribution.* — This Holarctic species ranges from Newfoundland (!, UASM) to Alaska and the Eastern Palaearctic region. The northern and southern limits are unknown, but it appears to be restricted to boreal and arctic regions. I examined two Alberta specimens from localities indicated in Figure 419.

#### *Agabus ontarionis* Fall, 1922

*Agabus ontarionis* Fall, 1922: 30. (Type locality — Bellville, Ontario.). — Hatch 1953: 224. — Carr and Leech 1966: 545. — Watts 1970: 724. — Wallis 1973: 108.

*Diagnosis.* — This species is well characterized by large size, dark color, fine but irregular elytral sculpture, widely dilated male protarsus and bifid aedeagus.

*Description.* — Measurements of 20 Alberta specimens are: TL — 9.60 to 10.96 mm ( $\bar{X} = 10.33 \pm 0.40$  mm); MW — 5.36 to 6.24 mm ( $\bar{X} = 5.82 \pm 0.22$  mm); TL/MW — 1.69 to 1.84 ( $\bar{X} = 1.78 \pm 0.04$ ); WC/WS — 2.81 to 3.24 ( $\bar{X} = 2.99 \pm 0.12$ ).

Color of head piceous to black except frontal spots, anterior margin of clypeus, labrum and mouthparts, rufous; antenna testaceous except outer articles infusate apically; palpi testaceous except terminal article of each palpus piceous on apical half. Pronotum piceous to black medially, lateral margins broadly rufous. Scutellum piceous. Elytron rufous laterally, piceous to black medially and apically on disc; epipleuron reddish brown. Ventral surface piceous to black except metacoxal process and posterior margins of sterna 3 to 6, rufous. Legs dark rufous.

Elytron of male with meshes small (Fig. 305), irregular in size and shape basally more rounded and equal in size laterally and apically, smooth or with partially effaced secondary sculpture. Many females with elytral sculpture deeply impressed, irregular in size and shape over much of elytron and more or less granular, with secondary reticulation.

Clypeus narrowly but completely beaded. Pronotum with lateral bead narrow, clearly delimited medially but on many specimens becoming obsolete towards front angle. Prosternal process narrowly and strongly convex, medial convexity narrowly rounded in cross section: apex bluntly pointed. Metasternum with anteromedial emargination well developed. Metafemur relatively slender. Metatibia with posteroventral series of punctures more or less continuous along hind margin: entire ventral surface with small sparsely spaced punctures (better developed on male than on female). Metatarsal article 1 glabrous beneath.

Male with articles 1 to 3 of protarsus (Fig. 177) relatively broadly dilated (ratio width article 1/width article 4 = 2.0 to 2.6), with moderate sized, oval scales beneath: protarsal article 5 (Fig. 168) slender, without ventral tooth; protarsal claws slender, subequal in length, slightly sinuate beneath. Aedeagus (Fig. 202) with subapical ventral spine, apex slightly twisted to right; basal piece small.

*Taxonomic notes.* — This species is no doubt closely related to *A. ajax* which it closely resembles in habitus and in such characters as shape of the prosternal process, structure of aedeagus and dilation and vestiture of the male protarsus.

*Natural history notes.* — *A. ontarionis* is confined largely to the forested portions of the

province, living in parkland, mixed forest, and coniferous forest areas. Specimens are usually in cold *Carex* marshes, often where the water is shaded by willow, but not in *Sphagnum* bogs. However, several series of specimens were found in emergent *Carex* in shallow warm ponds in open sites (e.g., borrow-pits, roadside ditches). Most specimens were collected during July, and many specimens found during late June and early July (June 21 to July 18) have been teneral. Perhaps this species, like *A. ajax*, overwinters in an immature stage.

*Distribution.* – This species ranges from Ontario and Manitoba to British Columbia. The northern and southern limits are unknown. In Alberta, specimens have been collected from the U.S. border to the Northwest Territories border. I examined 53 specimens from Alberta localities (map, Fig. 418).

*Agabus elongatus* Gyllenhal, 1827

*Agabus elongatus* Gyllenhal, 1827: 381. (Type locality – unknown to me.) – Aubé, 1836: 176. – Aubé 1838: 350. – Thompson 1860: 62. – Gemminger and Harold 1868: 454. – Sharp 1882: 522. – Carr 1930: 279. – Zimmermann 1934: 150. – Leech 1939: 217. – Blackwelder 1948: 4. – Zaitsev 1953: 265.

*Agabus bryanti* Carr, 1930: 278. (Type locality – Shingle Point, Yukon Territory.) – Leng and Mutchler 1933: 15.

*Diagnosis.* – Adults are small, characterized by narrow subparallel shape, relatively broad head, flattened prosternal process and male protarsal characters.

*Description.* – Measurements of three population samples are presented in Table 1.

Table 1. Measurements and ratios of selected North American population samples of *Agabus elongatus* Gyllenhal.

Locality	N	TL (mm)	TL/MW	WC/WS
Churchill, Man.	12	6.24 - 6.80 (6.52±.23)	1.97 - 2.10 (2.05±.04)	2.00 - 2.29 (2.15±.08)
Tunanuk, N.W.T.	14	5.84 - 6.74 (6.28±0.24)	2.00 - 2.11 (2.04±.03)	1.96 - 2.27 (2.16±.10)
Swan Hills, Alta.	2	7.36 - 7.44 (7.40)	2.07 - 2.14 (2.11)	2.31 - 2.40 (2.36)

Head black; labrum and frontal spots rufous; antenna testaceous, outer articles slightly infuscate; palpi testaceous. Pronotum black, lateral and posterior margins narrowly dark rufous or piceous. Elytron brown laterally, darkened medially on disc; epipleuron dark internally, reddish laterally. Ventral surface black, metacoxal process and posterior margins of sterna 3 to 6, piceous. Legs testaceous to pale brown, femora infuscate at least basally.

Sculpture of elytron (Fig. 303) of small, rounded meshes.

Pronotum broadly and evenly convex, convexity originated immediately inside lateral bead; lateral bead very narrow, clearly delimited throughout length. Prosternal process slightly broadened behind procoxae, flat or even slightly concave basally, slightly but evenly convex toward apex; glabrous. Protibia broadly expanded apically, apex rounded. Metatibia with from one to six punctures along posteroventral margin, punctures restricted to basal half on most specimens. Metatarsal article 1 with one to four ventral setae.

Male with antenna subserrate (Fig. 143), articles 5 to 10 each with anterior apical angle somewhat produced. Protarsus strongly modified: article 5 (Fig. 164) very long, with large acute ventral tooth; articles 1 to 3 only slightly dilated, each with few short small oval scales beneath; anterior protarsal claw shorter and narrower than posterior, deeply emarginate basally. Aedeagus (Fig. 203) with subapical ventral spine: paramere very broad in ventral view, flattened, apex densely setose.

*Taxonomic notes.* – Leech (1939) regarded *A. bryanti* Carr as conspecific with *A. elongatus* Gyll. Twelve paratypes of *A. bryanti* (UASM) agree well with the Alberta specimens of *A. elongatus* in all features except size. Specimens from arctic Canada are considerably smaller

than the two Alberta males. Measurements of three population samples of *elongatus* are given in Table 1.

*Natural history notes.* — In the locality 20 miles north of the town of Swan Hills, two specimens of *elongatus* were collected from small pools of water located around the edge of an oil well clearing in a black spruce-*Sphagnum* swamp. These pools were less than two feet in diameter, shaded by willow, and the water was cold to touch. The depth was 6 to 18 inches, the bottom covered with masses of waterlogged willow leaves, grass stems, etc.

*Distribution.* — This Holarctic species is mainly on tundra. North American localities from which I have seen specimens are: Shingle Point, Yukon Territories (Carr, 1930: CNC, UASM!, USNM); Tunanuk, N.W.T. (UASM!); Churchill, Manitoba (UASM!). I examined two specimens from the following Alberta locality (Fig. 416): Hwy. 18, 20 mi N of Swan Hills, May 30, 1971.

#### *Agabus lutosus* LeConte, 1853

*Agabus lutosus* LeConte, 1853: 31. (New name for *A. discolor* LeConte, not Harris.). Not Crotch, 1873. LeConte 1863a: 17. — Horn 1883: 278. — Leng 1920: 79. — Zimmermann 1920: 165. — Fall 1922: 22. — Leech 1942c: 131. — LaRivers 1951: 403. — Hatch 1953: 220. — Leech and Chandler 1956: 320. — Leech 1964: 81. — Carr and Leech 1966: 545. *Agabus discolor* LeConte, 1852: 204. (Type locality — San Francisco, California.) Not Harris, 1828. *Gaurodytes lecontei* Crotch, 1873: 417. (New name for *A. discolor* LeConte.). — Sharp 1882: 523. — Zimmermann 1919: 211.

*Diagnosis.* — Of the group of species whose adults possess a dark head and pronotum and pale elytra, this is one of the most easily recognized. Shape of the body is narrower than in other species of the group and the anterior protarsal claw of the male has a distinct ventral tooth.

*Description.* — Measurements of 30 specimens from the Cardston and Waterton areas of Alberta are: TL — 7.28 to 8.56 mm ( $\bar{X} = 8.12 \pm 0.24$  mm); MW — 4.00 to 4.48 mm ( $\bar{X} = 4.27 \pm 0.11$  mm); TL/MW — 1.82 to 1.96 ( $\bar{X} = 1.90 \pm 0.03$ ); WC/WS — 2.10 to 2.45 ( $\bar{X} = 2.28 \pm 0.09$ ).

Head black except frontal spots, anterior margin of clypeus and clypeus medially on some specimens, rufous; labrum testaceous; antenna testaceous except articles 5 to 11 infusate apically; palpi testaceous except terminal article of each palpus infusate apically. Pronotum black except lateral margin narrowly rufous, posterior margin piceous. Elytron with epipleuron, lateral and basal margins, testaceous; disc darker brown medially and apically. Ventral surface black except metacoxal processes and hind margins of abdominal sterna 3 to 6, rufous. Legs rufous except coxae, and femora basally and ventrally, dark piceous to black.

Elytral sculpture sexually dimorphic. Male with sculpture (Fig. 306) basomedially of small somewhat rounded or hexagonal meshes, of various sizes especially laterally and apically; with numerous fine punctures, each situated on a mesh. Female (Fig. 307) with lines coarse, deeply impressed in form of strongly convex meshes of moderate size and longitudinally stretched basomedially, smaller and more irregularly oriented laterally and apically; along basolateral convexity meshes small and longitudinally stretched.

Clypeus completely beaded. Pronotum with lateral margin slightly sinuate at front angle; lateral bead narrow and strongly delimited; disc immediately internal to bead flat. Prosternal process narrow, acuminate apically; dorsal surface strongly and smoothly convex, flatter basally, sparsely and finely punctate. Metatibia with posteroventral series of punctures, represented by only a few punctures basally, or with series extended onto distal half; medioventral series of punctures small setiferous, irregular row on basal quarter to third; medioventral face very finely and sparsely micropunctate.

Male with articles 1 to 3 of pro- and mesotarsus broadly dilated, each article with large oval scales on ventral surface; anterior protarsal claw (Fig. 165) short, with distinct ventral medial or subapical tooth usually directed anteriorly. Aedeagus (Fig. 204) with subapical ventral spine.

*Taxonomic notes.* — This and *A. griseipennis* LeConte, 1859 are very similar, probably allopatric, species. Leech (1942c) assigned Alberta specimens to *A. lutosus* which he separates from *A. griseipennis* by chaetotaxy of the male protarsal article 5, and shape of the male protarsal claw. However, he states that “the most *griseipennis*-like form is seen in males from Alberta, and as these specimens are also paler and more elongate (than more western specimens of *lutosus*), they may constitute a valid subspecies”. I have not had sufficient experience with either of these species outside of Alberta to venture an opinion on their status, but distributional and morphological data seem to indicate that the two are geographical forms of a single species.

Leech (1942c) recognizes two subspecies of *A. lutosus*: *A. lutosus*, ranging from southern California to southern British Columbia and east to Nevada and Alberta; and *A. mimus* Leech, 1942, from coastal British Columbia and Mount Rainier, Washington.

*Natural history notes.* — Adults are found in emergent vegetation along margins of small slow-flowing foothill and prairie creeks and springs, in pools located in beds of otherwise dry intermittent creeks, and in stream-fed ponds. During spring, specimens were collected from small ponds and puddles, probably as a result of spring dispersal. Teneral specimens were collected in early July.

*Distribution.* — See above under taxonomic notes. I examined 187 specimens from Alberta localities (map, Fig. 420).

*Agabus nectris* Leech, 1942

*Agabus nectris* Leech, 1942c: 133. (Type locality — Lumby, British Columbia). — Blackwelder 1948: 4. — Hatch 1953: 222.

*Agabus obliteratus* Hatch, 1933b: 10, not LeConte, 1859a: 5.

*Agabus morosus* auctorum, not LeConte, 1852: 204.

*Diagnosis.* — In the Alberta fauna, specimens of *A. nectris* can usually be recognized on the basis of combination of color, laterally rounded pronotum, broad lanceolate prosternal process which is on a slightly lower plane than the medial portion of the prosternum, and micropunctate metafemur and dorsal surface of metatarsal article 1.

*Description.* — Measurements of 20 specimens from the Calgary area, are: TL — 6.56 to 7.76 mm ( $\bar{X} = 7.30 \pm 0.27$  mm); MW — 3.28 to 4.08 mm ( $\bar{X} = 3.81 \pm 0.18$  mm); TL/MW — 1.86 to 2.00 ( $\bar{X} = 1.92 \pm 0.04$ ); WC/WS — 2.21 to 2.60 ( $\bar{X} = 2.44 \pm 0.11$ ).

Head black except frontal spots and labrum testaceous to rufous; antenna testaceous except articles 3 or 4 to 11 lightly infusate, at least apically; palpi testaceous except terminal article of each palpus infusate apically. Pronotum black except lateral margin narrowly rufous. Male with elytron brown basally, piceous toward apex and testaceous to pale brown along lateral margin. Female with elytron darker, largely piceous to black with basal and lateral margins somewhat paler. Epipleuron piceous with outer margin narrowly paler. Ventral surface black except apex of prosternal process, metacoxal process, and hind margins of sterna 3 to 6, piceous. Legs brown except femora black basally and medially, and metatibiae infusate.

Sculpture of head and pronotum of meshes irregular in size and shape (some females with meshes medially on pronotum somewhat longitudinal in arrangement), with sparse small punctures, otherwise smooth. Male elytron (Fig. 308) with finely impressed lines in form of meshes of irregular angulate shape and varied size; meshes smooth and shiny. Female (Fig. 309) with lines deeply impressed, meshes somewhat convex, irregular in size and shape or on some females slightly longitudinal in arrangement basally on disc; meshes smooth and shiny, or some specimens with trace of obsolete secondary sculpture.

Clypeus with anterior bead complete. Pronotum rounded laterally, hind angle rounded hence lateral margin of pronotum and elytron discontinuous in outline; lateral bead of moderate width, well defined throughout length. Prosternal process on a lower plane than medial longitudinal portion of prosternum; process broad and lanceolate, flat to slightly and evenly convex basally, more convex toward apex; surface glabrous, finely punctate. Metasternum incised anteromedially to level of hind margin of mesocoxae. Metatibia of most specimens without posteroventral row of punctures; medioventral face bearing numerous small elongate punctures. Metatarsal article 1 with dorsal surface finely micropunctate.

Male with articles 1 to 3 of pro- and mesotarsi broadly dilated and bearing small oval scales beneath; protarsal claws (Fig. 169) little modified; anterior claw slightly longer than posterior; posterior claw slightly sinuate ventrally. Aedeagus (Fig. 205) bifid apically, ventral spine relatively broad.

*Taxonomic notes.* — Leech (1942) indicated that this species is very similar to *A. obliteratus* LeConte, and that these two allopatric species are best separated on the basis of punctation of the metatibia. As this is a rather minor character and subject to individual variation, it may be best to treat these forms as conspecific subspecies.

*Natural history notes.* — Leech (1942) described the habitat of *A. nectris* as: “small weedy streams with but little current”. I collected specimens from small prairie and foothill streams, intermittent creeks and small springs. In addition I found teneral specimens in prairie sloughs and in roadside ponds, suggesting that the insects developed in these sites. Most teneral specimens were collected from July 6 to August 23. Leech gives a record for flight on April 20.

*Distribution.* — The species *A. nectris* was recorded from Montana, southern Alberta, southern British Columbia, Idaho, Washington and Oregon. I examined 150 specimens from Alberta

localities (map, Fig. 421).

*Agabus audeni* Wallis, 1933

*Agabus audeni* Wallis, 1933b: 270. (Type locality – Okanagan, British Columbia.). – Blackwelder 1939: 17. – Hatch 1953: 224. – Carr and Leech 1966: 544.

**Diagnosis.** – These large adults share with those of *A. canadensis* fine isodiametric elytral sculpture and laterally inflated pronotum. Specimens of *A. audeni* are readily recognized by larger size, color, shape of the prosternal process and males are without a subapical ventral spine in the aedeagus.

**Description.** – Measurements of 20 specimens from 4 mi S High Level, Alberta, are: TL – 8.96 to 10.24 mm ( $\bar{X}$  = 9.56 ± 0.36 mm); MW – 4.80 to 5.48 mm ( $\bar{X}$  = 5.18 ± 0.20 mm); TL/MW – 1.78 to 1.89 ( $\bar{X}$  = 1.85 ± 0.03); WC/WS – 2.77 to 3.33 ( $\bar{X}$  = 3.11 ± 0.14).

Head black except frontal spots, anterior margin of clypeus, and frons above base of antenna, dark rufous; labrum rufous; antenna testaceous except distal articles lightly infusate on some specimens; palpi testaceous. Pronotum disc black, lateral margins broadly rufous. Elytron brown except lateral margin paler and epipleuron rufous, slightly infusate along inner margin. Ventral surface mainly piceous to black. Legs rufous except metafemur and metatibia darker.

Elytron with sculpture (Fig. 310) of small rounded more or less isodiametric meshes and with small punctures, each medially in enlarged mesh.

Anterior margin of clypeus completely beaded. Pronotum with lateral bead narrow (at widest, about one half width of apex of antennal article 3), widest in basal half and gradually narrowed toward anterior angle; pronotum with disc strongly inflated inside bead, especially on anterior half. Prosternal process strongly but evenly convex in cross section, glabrous but bearing micropunctuation. Metasternum with anteromedial emargination well developed. Metatibia with posteroventral series of punctures in form of loose line along basal 0.66 to 0.75 of length. Metatarsal article 1 with group of ventral setae. Metacoxal line sinuate but only slightly so on many specimens.

Male with articles 1 to 3 of pro- and mesotarsi narrowly dilated (article 3 barely wider than 4) and with small oval scales beneath; protarsal claws (Fig. 170) similar in shape, shallowly sinuate ventrally; anterior claw slightly longer and broader than posterior. Aedeagus (Fig. 206) slender, simple, without subapical ventral spine; apex very slightly bent to right; paramere normal.

**Taxonomic notes.** – Adults very closely resemble those of *A. canadensis* Fall. Hence, it is interesting that the aedeagus of *A. audeni* lacks the subapical ventral spine characteristic of all other similar species. In spite of the lack of this otherwise consistent character, I believe that *A. audeni* is still best placed in close association with *A. canadensis* Fall.

**Natural history notes.** – Carr and Leech (1966) described the habitat in which this species is usually found. In northern Alberta, specimens of *A. audeni* are often abundant in dense *Carex* marshes, usually in water depths of 6 to 18 inches, in areas containing dense mats of decaying *Carex* stalks and the water is cold and shaded by thick stands of live *Carex* and willow. It is sometimes taken in *Sphagnum* bogs. Against Carr and Leech, who consider *A. audeni* an early spring insect, I have collected the majority of my specimens during July. Teneral specimens have been collected July 10 and 17.

**Distribution.** – This species occurs in British Columbia, Alberta and the Northwest Territories (Aklavik, UASM!). I examined more than 170 specimens from Alberta localities (map, Fig. 422).

*Agabus canadensis* Fall, 1922

*Agabus canadensis* Fall, 1922: 27. (Type locality – Aweme, Manitoba.). – Leng and Mutchler 1927. Hatch 1953: 223. – Gordon and Post 1965: 20. – Carr and Leech 1966: 545. – James 1970: 94. – Wallis 1973: 107.

**Diagnosis.** – The broadly rufous lateral margin of the pronotum and moderate size offer fairly reliable characters for the separation of this species from that species group whose members have black pronota and brown elytra and fine rounded elytral sculpture.

**Description.** – Measurements and ratios of 20 specimens from 30 mi S Youngstown, Alberta, are: TL – 6.88 to 7.92 mm ( $\bar{X}$  = 7.41 ± 0.28 mm); MW – 3.76 to 4.40 mm ( $\bar{X}$  = 4.13 ± 0.18 mm); TL/MW – 1.73 to 1.85 ( $\bar{X}$  = 1.79 ± 0.04); WC/WS –

2.19 to 2.65 ( $\bar{X} = 2.45 \pm 0.13$ ).

Head black except frontal spots, anterior margin of clypeus, and frons above base of antenna, dark rufous; antennae testaceous basally, outer articles rufous and infusate apically; labrum rufous; palpi rufous except terminal article of each palpus infusate apically on many specimens. Pronotum black except lateral margin very broadly rufous and posterior margin narrowly piceous. Elytron light brown basally and laterally, disc darker behind; epipleuron pale brown. Ventral surface of body largely black; prosternum laterally, metacoxal process and posterior margins of abdominal sterna 3 to 6, rufous. Legs rufous.

Elytron with sculpture (Fig. 311) of small rounded more or less isodiametric meshes; basomedially meshes most varied in size; elytron punctate, each puncture medially in slightly enlarged mesh.

Anterior margin of clypeus with complete bead. Lateral bead of pronotum narrow (less than 0.5 width of apex of antennal article 3 at widest point), broadest basally and narrowed gradually toward anterior angle. Lateral margin of pronotal disc, immediately inside bead, inflated along anterior half. Prosternal process smoothly convex, glabrous but sparsely and finely punctate; apex acute. Anteromedial metasternal impression well developed. Metatibia with varied number of punctures along posteroventral margin; most specimens with punctures on basal half and on some specimens, punctures extended along entire margin in form of more or less complete row. Metatarsal article 1 of most specimens with small group of ventral setae.

Male with protarsus very narrowly dilated, article 1 1.4 to 1.5 as broad as article 4; articles 1 to 3 with small oval scales on ventral surface; protarsal claws (Fig. 171) subequal in length; anterior claw sinuate ventrally with apex acute and strongly arcuate. Aedeagus (Fig. 207) with subapical spine.

*Taxonomic notes.* — Adults of *A. canadensis* Fall are very similar in almost all respects to those of *A. phaeopterus* (Kirby) and the two species are probably very closely related. In Alberta, these species are largely allopatric; in areas of sympatry, there is no evidence of hybridization.

*Natural history notes.* — This species is a common inhabitant of temporary prairie ponds. Most adults were collected in the early spring from emergent or flooded vegetation along edges of ponds and sloughs whose water level was raised by melt water. Specimens of *A. canadensis* are most abundant in ponds situated on rough fescue grasslands. However, they also occur in water on mixed and shortgrass prairie as well as in parkland and coniferous forest zones, especially when these habitats are in close proximity to prairie habitats as in foothills of the southwestern portion of the province. Specimens were found occasionally in saline sloughs but the species does not appear to be a regular member of this fauna. Teneral specimens were collected from May 31 to June 16. Specimens were observed flying from a small prairie slough 6 mi N Standard on May 3, 1972.

*Distribution.* — This species was recorded from Ontario and North Dakota to eastern British Columbia. The southern limits of the range are unknown. In Alberta, *A. canadensis* ranges to about 55° N, and has not been collected from the Peace River area. I examined more than 350 specimens from Alberta localities (map, Fig. 423).

#### *Agabus phaeopterus* (Kirby, 1837)

*Colymbetes phaeopterus* Kirby, 1837: 70. (Lectotype — (here selected), ♂ in BMNH labelled as follows: Type; N. Amer. 5774b; *phaeopterus* Kirby.) Mannerheim 1853: 159. — Melsheimer 1853: 30. — LeConte 1863a: 17. — Gemminger and Harold 1868: 454. — Sharp 1882: 763. — Horn 1883: 282. — Leng 1920: 79. — Zimmermann 1920: 163. — Fall 1922: 28. — Brown 1930b: 236. — J. Balfour-Browne 1948: 160, 164. — Hatch 1953: 223. — Carr and Leech 1966: 545. — James 1970: 94. — Wallis 1973: 107.

*Diagnosis.* — Closely resembling the species *A. canadensis* but darker in color with the pronotum lacking a broad rufous lateral margin, metatibia with posteroventral row of setae lacking or reduced and metatarsal article 1 glabrous beneath.

*Description.* — Measurements and ratios of 20 specimens from Edson and Fickle Lake, Alberta, are: TL — 6.56 to 7.28 mm ( $\bar{X} = 6.93 \pm 0.19$  mm); MW — 3.52 to 3.92 mm ( $\bar{X} = 3.78 \pm 0.10$  mm); TL/MW — 1.79 to 1.89 ( $\bar{X} = 1.83 \pm 0.03$ ); WC/WS — 2.29 to 2.78 ( $\bar{X} = 2.52 \pm 0.12$ ).

Head black; frontal spots, anterior margin of clypeus, front above antennal base, and labrum, obscurely rufous; antenna testaceous, outer articles infusate apically; palpi testaceous, terminal article of each palpus infusate apically. Pronotum black with lateral bead and margin narrowly inside of bead, dark rufous to piceous; posterior margin narrowly piceous. Elytron with epipleuron and base light brown, disc darker brown to piceous medially and apically on some specimens. Ventral surface black; metacoxal process and posterior margins of sterna 3 to 6 narrowly rufous. Legs rufous; femora slightly darkened medially.



Elytron with sculpture (Fig. 312) of small rounded meshes, regular in size and shape over most of disc but slightly varied in size basomedially on some specimens; disc with sparse even punctation; punctures each situated medially in slightly enlarged mesh.

Clypeus with anterior bead complete. Pronotum with lateral bead narrow, widest basally and narrowing toward front angles; disc inside bead inflated, especially along anterior half of pronotal margin. Prosternal process convex, broadly rounded on most specimens but some specimens with broadly angulate medial convexity; glabrous with small separated punctures. Metatibia with posteroventral margin impunctate on most specimens or some specimens with scattered punctures along basal half. Metatarsal article 1 glabrous ventrally.

Male protarsal articles 1 to 3 narrowly dilated, with small oval scales on ventral surface; anterior protarsal claw slender and relatively short, slightly sinuate ventrally, apex acute but not as strongly arcuate as in *canadensis* adults; posterior claw distinctly although shallowly sinuate towards base. Aedeagus with subapical spine.

*Taxonomic notes.* – Prior to Fall's (1922) revision, the status of this species was in doubt. However, Fall demonstrated that *A. phaeopterus* is a valid species and provided a definition which has enabled subsequent authors to recognize it. In the Alberta fauna, the closest relatives are *A. bicolor* and *A. canadensis* Fall (see discussion under *A. canadensis*).

*Natural history notes.* – This species is widely distributed throughout the forested portions of the province, in areas of aspen parkland, mixed forests and coniferous forests. Specimens are also occasionally taken in small willow- and aspen-ringed pools on rough rescue prairie. A common habitat is the shallow water of cold *Carex* marshes. Many specimens were collected from *Typha* marshes, and from the zone of emergent vegetation along edges of borrow-pits, roadside ditches and other shallow man-made pools – all warm water habitats. The species appears to be largely allopatric with *A. canadensis* (see under *A. canadensis*). Teneral specimens were collected from July 3 to July 21. No records of flight are available.

*Distribution.* – *A. phaeopterus* occurs from Newfoundland and Nova Scotia to British Columbia and from Michigan, Wisconsin and Colorado (Doyleville, CARR !) north to at least the northern Alberta border. I examined more than 270 specimens from Alberta localities (map, Fig. 424).

#### *Agabus bicolor* (Kirby, 1837)

*Colymbetes bicolor* Kirby, 1837: 70. (Type specimen – in BMNH, labelled as follows: Type H.T. (red circle); N. Amer. ♀, 5773a; *bicolor* Kirby; ♂.) – Mannerheim 1853: 158. – Melsheimer 1853: 30. – LeConte 1861: 326. – LeConte 1863a: 17. – Gemminger and Harold 1868: 453. – Sharp 1882: 758. – Horn 1883: 282. – Leng 1920: 79. – Zimmermann 1920: 162. – Fall 1922: 29. – Wallis 1973: 107.

*Agabus mutus* Sharp, 1882: 513. (Lectotype – (here selected) female of pair of specimens on a card born by a single pin in BMNH, labelled as follows: ♀, Hudson's Bay 1879; Type H.T.; 1155; Sharp Coll. 1905-313; *Agabus mutus* Sharp type; *Agabus bicolor* Kby, *mutus* Shp.; Lectotype, *Agabus mutus* Shp., (♀, right side card) selected D.J. Larson.). – Leng 1920: 79. – Zimmermann 1920: 168.

*Diagnosis.* – Adults are similar to those of *A. phaeopterus* but are smaller, darker (especially elytra), and with elytral punctation indistinct.

*Description.* – Measurements of 20 specimens from 26 mi N Gift Lake, Alberta, are: TL – 6.56 to 7.12 mm ( $\bar{X}$  = 6.87 ± 0.15 mm); MW – 3.60 to 3.92 mm ( $\bar{X}$  = 3.76 ± 0.09 mm); TL/MW – 1.79 to 1.87 ( $\bar{X}$  = 1.83 ± 0.03); WC/WS – 2.48 to 3.00 ( $\bar{X}$  = 2.80 ± 0.13).

Head black with frontal spots, anterior margin of clypeus, and frons above base of each antenna, rufous; antenna testaceous to pale rufous with outer articles lightly infuscate; palpi rufous with terminal article of maxillary palpus lightly infuscate on some specimens. Pronotum black; lateral bead, lateral margin narrowly inside of bead and basal margin, dark rufous to piceous. Elytron with disc medially, piceous to black; epipleuron and lateral margin broadly rufous to rufopiceous. Ventral surface largely black. Legs dark rufous with femora and metatibia mainly piceous.

Elytron with sculpture (Fig. 313) of small, rounded or hexagonal meshes, irregular in shape but more or less similar in size; punctation fine and sparse, each puncture situated medially in slightly enlarged mesh.

Clypeus with anterior margin with complete but narrow bead. Pronotum with lateral bead of moderate width, widest basally and narrowed toward apex, anteriorly internal portion partly obscured in dorsal view by laterally inflated pronotal disc. Prosternal process markedly but smoothly convex in cross section, not carinate medially. Metatibia with few separated small setiferous punctures along posteroventral margin, punctures restricted to basal half to two thirds on most specimens. Metatarsal article 1 glabrous ventrally.

Male with articles 1 to 3 of pro- and mesotarsi very slightly broadened; each article with elongate small adhesive scales on

ventral surface. Protarsal claws slender, subequal in length; anterior claw evenly narrowed throughout length with ventral surface very slightly sinuate; posterior claw similar in shape to anterior but ventral situation more pronounced. Aedeagus with acute subapical ventral spine; apex distad to spine elongate and slender.

*Taxonomic notes.* — Sharp's collection contains a male and a female glued to one card and mounted on the same pin. The female appears to be a typical specimen of *A. bicolor*, as was suggested by Fall (1922), and I labelled it as lectotype. The male, however, differs from most specimens of *bicolor* in paler color, with the elytron more irregularly microsculptured and more distinctly punctate, and with the pronotum less strongly inflated inside the lateral bead. Of 12 specimens that Sharp reported to have examined, I could find only 8 in the BMNH. The series shows some variation and may be composite. However, I am not sufficiently familiar with the species in this group to permit me to assign them to any other species.

*Natural history notes.* — Most specimens of *A. bicolor* examined were collected from cold *Carex-Sphagnum* swamps, mostly from small willow-shaded pools with water cold to the touch. This species, and the two related species, *A. canadensis* and *A. phaeopterus* appear to form a replacement series in the various types of ponds in the province. The species *A. canadensis* occurs in warm ponds in both prairie and mixed forest associations; *A. phaeopterus* inhabits forest ponds but is usually not in cold waters of *Sphagnum* bogs, whereas *A. bicolor* is usually associated with *Sphagnum* and cold water.

General specimens were collected from July 10 to August 8.

*Distribution.* — This species probably has a wide distribution in the northern boreal portions of North America but has been recorded previously only from Manitoba and Edmonton, Alberta. I examined 70 specimens from Alberta localities (map, Fig. 425).

#### *Agabus confinis* (Gyllenhal, 1808)

*Dytiscus confinis* Gyllenhal, 1808: 511. (Type locality — not known), not Stephens 1828: 80. — Aubé, 1836: 158. — Aubé 1838: 333. — Gemminger and Harold 1868: 454. — Sharp 1882: 520. — Horn 1883: 178. — Wickham 1895b: 121. — Blatchley 1910: 226. — Carr 1920: 4. — Leng 1920: 79. — Zimmermann 1920: 162. — Fall 1922: 29. — Brown 1930b: 236. — Brown 1932b: 201. — Zimmermann 1934: 197. — Hatch 1953: 223. — Zaitsev 1953: 257. — Carr and Leech 1966: 545. — James 1970: 93. — Wallis 1973: 107.

*Agabus ovoideus* LeConte, 1863: 17. (*nomen nudum*).

*Gaurodytes ovoideus* Crotch, 1873: 418. — (Type locality — not specified, type series from Kansas and Lake Superior.)

*Gaurodytes longulus* LeConte, 1878a: 596. (Type locality — Lake Superior.). — Sharp 1882: 776. — Leng 1920: 79. — Zimmermann 1920: 167.

*Diagnosis.* — The combination of large size, dark color, finely and evenly reticulate elytral surface, and carinate prosternal process, make this one of the most distinctive species of the group whose members possess a subapical ventral spine on the aedeagus.

*Description.* — Measurements of 20 specimens from Fickle Lake, Alberta, are: TL — 8.16 to 9.12 mm ( $\bar{X} = 8.53 \pm 0.24$  mm); MW — 4.56 to 4.88 mm ( $\bar{X} = 4.68 \pm 0.11$  mm); TL/MW — 1.73 to 1.90 ( $\bar{X} = 1.82 \pm 0.04$ ); WC/WS — 1.88 to 2.27 ( $\bar{X} = 2.05 \pm 0.08$ ).

Head black except frontal spots, anterior margin of clypeus, and labrum, rufous; antenna pale rufous except outer articles lightly infuscate apically on some specimens; palpi pale except terminal article of each palpus lightly infuscate apically. Pronotum black except lateral bead and anterolateral angle, dark rufous or piceous. Scutellum piceous. Elytron dark brown to piceous, lateral margin and epipleuron externally, pale brown to light rufous. Ventral surface mainly black. Legs rufous except femur and metatibia piceous.

Elytron with meshes of sculpture (Fig. 314) small and rounded but unequal in size and varied in shape, especially basolaterally; more regular laterally and apically; fine sparse punctures present, each central in a mesh.

Clypeus with well defined anterior bead. Pronotum with lateral bead of moderate width, well defined and of more or less equal width throughout length; anterior sublateral margin not inflated inside bead. Prosternal process narrow, angularly convex in cross section with median convexity carina-like and sides concave externally; apex broadly pointed, not acuminate. Metasternal impression not extended to level of hind margin of mesocoxae. Metatibia with punctures along posteroventral margin various, on some specimens punctures extended along basal 0.66 of tibia, in form of continuous row of separated punctures, other specimens with only five or six punctures on basal third of tibia or punctures scattered irregularly along hind margin. Metatarsal article I glabrous beneath or with one or two ventral setae.

Male protarsal articles 1 to 3 slightly broadened, each with small adhesive scales on ventral surface; article 5 unmodified;

claws (Fig. 172) subequal in length, similar in shape, slender and only very slightly sinuate beneath. Aedeagus (Fig. 208) with ventral subapical spine; apex various in degree of reflexion.

*Taxonomic notes.* – Horn (1883), in his usual conservative manner, considered the names *A. ovoideus* (Crotch), *A. bicolor* (Kirby) and *A. phaeopterus* (Kirby) to be junior synonyms of *A. confinis*. Fall (1923) confirmed this synonymy for *A. ovoideus* but treated both of Kirby's species as valid. I agree with this conclusion and treat *A. bicolor* and *A. phaeopterus* as separate species.

*Natural history notes.* – This is one of the most commonly encountered species in cold-water ponds and bogs of the forested portions of the province. The species is a typical member of the *Sphagnum* bog fauna but also occurs in areas where *Sphagnum* is lacking, especially in dense stands of emergent *Carex* with the water surface shaded and cool. Most specimens were taken at elevations well below the tree line in mountain localities. Teneral specimens were collected from July 10 to August 5.

*Distribution.* – *A. confinis* is an Holarctic boreal species ranging in North America, from Quebec to British Columbia and from Michigan (Douglas L., UASM !) and Wisconsin, north to at least Churchill, Manitoba, and Great Slave Lake (Hay River, UC). I examined 356 specimens from Alberta localities (map, Fig. 426).

#### *Agabus congener* (Thunberg, 1794)

*Dytiscus congener* Thunberg, 1794: 75. (Type locality – not known to me.). – Gemminger and Harold 1868: 454. – Sharp 1882: 512. – Horn 1883: 278. – Zimmermann 1919: 210. – Leng 1920: 79. – Zimmermann 1920: 162. – Fall 1922: 25. – Brown 1930b: 236. – Zimmermann 1934: 202. – Brown 1937: 109. – Hatch 1953: 222. – Zaitsev 1953: 247. – Gordon and Post 1965: 20. – Wallis 1973: 107. (Old World synonymy omitted.)

*Diagnosis.* – This species and the following four form a group whose members differ slightly among themselves. No single character is diagnostic of *A. congener*, but taken together, the irregular-sized and shaped meshes of the elytron, dark lateral margins of the pronotum, faint aeneous sheen of the elytron, broadly convex prosternal process, infuscate antenna and palpi, low value for the ratio WC/WS, and aedeagus which is slightly broadened near the base of the subapical spine, allow the species to be fairly consistently recognized.

*Description.* – Measurements of 40 specimens from Nordegg and the headwaters of the Red Deer River, Alberta, are: TL – 6.96 to 8.24 mm ( $\bar{X} = 7.60 \pm 0.30$  mm); MW – 3.84 to 4.40 mm ( $\bar{X} = 4.14 \pm 0.13$  mm); TL/MW – 1.82 to 1.91 ( $\bar{X} = 1.86 \pm 0.29$ ); WC/WS – 1.64 to 2.14 ( $\bar{X} = 1.82 \pm 0.10$ ).

Head black except frontal spots and frons above base of antenna, rufous and clypeus with anterior margin narrowly piceous on some specimens; antenna rufous, articles 5 or 6 to 11 infuscate apically (rarely entirely pale); palpi rufous except terminal article of each palpus piceous apically. Pronotum black except lateral bead dark rufous or piceous, side of disc internal to bead piceous or black. Elytron with humerus, lateral margin and epipleuron rufous to reddish brown, disc piceous medially and apically and many specimens with faint aeneous sheen. Ventral surface mainly black. Legs rufous except femur at apex, and metatibia, piceous; metatarsi dark rufous.

Elytron with lines of sculpture (Fig. 315) fine; meshes very unequal in size and shape, angular in outline on most specimens not rounded, unequal over disc; small sparse inconspicuous punctures on some meshes. Female with lines of sculpture on basomedial portion of disc with lines relatively deeply impressed, sculpture pronouncedly coarser.

Clypeus finely and completely beaded. Lateral bead of pronotum of moderate width, well delimited and of equal width throughout length. Prosternal process basally with low even convexity, more convex toward apex but not distinctly carinate or tectiform: process finely punctate, rarely setose. Metasternal wings broad. Metatibia of most specimens with several scattered punctures along posteroventral margin, at least on basal quarter.

Male articles 1 to 3 of pro- and mesotarsi slightly broadened; each article with small adhesive scales beneath, scales slightly larger and not so elongate as those of *A. approximatus*; anterior protarsal claw slightly longer and broader than posterior, both with ventral margin straight or just perceptibly sinuate. Aedeagus (Fig. 209) with subapical ventral spine short, aedeagus slightly broadened subapically at level of base of spine.

*Taxonomic notes.* – This species varies markedly over its wide geographical range, but a detailed study has not been made. As a result, the status of *A. congener* is not clear. Within Alberta, the form treated as *A. congener* is the most stable in terms of structural characters and is the most easily recognized species of its group. In several localities, specimens were collected

in mixed series with specimens of *A. discolor* and *A. approximatus*, and in most situations intergradation is not indicated. However, a series of five specimens from the headwaters of the Livingstone River (3.6 mi N Jct Kananaskis Hwy. and Livingstone R., UC) possess characteristics of *A. discolor*, *A. approximatus* and *A. congener* in various combinations. In spite of this, I regard *A. congener* as a valid species primarily on the basis of its morphological stability over a wide range in North America. I have seen specimens from the Yukon, Quebec and Labrador which correspond closely to Alberta specimens.

The names *A. discolor* (Harris), *A. ambiguus* (Say), *A. morosus* LeConte, *A. inscriptus* (Crotch) and *A. phaeopterus* (Kirby) were placed as synonyms of *A. congener* by Zimmermann (1919). However, Fall (1922) demonstrated that each of these names applies to a valid species.

*Natural history notes.* – These beetles appear to be rather local in distribution. Most have been collected from among emergent sedges and rushes along margins of small spring- or seepage-fed pools in forested portions of the province, mostly from foothills or hilly regions – presumably areas where springs and seepage areas are most frequently found. Teneral specimens were collected from July 31 to August 22, somewhat later in the year than tenerals of most related species. Generally, specimens of *congener* are found more frequently during summer months than in early spring, an unusual temporal pattern for a species of *Agabus*.

*Distribution.* – This species is holarctic in boreal and arctic regions, and is recorded from Britain to Siberia and from Alaska to Newfoundland. I examined 94 specimens from Alberta localities shown in Figure 427.

#### *Agabus discolor* (Harris, 1828)

*Colymbetes discolor* Harris, 1828: 164. (Type locality – not stated), not LeConte, 1851. – Melsheimer 1853: 30. – Sharp 1882: 759. – Gemminger and Harold 1868: 454. – Horn 1883: 278. – Leng 1920: 79. – Zimmermann 1920: 163. – Fall 1922: 26. – Gordon and Post 1965: 20. – Watts 1970: 724. – Wallis 1973: 107.

*Diagnosis.* – Specimens are similar to those of *A. congener*, but generally elytral sculpture is finer, lateral margin of the pronotum inside the lateral bead is constantly rufous, and the metasternal wing is narrow. On unrubbed specimens, the prosternal process is conspicuously setose, more so than on any similar species.

*Description.* – Measurements of 30 specimens from 8 mi E Nordegg (20 specimens) and 2 mi S Indian Cabins on Hwy. 35 (10 specimens) are: TL – 6.88 to 7.68 mm ( $\bar{X} = 7.25 \pm 0.18$  mm); MW – 3.68 to 4.24 mm ( $\bar{X} = 3.98 \pm 0.12$  mm); TL/MW – 1.75 to 1.90 ( $\bar{X} = 1.82 \pm 0.04$ ); WC/WS – 2.28 to 2.84 ( $\bar{X} = 2.61 \pm 0.13$ ).

Head black except frontal spots, frons above base of antenna, and anterior 0.33 to 0.5 of clypeus, rufous; antenna rufous, outer articles lightly infusate apically or not; palpi rufous except terminal article of maxillary palpus lightly infusate or not. Pronotum black except lateral bead rufous to piceous; lateral margin of disc internal to bead rufous; basal margin narrowly rufous. Elytron with epipleuron, lateral and basal margins, testaceous; disc darkened internally and apically, brown to piceous. Ventral surface black except apex of prosternal process, metacoxal process, internal portion of sternum 1 of some specimens, and posterior margin of sterna 3 to 6, rufous. Legs rufous to brown except femur, at least medially and metatibia, darkened.

Elytron with lines of sculpture (Fig. 316) fine, meshes small, somewhat rounded in outline but on most specimens distinctly irregular in size and shape, especially medially and basally; with small scattered punctures both on meshes and in lines. Sternum 6 posteromedially with punctures and coarse transverse lines but lines not in form of very coarse, convex meshes.

Clypeus with complete fine anterior bead. Lateral bead of pronotum of moderate even width throughout length or slightly narrowed anteriorly, well delimited from disc basally and medially, less so toward anterolateral angle: disc inside lateral bead more or less flat or gradually and evenly convex, not decidedly inflated. Prosternal process broad, ventral surface smoothly and evenly convex or with broad medial longitudinal angulation; surface punctate and on many specimens with distinct erect setae, best seen in lateral view. Metasternal wings narrow. Metatibia with internal ventral margin impunctate or with few small punctures near base. Metatarsal article I glabrous ventrally.

Male articles 1 to 3 of protarsus very slightly broadened, each article with small elongate scales on ventral surface: anterior protarsal claw very slightly longer than posterior, slightly broader and with ventral surface more or less straight medially when seen from side; posterior claw slightly but evidently sinuate along ventral margin. Aedeagus with subapical ventral spine; narrowed toward apex and not broadened subapically.

*Taxonomic notes.* – This species has had a complex taxonomic history. Gemminger and Harold considered it to be conspecific with *A. phaeopterus* (Kirby). LeConte used the name

*A. discolor* LeConte for specimens of *A. lutosus*. Crotch corrected this homonymy by proposing the replacement name *A. lecontei*, for *A. discolor sensu* LeConte, but aside from this made no reference to the status or application of the name *A. discolor* (Harris). Horn placed the name *A. discolor* (Harris) as a junior synonym of *A. ambiguus* (Say) which he in turn considered to be conspecific with *congener* (Paykull). Leng listed the names *ambiguus* (Say) and *subfuscatus* Sharp as junior synonyms of *discolor* while Zimmermann placed the name *A. discolor* as a junior synonym of *A. congener*. Fall recognized *A. discolor* (Harris) as a valid species and was the first to provide a description adequate for its recognition.

*Natural history notes.* – Most adults of *A. discolor* that I found were among emergent vegetation or in plant debris along margins of small slow-flowing streams, in seepage areas, or in small grass- or sedge-filled spring or stream-fed pools, in forested portions of the province. Teneral specimens were collected from July 8 to July 17.

*Distribution.* – Fall records this species from New England to Manitoba. I examined 26 specimens from Manitoba (UASM), all of which are similar to Alberta specimens, and 126 specimens from Alberta localities (map, Fig. 428).

#### *Agabus approximatus* Fall, 1923

*Agabus approximatus* Fall, 1923: 26. (Type locality – Horseshoe Peak Divide, San Mig. Co., Colorado.) – Leng and Mutchler 1927: 17. – F. Balfour-Browne 1950: 77. – Hatch 1953: 222. – Leech and Chandler 1956: 321. – Anderson 1962: 69.

*Diagnosis.* – Adults are very close to those of *A. congener* and *A. discolor*. Paler integument and narrower subapical portion of the aedeagus separate specimens of *A. approximatus* from those of *A. congener*. It is not possible to distinguish constantly between *A. approximatus* and *A. discolor*, but specimens of the former generally have more coarsely impressed elytral micro-sculpture, lateral margin of pronotum is less broadly rufous, prosternal process is more strongly angulate medially and the metasternal wing is broader.

*Description.* – Measurements of 25 specimens from the Cardston, Alberta, area are: TL – 7.60 to 8.48 mm ( $\bar{X} = 7.87 \pm 0.20$  mm); MW – 4.16 to 4.48 mm ( $\bar{X} = 4.23 \pm 0.10$  mm); TL/MW – 1.76 to 1.89 ( $\bar{X} = 1.82 \pm 0.04$ ); WC/WS – 1.84 to 2.21 ( $\bar{X} = 2.01 \pm 0.10$ ).

Head black except frontal spots and, on some specimens, anterior margin of clypeus narrowly rufous; antenna rufous, terminal articles lightly infusate apically or not; palpi testaceous, except apex of terminal article of maxillary palpus lightly infusate on some specimens. Pronotum black except lateral bead and a narrow lateral margin of disc just internal to bead, rufous. Elytron with epipleuron, basal and lateral margins, testaceous to pale brown; disc brown to piceous brown, rarely piceous; without metallic reflection. Ventral surface mainly black. Legs rufous except femora, at least medially, and metatibia, piceous.

Elytron with lines of sculpture (Fig. 317) generally deeper than in *A. discolor*, meshes generally larger and of obviously different shapes and sizes over all but extreme apex; with scattered small punctures situated medially on larger meshes.

Structure similar to *A. discolor* but differing as follows: prosternal process strongly convex, from strongly and evenly convex in cross-section to tectiform, to more or less carinate with sides lateral to median ridge concave; glabrous on most specimens. Ratio WC/WS less than for *A. discolor*. Sexual characters as in *discolor*. Aedeagus as in Figure 210.

*Taxonomic notes.* – Specimens of *A. approximatus* from southwestern Alberta are distinct from specimens of *A. discolor* from central and northern Alberta. However, populations from the Cypress Hills and localities in the latitude of Calgary to Edmonton, often possess characteristics of both species, including a ratio of WC/WS of an intermediate value, and hence they could as easily be assigned to one species as the other. The approach taken here, that is assigning both forms the rank of full species, is not justified on the basis of variation shown in Alberta populations. However, a careful study of type material and of variation shown by both forms is necessary before their status can be determined. The following species, *A. sp.* near *approximatus*, shows the same sort of relationship to *A. approximatus* the latter shows to *A. discolor*, but it, too, is treated as a full species for it also has a discrete geographical range and occupies a somewhat different habitat.

*Natural history notes.* – Like *A. discolor*, this species inhabits patches of emergent vegetation

in small, often warm, slow-flowing creeks and springs, or in pools or ponds fed by at least temporary streams. Specimens are often found in drying pools situated in the beds of melt-water creeks. Many teneral specimens were collected during the last two weeks of June, but as adults are often abundant in early spring, possibly overwintering occurs in the adult stage with larval development in early spring. This appears even more likely as certain forms of habitat in which the species occurs, persist only a short time during and just after spring run-off.

*Distribution.* — The species ranges from Colorado and Utah to California, and north to British Columbia and southern Alberta. I examined 130 specimens from Alberta localities (map, Fig. 429).

*Agabus* species near *approximatus*

*Diagnosis.* — This species is very similar to *A. approximatus* but differs in the ways given in the following description.

*Description.* — Measurements of two population samples are: — Highwood Pass (N = 20): TL — 6.96 to 8.00 mm ( $\bar{X}$  = 7.52 ± 0.30 mm); MW — 3.68 to 4.24 mm ( $\bar{X}$  = 4.04 ± 0.18 mm); TL/MW — 1.80 to 1.93 ( $\bar{X}$  = 1.86 ± 0.03); WC/WS — 1.76 to 2.35 ( $\bar{X}$  = 2.10 ± 0.16); Bow Lake, Banff National Park (N = 35): TL — 6.72 to 8.40 mm ( $\bar{X}$  = 7.42 ± 0.37 mm); MW — 3.60 to 4.24 mm ( $\bar{X}$  = 3.96 ± 0.17 mm); TL/MW — 1.80 to 1.96 ( $\bar{X}$  = 1.88 ± 0.04); WC/WS — 1.89 to 2.42 ( $\bar{X}$  = 2.12 ± 0.12).

Color usually darker than that of *A. approximatus*: antenna and palpi rufous; antenna with articles 5 or 6 to 11 lightly infuscate apically, terminal article of each palpus lightly infuscate apically on many specimens; lateral bead of pronotum rufous, but disc internal to bead very narrowly rufous or, on most specimens, piceous; elytron with disc dark rufous to piceous, with humerus, lateral margin and epipleuron, pale brown.

Elytron with lines of sculpture (Fig. 318) more deeply impressed, especially on female; meshes very irregular in size and shape.

Prosternal process strongly convex, tectiform or carinate but on most specimens sides lateral to medial convexity not concave. Aedeagus as in Figure 211.

*Taxonomic notes.* — Specimens of this species from higher elevations of western Alberta are distinct from prairie specimens of *A. approximatus*. However, in the southwestern foothills, this species and *A. approximatus* intergrade. Both this species and *A. discolor* have been collected from the same pond in the Nordegg area but specimens showed no sign of intergradation. Because of the unsettled state of classification of this group of species, I have not proposed a name for this form, as such would introduce additional nomenclatural complexity.

*Natural history notes.* — This insect inhabits small moss-ringed alpine pools to elevations of at least 6800'. Specimens were also collected in subalpine localities among emergent vegetation in small seepage or spring-fed pools, usually in cool water over a bottom of black organic silt. Teneral specimens were collected July 31 and August 1.

*Distribution.* — Not known outside of Alberta, the species is restricted to the Rocky Mountains and adjacent foothills. I examined more than 200 specimens from Alberta localities (map, Fig. 430).

*Agabus inscriptus* (Crotch), 1873

*Gaurodytes inscriptus* Crotch, 1873: 422. (Type locality — Labrador.). — LeConte 1863a: 17 (nomen nudum). — Leng 1920: 79. — Zimmermann 1920: 163. — Fall 1922: 27. — Fall 1926: 141. — Brown 1930: 236. — Hatch 1953: 223. — Wallis 1973: 107.

*Agabus smithi* Brown, 1930a: 88. (Type locality — Copper Mtn. near Creston, B. C.). — Leng and Mutchler 1933: 15. — Leech and Chandler 1956: 321. — Hatch 1953: 223.

*Diagnosis.* — This species varies markedly and may be a composite of two or three poorly differentiated species. It is a member of the *A. congener* group and is most easily recognized on the basis of small size and broad metasternal wings.

*Description.* — Measurements and ratios for population samples from two localities are: Junction of S and W Castle Rivers (N = 20): TL – 6.16 to 6.96 mm ( $\bar{X} = 6.59 \pm 0.21$  mm); WC/WS – 1.81 to 2.35 ( $\bar{X} = 2.02 \pm 0.13$ ); Jasper National Park, Maligne Range (N = 20): TL – 6.40 to 7.20 mm ( $\bar{X} = 6.80 \pm 0.23$  mm); WC/WS – 1.86 to 2.30 ( $\bar{X} = 2.08 \pm 0.12$ ).

Head black except rufous frontal spots and anterior margin of clypeus of some specimens piceous; antenna rufous, articles 5 to 11 lightly infusate apically or not; palpi rufous, terminal article of each palpus with apex lightly infusate or not. Pronotum black except lateral bead dark rufous to piceous and some specimens with disc narrowly inside of bead, rufous. Elytron with basal and lateral margins and epipleuron, brown; disc darker medially and apically, dark brown to piceous. Ventral surface black except posterior margin of sterna 3 to 6, rufous. Legs rufous except femora darkened medially.

Sculpture of head and pronotum various. Elytron (Fig. 319, 320, 321) with lines lightly impressed, meshes small; sculpture various, meshes from small more or less rounded to very irregular in shape and size, but most specimens, at least basomedially meshes of unequal size and shape.

Clypeus with anterior bead fine but complete. Pronotum with disc inside anterior portion of lateral bead more or less flat or at most gently convex and not abruptly inflated. Prosternal process various, broadly and evenly convex to subangularly convex but not carinate; glabrous. Metatibia punctate along inner ventral margin or not. Metatarsal article 1 glabrous ventrally.

Male articles 1 to 3 of pro- and mesotarsi very slightly widened, each with numerous small narrow scales on ventral surface; protarsal claws slightly elongated, anterior claw slightly longer and broader than posterior, not sinuate beneath; posterior claw with slight ventral sinuation. Aedeagus slender, not swollen subapically; with elongate subapical ventral spine.

*Taxonomic notes.* — Most Alberta specimens can be assigned to one of three forms, although they are not strongly differentiated and some specimens could be as easily placed with one as another. However, there is justification for their recognition, at least informally, for they are mainly allopatric and differ in habitat, although this may result from each form occupying a different physiographic area. Because these forms are very similar to one another, they may be localized races or ecotypes of a widespread species.

Below, for each of these forms, are given diagnostic characteristics, names, habitat and distribution in Alberta.

Form A. — This is the typical form to which the name *A. inscriptus* (Crotch) applies. It is transcontinental in the northern or boreal portions of the continent, and inhabits the boreal portion of Alberta, and intergrading with form B in the Swan Hills and along the Rocky Mountain foothills. Characteristics of Form A are:

Microsculpture of pronotum fine, meshes small and on most specimens not longitudinally stretched anteromedially on disc. Elytron with meshes (Fig. 319) small and rounded. Prosternal process relatively broad, lowly and evenly convex or with low broad medial longitudinal angulation. Metatibia with posterior ventral margin impunctate on most specimens.

Most specimens have been collected from sphagnum bogs. Teneral specimens have been collected from July 17 to 31.

I examined 55 specimens from Alberta localities (map, Fig. 431).

Form B. — This is without a formal name. In many characteristics it is intermediate between forms A and C; yet it retains a distinctive appearance. The principal characteristics are:

Color dark, clytron mainly piceous; tibia of many specimens infusate. Pronotum with meshes of sculpture larger than in form A, meshes somewhat elongate anteromedially. Elytron with meshes (Fig. 320) very irregular in size and shape, lines relatively deeply impressed, especially on female. Prosternal process strongly convex, with distinct rounded medial angulation. Metatibia with inner ventral margin impunctate or with few punctures near base or rarely scattered along much of length of the tibia. Aedeagus as in Figure 212.

These insects are found in small alpine and subalpine pools, to an elevation of at least 7300', among sedges or rushes or in very small moss-ringed pools. Teneral specimens have been collected on August 9.

This form is known only from the Rocky Mountains and adjacent foothills and from the higher elevations in the Swan Hills. I examined 98 specimens (map, Fig. 432).

Form C. — I compared Alberta specimens with a male paratype of *A. smithi* Brown and they agree well in all characters including punctuation and microsculpture. Characteristics are:

Color pale, clytron of many specimens uniformly brown or pale piceous. Dorsal surface densely punctate. Pronotum with meshes of sculpture large, somewhat elongate anteromedially, with numerous small punctures both in lines and on meshes. Elytron with meshes (Fig. 321) generally rounded in shape, irregular in size, with numerous distinct punctures, each medially on a mesh. Prosternal process with rounded or subangulate medial convexity. Metatibia with inner ventral margin with punctures on most specimens forming row along much of length. Aedeagus as in Figure 213.

The specimens that I have collected were found among emergent *Carex* along backwaters

of very small slow creeks and along the margin of an old largely grown-in beaver pond.

This form is known from southeastern British Columbia and extreme southwestern Alberta. I examined 50 specimens (map, Fig. 433).

*Agabus bifarius* (Kirby, 1837)

*Colymbetes bifarius* Kirby, 1837: 71. (Type specimen – female in BMNH labelled as follows: Type H.T.; N. Amer. 5775a; *Colymb. bifarius* Kirby, N. Amer. 5775 Rev. W. Kirby !). – LeConte 1850: 214. – Melsheimer 1853: 30. – LeConte 1863a: 17. – Gemminger and Harold 1868: 453. – Crotch 1873: 414. – Sharp 1882: 537. – Wickham 1895b: 118. – Leng 1920: 79. – Zimmermann 1920: 185. – Brown 1930b: 237. – Leech 1942a: 87. – Leech 1942b: 357. – Hatch 1953: 228. – Zimmermann 1934: 144. – F. Zaitsev 1953: 266. – Carr and Leech 1966: 98. – James 1970: 94. – Wallis 1973: 108.

**Diagnosis.** – The pattern of elytral sculpture, in part of numerous deeply impressed more or less separated lines longitudinally oriented basally but transverse apically, is unique to this species.

**Description.** – Measurements of 20 specimens from Calgary, Alberta are: TL – 6.24 to 6.72 mm ( $\bar{X} = 6.43 \pm 0.15$  mm); MW – 3.28 to 3.68 mm ( $\bar{X} = 3.41 \pm 0.09$  mm); TL/MW – 1.82 to 1.95 ( $\bar{X} = 1.88 \pm 0.03$ ); WC/WS – 2.95 to 4.07 ( $\bar{X} = 3.49 \pm 0.26$ ).

Body piceous to black. Head with frontal spots, anterior margin of clypeus, anterolateral portions of frons, and labrum, rufous; antenna testaceous to rufous with articles 5 to 11 infusate apically; palpi testaceous, terminal article of each palpus infusate. Pronotum with lateral and basal margins rufous. Scutellum and elytron uniformly piceous to black. Ventral surface piceous to black except prosternal process, metacoxal process, and posterior margin of abdominal sterna, rufous to pale piceous. Legs rufous except femora infusate medially and also basally on some specimens.

Male sculpture of elytron (Fig. 322) of deeply impressed, short, separated lines, directed longitudinally on basal portion of disc, oblique medially and transverse apically on disc; interspaces with fine, more or less isociametric microreticulation and with widely scattered inconspicuous punctures. Female (Fig. 323, 324) with similar pattern of primary sculpture but lines deeper and denser, on some specimens more or less merging or interconnected but not in form of definite meshes; interspaces with secondary sculpture coarse, punctation deeper and denser than on male.

Clypeus with anterior bead interrupted medially or not. Pronotum with lateral bead of moderate width, clearly delimited posteriorly and medially but indistinct toward front angle. Prosternal process subangularly convex in cross section, punctate and sparsely setose. Anteromedial portion of metasternum impressed. Metasternal wings very narrow. Metatibia with punctures of posteroventral margin restricted to basal third. Metatarsal articles 1 and 2 with very fine sparse punctation on dorsal surface.

Male with protarsal claws as in Figure 173. Aedeagus as in Figure 214.

**Taxonomic notes.** – This is the only water beetle in the fauna known to be wing dimorphic. The wing is either normally developed with a reflexed apex or is narrowed and shortened to about the length of a normal wing between its base and the first bend in the apical reflexion. The majority of the population samples that Leech (1942a) and I examined, contain both long- and short-winged individuals. However, micropterous specimens predominate in most Alberta samples. Table 2 summarizes data on wing length in selected Alberta populations of *A. bifarius*. Insufficient samples are available to delimit patterns of variation but it appears as though mountain and foothills areas have the highest frequency of micropterous individuals, the Peace River area the lowest, and the prairie and boreal portions of the province intermediate frequencies.

Leech (1942a) noted that the western populations of this species showed sexual dimorphism in elytral sculpture while eastern North American populations did not, or at least the majority of the females resembled the males.

**Natural history notes.** – This species occurs in a variety of habitats, from temporary to permanent ponds in both prairie and forested portions of the province. However, it appears to be most abundant in shallow temporary ponds situated in rough fescue prairie or in the parkland areas. These ponds are typically shaded, at least in part, by willow, aspen and emergent vegetation as well as dense accumulations of *Carex* and grass stalks. This is one of the first species to become active in the spring, and specimens were found copulating in a thin layer of melt water which covered the ice of a still frozen pond. Many teneral specimens were seen from July 4 to July 21.

**Distribution.** – Leech (1942a) recorded *A. bifarius* from New Hampshire and Massachusetts to British Columbia, and south to Illinois. The northern limits are unknown but I examined



specimens from Churchill (Wallis, UASM) and Great Salve Lake, N.W.T. (UC), and more than 500 specimens from Alberta localities (map, Fig. 434).

Table 2. Data on variation in wing length among selected Alberta population samples of *Agabus bifarius* Kirby.

Locality	N	% micropterous
18 mi S Irvine	32	81
8 mi W Calgary	71	83
Forestry Trunk-Road, 21 mi N Hwy 1A	31	100
Teepee-pole Creek, W Bearberry	19	68
4 mi S Lacombe	14	79
8 mi E Nordegg	19	95
Edmonton	18	56
44 mi N Hinton	13	100
10-12 mi S Swan Hills	45	82
2 mi S Ft. McKay	13	85
Peace River area (pooled localities)	19	37

#### *Agabus antennatus* Leech, 1939

*Agabus antennatus* Leech, 1939: 217. (New name for *A. clavatus* LeConte.). – Hatch 1953: 228. – Anderson 1962: 70. – Gordon and Post 1965: 21. – Wallis 1973: 108.

*Agabus clavatus* LeConte, 1859a: 4. (Type locality – Loup Fork of Platte R., Nebraska.). – Not Latreille, 1804. – LeConte 1863a: 17. – Gemminger and Harold 1868: 454. – Crotch 1873: 414. – Sharp 1882: 536. – Carr 1920: 4. – Leng 1920: 79. – Zimmermann 1920: 181. – Fall 1922: 34. – Brown 1931: 116. – F. Balfour-Browne 1950: 36, 143. – Watts 1970: 723.

**Diagnosis.** – Enlarged metacoxal plates and clavate antennae separate males from those of other Alberta species of *Agabus*.

**Description.** – Measurements of 20 specimens from the vicinity of Beauvis Lake Provincial Park (nr. Pincher Creek), Alberta, are: TL – 7.36 to 8.00 mm ( $\bar{X} = 7.68 \pm 0.19$  mm); MW – 3.68 to 4.28 mm ( $\bar{X} = 3.97 \pm 0.14$  mm); TL/MW – 1.87 to 2.02 ( $\bar{X} = 1.94 \pm 0.04$ ); WC/WS – 3.50 to 4.18 ( $\bar{X} = 3.88 \pm 0.22$ ).

Body brown to piceous. Antenna with articles 9 or 10 to 11 darkly infuscate; palpi pale with apical half of terminal article of each palpus black. Elytron with lateral and basal margins testaceous to pale brown, disc darker, brown to piceous medially and apically. Ventral surface reddish brown except metasternal wings, metacoxae and basal portions of abdominal sterna, dark brown to piceous.

Elytron with sculpture (Fig. 325) of small hexagonal isodiametric meshes, lines deepest basally and shallower toward apex; with scattered small punctures, mainly in intersections of lines.

Clypeus finely and completely margined. Pronotum with lateral bead broad; anterolateral angles large, extended relatively far forward; lateral margin evenly arcuate. Prosternal process angularly convex medially, more rounded basally and apically; apex acute. Metasternum with anteromedial margin incised to level of hind margin of mesocoxae. Metasternal wings very narrow; metacoxae large, extended forward to level of hind margin of mesocoxae. Metatibia with few punctures along at least basal third of posteroventral margin.

Male smaller than female, less convex dorsally and narrower and more parallel sided. Male with antennal articles 5 to 11 expanded laterally, subclavate narrow club (Fig. 144). Protarsal claws (Fig. 174) slightly elongated, anterior claw rather narrow and straight, posterior claw shorter and distinctly sinuate beneath; protarsal article 5 with a small blunt ventral tooth, ventral setae reduced and restricted to region of tooth. Aedeagus (Fig. 215) narrow, apex bluntly rounded, not twisted; basal piece small; paramere short, triangular in lateral view.

**Taxonomic notes.** – The systematic position of this species is in doubt. Although it shares male clavate antennae with *A. serricornis* (Paykull), *A. clavicornis* Sharp and *A. verus* Brown, Brown (1931), Leech (1939) and F. Balfour-Browne (1950) express doubt that *A. antennatus* is related to the others. However, the relatively large metacoxal plates, hexagonal or rounded

isodiametric sculpture of the elytron, and brown to piceous color of body, are characters shared by all of these species as well as an essentially similar form of male genitalia. These characters increase the plausibility of the four species being a natural unit.

*Natural history notes.* — *A. antennatus* is common in the emergent zone of warm shallow ponds and lakes of the parkland and mixed forest regions of the province. Although less common elsewhere, specimens have been found in most areas of the province, usually in warm permanent ponds but occasionally in cold *Carex* marshes and along the margins of slow creeks. Teneral specimens were collected from July 7 to August 29. Watts (1970) described the larva.

*Distribution.* — The species ranges from Manitoba to British Columbia and from Nebraska to the Mackenzie Delta (Aklavik, UASM). I examined 430 specimens from Alberta localities (map, Fig. 435).

#### Genus *Carrhydrus* Fall, 1923

*Carrhydrus* Fall, 1923: 35. (Type species — *Carrhydrus crassipes* Fall, by monotypy.)

The single species is known only from Alberta and the District of Mackenzie, Northwest Territories. Males are remarkable for the great development of their secondary sexual characters. Both sexes are identified to genus by the distinctive structure of the mouthparts: penultimate article of labial palpus expanded and triangular in cross section with faces more or less concave; submentum with transverse series of coarse parallel longitudinal ridges. These structures have been interpreted as forming a stridulatory organ with the sharp posterior face of the labial palpus acting as the plectrum which is drawn across the file on the submentum (Larson and Pritchard, 1974).

Additional characteristics of the genus are: clypeus with anterior margin finely but more or less completely margined; eye emarginate above base of antenna; pronotum margined laterally; prosternum and process in same plane, prosternal process elongate and slender, received into a deeply impressed groove on anteromedial portion of metasternum; mesosternum large, prominent; metacoxal lobes rounded; metafemur with well developed subapical comb; metatibia without bifid setae, female with posterior margin of metatibia and external margin of metatarsal article 1 without natatorial setae; metatarsal articles very slightly and broadly lobed on apical margin, almost truncate; metatarsal claws unequal, outer claw about one half length of posterior claw; parameres broad, longer than aedeagus, densely setose; aedeagus short, slender and simple; ovipositor short, setose, not adapted for piercing or sawing.

#### *Carrhydrus crassipes* Fall, 1923

*Carrhydrus crassipes* Fall, 1923: 35. (Type locality — Edmonton, Alberta.). — Leng and Mutchler 1927: 18. — Leech 1942b: 361. — Arnett 1963: 198.

*Diagnosis.* — Characters are presented under the generic description.

*Description.* — A large, robust species showing strong sexual dimorphism. Males larger than females, more robust with maximum width near base of elytra. Females more evenly oval in outline, maximum width near middle of elytra.

Measurements and ratios are: males (N = 20), TL — 11.76 to 13.28 mm ( $\bar{X}$  = 12.67 ± 0.38 mm); MW — 6.40 to 6.96 mm ( $\bar{X}$  = 6.76 ± 0.15 mm); TL/MW — 1.80 to 1.95 ( $\bar{X}$  = 1.87 ± 0.04). Females (N = 20), TL — 10.56 to 11.60 mm ( $\bar{X}$  = 11.10 ± 0.27 mm); MW — 5.48 to 6.32 mm ( $\bar{X}$  = 5.84 ± 0.21 mm); TL/MW — 1.84 to 1.93 ( $\bar{X}$  = 1.90 ± 0.03).

Body piceous to almost black medially on disc of pronotum and elytron; head, lateral margins of pronotum and elytron, and prosternum, dark rufous; antenna and palpi rufous. Metacoxal process, apical margins of abdominal sterna, and legs, rufopiceous. Female generally slightly darker than male.

Sculpture on head and disc of pronotum of well impressed lines in form of small meshes of irregular shape and alignment; meshes with strong secondary reticulation; with fine punctures chiefly at intersection of lines; sculpture irregularly granular laterally on pronotum. Elytron with sculpture finely granular, of small rounded more or less isodiametric meshes with numerous small scattered punctures.

Male with many secondary sexual characters. Antenna with articles 5 to 10 broadened laterally, flattened ventrally. Front and middle legs strongly modified, middle legs more so than front: profemur strongly dilated apically, outer margin sinuate and external apical angle produced; protarsus with articles 1 to 3 dilated, article 1 very large, triangular, strongly convex dorsally, articles 2 and 3 short, transverse, each article bearing numerous small rounded scales on ventral surface; article 5 triangular in lateral view, base broad, narrowed distally; protarsal claws elongate, posterior claw longer and broader than anterior; middle

leg similar to front leg but femur larger, metatibia strongly and evenly dilated distally, outer margin more or less straight even to apex of prolonged external apical angle; mesotarsi with article 1 very large, much larger than comparable article of protarsus, articles 2 and 3 short and transverse, articles 4 and 5 and mesotarsal claws not modified. Metasternum concave in lateral view, metacoxal processes prolonged posteriorly and ventrally, in lateral view forming an even arc with concave metasternum. Metatibia with dense brush of setae along posterior margin; metatarsal articles each with setose brush on hind margin, least developed on article 2; metatarsal article 1 elongate, subequal in length to combined length of articles 2 and 3. Aedeagus and parameres as in Figure 216.

*Taxonomic notes.* — Structure of the labial palpus and submentum exhibited by members of *Carrhydrus* seem unique in the Dytiscidae. On the other hand, almost all other characteristics shown by this genus are possessed by one or more species belonging to other genera of the tribe Agabini. This is especially true of the species placed in *Agabus s. str.*, for example the species *A. verus* Brown, *A. serricornis* (Payk.), and *A. clavicornis* Sharp. Along with these species *C. crassipes* shares the narrowly margined clypeus, expanded male antenna, relatively strongly developed mesosternum, heavy legs and broad, dorsally convex basal articles of pro- and mesotarsi, development of setose brushes on the hind margin of the metatibia and along the posterior margins of the metatarsal articles, and elongate metatarsal article 1. Many of these modifications are more strongly developed in *Carrhydrus* than in the species of *Agabus*. Nevertheless the basic similarities in structure are evident. With these characters eliminated, *Carrhydrus* differs from certain species included in *Agabus* only in shape of the labial palpus and submentum (several different types of possible stridulatory organs have been evolved in *Agabus* (Larson and Pritchard, 1974)), concave metasternum and elongate metacoxal processes (a secondary sexual character), and unequal metatarsal claws.

It seems that *C. crassipes* is a highly modified species closely related to members of the *serricornis* group of *Agabus* (*Agabus s. str.*). The question of whether to retain *Carrhydrus* as a separate genus or to combine it with *Agabus s. str.* is one that can only be properly answered when a sound supraspecific classification of the genus *Agabus* is developed. For the present, I regard *Carrhydrus* as a distinct genus but recognize its strong affinities with *Agabus*.

*Natural history notes.* — These insects are in permanent ponds and marshes in the forested portions of the province. Most specimens have been found in floating mats of decaying grasses or *Carex* stalks in water from 8 to 36 inches deep. The beetles are especially common in newly formed beaver ponds in which there are large quantities of submerged and putrifying grasses and other terrestrial vegetation. Few specimens have been found in shallow water along the margins of ponds or marshes. The beetles are almost always highly aggregated, and when discovered, a series can usually be taken from an area of a few square feet. Teneral specimens have been collected on July 17 (High Level, Alberta).

*Distribution.* — This species is known from only Alberta and the western Northwest Territories. It has been recorded from Alabama (Arnett, 1963), no doubt in error due to misinterpretation of the abbreviation for Alberta used by Leng and Mutchler (1927). I examined 76 specimens from Aklavik, N.W.T. and Alberta localities (map, Fig. 436).

#### Genus *Ilybius* Erichson, 1840

*Ilybius* Erichson, 1840: 34. (Type species — *Dytiscus fenestratus* F., designated by Westwood 1840: 8.)

Members of this genus resemble large specimens of *Agabus* but can almost always be recognized by their distinctive habitus: body elongate oval with dorsal surface relatively strongly convex. Most species of *Agabus* tend to be more flattened dorsally. Characteristics shared by all Alberta members of the genus are:

Size moderate to large, 7.7 to 12.6 mm; body oval to more or less parallel sided medially; strongly convex dorsally. Color dark except lateral margins of body of some specimens rufous: clytron with medial sublateral and subapical pale spot, indistinct on some specimens. Head with clypeal impressions, elongate and close to anterior margin, extended parallel to anterior margin but not in contact medially. Pronotum with lateral bead; lateral margin more or less evenly arcuate, posterolateral angles

rounded and obtuse. Prosternum and prosternal process longitudinally carinate; metasternum sharply incised. Metatarsus with articles 1 to 4 with external apical angles lobed; metatarsal claws unequal. Male articles 1 to 3 of pro- and mesotarsi somewhat dilated, each article with numerous long stalked golden scales beneath; protarsal claws slightly modified: some specimens with narrow longitudinal keel between metacoxa or medially on abdominal sternum 6; parameres symmetrical, setose apically; many specimens with parameres with adhesive setae along inner ventral margin. Female with inner margin of metatibia and external margin of metatarsal article 1, glabrous (except for females of *discedens*); sternum 6 emarginate medially, with posteromedial knob; valves of ovipositor (Fig. 224) strongly sclerotized, elongate and ventrally toothed.

Males of Alberta *Ilybius* are relatively easy to identify to species for they possess a number of secondary sexual characters easily interpreted and usually characteristic of a given species. A ridge along the outer dorsal margin of metatarsal articles 1 to 4, divides the males into two main groups. Other characters useful for identification of males are the sculpture on abdominal sternum 6 and shape of the aedeagus. Females possess fewer distinctive characters and for this reason are difficult to identify to species if they cannot be associated with males. For females, the most useful characters are: color, microsculpture of elytron, punctuation of the metatibia, and the extent of the marginal beading on sternum 6. Color, especially degree of infuscation of the antenna, is variable, but has been used in the following key because it is useful for the majority of specimens. Also extent of punctuation on the metatibia is subject to variation but again in most cases it provides a useful character.

The following key is satisfactory for males and most females. However, for some females identification may only be possible through examination of a series or association with a male.

#### Key to the Alberta species of *Ilybius* Erichson

- |        |  |  |
|--------|--|--|
| 1      | Males .....  | 2                                      |
| 1'     | Females .....  | 7                                      |
| 2 (1)  | Metatarsal articles 1 to 4 with longitudinal ridge or bead along dorsal external margin .....  | 4                                      |
| 2'     | Metatarsal articles 1 to 4 without external dorsal ridge .....   | 3                                      |
| 3 (2') | Lateral margin of pronotum and elytron black; metacoxa without low medial longitudinal keel; aedeagus very large (Fig. 217); elytron with meshes of sculpture - not longitudinally stretched .....           | <i>I. discedens</i> Sharp, p. 372      |
| 3'     | Lateral margin of pronotum and elytron rufous; metacoxa with medial longitudinal keel; aedeagus smaller (Fig. 218); elytron basally with meshes of sculpture elongate in orientation on many specimens ..... | <i>I. fraterculus</i> LeConte, p. 373  |
| 4 (2)  | Posterior margin of sternum 6 with number of strong longitudinal rugae or striae; scattered setiferous punctures more or less hidden in rugae .....  | 5                                      |
| 4'     | Sternum 6 with posterior margin smooth, at least medially, or some specimens with few obsolete striae laterally; setiferous punctures evident .....  | <i>I. pleuriticus</i> LeConte, p. 375  |
| 5 (4)  | Sternum 6 with thin longitudinal medial keel just anterior to hind margin; body black dorsally, rarely with metallic sheen; antenna with terminal article infusate .....                                     | 6                                      |
| 5'     | Sternum 6 without posteromedial longitudinal keel; dorsal surface of most specimens with distinct aeneous sheen; antenna entirely pale. <i>I. subaeneus</i> Erichson, p. 374                                 |  |
| 6 (5)  | Aedeagus tapered evenly to apex, not subapically flanged; metatibia with a series of punctures extended entire length of ventral face. <i>I. angustior</i> (Gyllenhal), p. 375                               |  |
| 6'     | Apex of aedeagus spear-shaped in ventral view; metatibia with coarse punctures of ventral face restricted to basal third, remainder of tibia very finely and sparsely punctate .....                         | <i>I. quadrimaculatus</i> Aubé, p. 376 |
| 7 (1') | Metatibia with inner margin between ventral and dorsal rows of coarse spines with series of long brown natatorial setae; meshes of elytral sculpture basally with scattered                                  |  |

- small punctures; metatibia with ventral face more or less impunctate or with small widely scattered punctures . . . . . *I. discedens* Sharp, p. 372
- 7' Inner margin of metatibia glabrous, without natatorial setae; elytron with meshes of sculpture largely impunctate; metatibia with ventral face impunctate or punctate medially . . . . . 8
- 8 (7') Antenna with outer articles lightly infuscate or at least with article 11 piceous medially; lateral margin of pronotum (except for front angles) dark piceous or black inside lateral bead . . . . . 11
- 8' Antenna entirely pale; lateral margin of pronotum medial to lateral bead, broadly rufous, or if piceous, elytron with aeneous sheen. . . . . 9
- 9 (8') Metatibia with ventral face very finely and sparsely punctate; meshes of elytral sculpture with distinct longitudinal orientation on basomedial portion of disc . . . . . *I. fraterculus* LeConte, p. 373
- 9' Metatibia with medial longitudinal series of punctures, smaller or not on apical half than on basal half; elytral sculpture with meshes smaller, more irregular in shape and usually without suggestion of longitudinal orientation. . . . . 10
- 10 (9') Dorsal surface with distinct aeneous sheen on most specimens; lateral margin of pronotum piceous inside lateral bead or rarely rufous; lateral bead of sternum 6 complete at external angle of medial emargination: size smaller, 9.9 to 11.0 mm . . . . . *I. subaeneus* Erichson, p. 374
- 10' Dorsal surface of body without aeneous sheen; lateral margin of pronotum broadly rufous; sternum 6 with marginal bead broken or obsolete lateral to external angle of medial emargination; larger, 10.7 to 12.6 mm . . . *I. pleuriticus* LeConte, p. 375
- 11 (8) Metatibia with ventral medial surface coarsely punctate throughout length: smaller, 8.4 to 9.5 mm . . . . . *I. angustior* (Gyllenhal), p. 375
- 11' Metatibia with ventral face impunctate in apical half or with only very small fine punctures much smaller than those of basal half: larger, 10.0 to 11.1 mm . . . . . *I. quadrimaculatus* Aubé, p. 376

*Ilybius discedens* Sharp, 1882

*Ilybius discedens* Sharp, 1882: 557. (Lectotype, here selected – male in BMNH labelled as follows: *Ilybius discedens* ♂ type, D.S., Hudsons Bay 1879; Type H.T.; Sharp Coll.; 1905-313; Type 930 *I. discedens* to go next 850, Hudson's Bay.). – Leng 1920: 80. – Fall 1927b: 283. – Brown 1930b: 237. – Brown 1932b: 201. – Wallis 1939c: 197. – James 1970: 94. – Wallis 1973: 109.

**Diagnosis.** – The combination of small size, dark color, the very large aedeagus of the male and presence of setae along the inner posterior margin of the metatibia of the female, make this one of the most distinctive species of *Ilybius*.

**Description.** – Measurements of 20 specimens from northern Alberta are: TL – 7.68 to 9.04 mm ( $\bar{X}$  = 8.20 ± 0.32 mm); MW – 4.08 to 4.80 mm ( $\bar{X}$  = 4.32 ± 0.18 mm); TL/MW – 1.85 to 1.96 ( $\bar{X}$  = 1.90 ± 0.03); WC/WS – 2.85 to 3.54 ( $\bar{X}$  = 3.18 ± 0.17).

Body black, without metallic sheen. Head with labrum and anterior margin of clypeus, dark rufous; antenna and palpi rufous. Lateral margins of pronotum and elytron, piceous. Elytron with short sublateral vitta near middle and small subapical spot (on some specimens these pale spots visible only when elytron is lifted). Legs dark rufous to piceous.

Elytron with sculpture of deeply impressed lines in form of small somewhat rounded meshes not stretched longitudinally; meshes with fine secondary reticulation somewhat effaced basally but stronger laterally and apically: small punctures both in meshes and at intersections of lines. Sexes with sculpture similar but female with sculpture deeper and less shiny; male unusually shiny for genus.

Metatibia with few coarse punctures basally on ventral face, otherwise impunctate or with only few scattered inconspicuous punctures.

Male with metatarsal articles without external dorsal ridge. Metacoxae without medial longitudinal keel. Sternum 6 with apex broadly truncate or shallowly bisinuate; flat posteromedially and longitudinally striate laterally. Aedeagus (Fig. 217)

very large, apex broadened and reflexed ventrally; paramere slender, setose on apical half only and lacking adhesive setae.

Female internal margin of metatibia and outer margin of metatarsal article 1 with sparse brown natatorial setae. Sternum 6 deeply emarginate, posteromedially produced into rounded knob or keel, laterally with few setiferous punctures and poorly defined rugae.

*Taxonomic notes.* — Sharp's male type agrees well with Alberta specimens of *I. discedens* in shape of the aedeagus and in secondary sexual characters. I have not noticed any important variation in this species.

Among the Alberta species assigned to the subfamily Colymbetinae, this species and members of the genus *Coptotomus* are unique in that the female possesses natatorial setae on the metatibia and along the outer margin of metatarsal article 1.

*Natural history notes.* — Members of this species are almost entirely restricted to cold waters of *Sphagnum* bogs but sometimes are found in moss mats in cold *Carex* marshes. Very teneral specimens were collected on July 6, but tenerals were taken on many occasions between July 6 and August 1. I have not seen flight records.

*Distribution.* — The species is transcontinental in boreal North America, ranging from Newfoundland (St. Anthony, UASM !) and New Hampshire (Mt. Washington, UASM !), to Alaska (Nome, UASM !). In Alberta, the species is probably widespread throughout the boreal and mixed forest areas south along the east slope of the Rocky Mountains to the Bow River drainage. I examined 107 specimens from Alberta localities (map, Fig. 437).

#### *Ilybius fraterculus* LeConte, 1862

*Ilybius fraterculus* LeConte, 1862: 521. (Type locality — North Red River.) — LeConte 1863a: 17. — Gemminger and Harold 1868: 451. — Crotch 1873: 412. — Blatchley 1910: 222. — Leng 1920: 80. — Fall 1927b: 283. — Wallis 1939c: 199. — LaRivers 1951: 403. — Hatch 1953: 230. — Leech and Chandler 1956: 321. — Anderson 1962: 71. — Gordon and Post 1965: 21. — Wallis 1973: 109.

*Diagnosis.* — The longitudinally stretched meshes on the basomedial portion of the elytron, broadly rufous lateral margins of the body, and sparsely and finely punctate metatibia, are characteristic of both sexes of this species.

*Description.* — Measurements and ratios of 20 specimens from southern Alberta are: TL — 9.76 to 10.64 mm ( $\bar{X}$  = 10.22 ± 0.22 mm); MW — 5.36 to 5.76 mm ( $\bar{X}$  = 5.53 ± 0.12); TL/MW — 1.74 to 1.91 ( $\bar{X}$  = 1.85 ± 0.03); WC/WS — 2.32 to 2.55 ( $\bar{X}$  = 2.42 ± 0.06).

Dorsal surface piceous to black with faint aeneous or cupreous sheen on some specimens. Head with frontal spots, anterior margin of frons, clypeus and labrum, rufous; antenna and palpi entirely testaceous. Lateral margins of pronotum and elytron broadly rufous. Epielytron rufous. Ventral surface rufous to piceous. Legs rufous to piceous.

Elytron with sculpture of small meshes formed by well impressed lines; meshes irregular in size and shape over most of disc but longitudinally oriented basomedially.

Metatibia with ventral face coarsely punctate on basal 0.25 to 0.33, otherwise surface with only sparse fine punctures.

Male metacoxa with small medial keel; sternum 6 smooth medially, with few scattered punctures along hind margin and short more or less obsolete rugae present laterally; metatarsal articles 1 to 4 without dorsal submarginal ridge; male genitalia as in Figure 218; parameres without adhesive setae; aedeagus with apex bent to right. Female sternum 6 emarginate medially, sides lateral to emargination with few scattered setiferous punctures but without longitudinal rugae.

*Taxonomic notes.* — According to Wallis (1939) this species is closely related to *I. confusus* Aubé (1838), *I. denikei* Wallis (1933) and *I. incarinatus* Zimmermann (1928). The eastern species *I. confusus* is certainly distinct and differs from *I. fraterculus* in better developed punctation of the metatibia, the aedeagus without the apical right-handed hook and the metacoxal plates relatively larger. I have not examined specimens of *I. denikei* or *I. incarinatus* and hence cannot venture an opinion on their validity. However, Wallis separated *I. incarinatus* from *I. fraterculus* on the basis of its small size, and gave a length of 9.5 to 10 mm for *I. incarinatus* while *I. fraterculus* is said to be greater than 10 mm. This distinction does not hold for Alberta specimens and many specimens would key to *I. incarinatus* in Wallis' key.

In the above key to species, specimens of *I. laramaeus* LeConte (1859) key to *I. fraterculus*. However, Wallis states that the two can be separated on the basis of a carina present on sternum

6 of male specimens of *I. laramaeus* but absent from males of *I. fraterculus*. The species *I. laramaeus* has not been collected in Alberta but as it is known from North Dakota to Wyoming and Colorado (Gordon and Post, 1965) it may be in the extreme southern portion of the province.

*Natural history notes.* – This species is most frequently found in prairie ponds, but also in ponds in the parkland and mixed forest areas of the province. Most specimens have been collected from shallow water among stands of emergent *Juncus* or *Carex*. Teneral specimens have been collected from June 13 to July 23 hence it is possible that overwintering could occur, in part, in an immature stage. However, many fully mature adults have been collected in late April and early May indicating that they hibernated in the adult stage.

Gordon and Post (1965) record large numbers of this species coming to light in North Dakota.

*Distribution.* – This species is primarily western in distribution, being recorded from Indiana and Manitoba to California and British Columbia. It has been collected as far north as 57° latitude in Alberta but is common only south of the Athabasca River. I examined 221 specimens from Alberta localities indicated in Figure 438.

#### *Ilybius subaeneus* Erichson, 1837

*Ilybius subaeneus* Erichson 1837, 156. (Type locality – Berlin, Brandenburg, Germany.). – Gemminger and Harold 1868: 452. – Hamilton 1894: 357. – Keen 1895: 167. – Wickham 1895b: 118. – Blatchley 1910: 222. – Zimmermann 1919: 217. – Carr 1920: 4. – Leng 1920: 80. – Fall 1927b: 282. – Brown 1932b: 201. – Zimmermann 1935: 83. – Wallis 1939c: 193. – Hatch 1953: 229. – Zaitsev 1953: 279. – Anderson 1962: 70. – Wallis 1973: 109.

*Ilybius viridianeus* Crotch 1873: 441. (Type locality – not restricted, described from specimens from Kansas and Hudson's Bay.). – (Old World synonymy omitted.).

*Diagnosis.* – Most specimens are immediately recognized by the aeneous or greenish sheen of the elytra which is generally better developed than that of specimens of *I. fraterculus* or *I. pleuriticus*. Males are identified by the margined metatarsal articles and sternum 6 which is coarsely longitudinally striate but without a medial carina.

*Description.* – Measurements of 20 specimens from the Peace River area of Alberta are: TL – 9.92 to 10.96 mm ( $\bar{X}$  = 10.46 ± 0.22 mm); MW – 5.20 to 5.92 mm ( $\bar{X}$  = 5.62 ± 0.14 mm); TL/MW – 1.82 to 1.91 ( $\bar{X}$  = 1.86 ± 0.25); WC/WS – 2.32 to 2.65 ( $\bar{X}$  = 2.43 ± 0.08).

Color generally piceous to black, dorsal surface with an evident aeneous sheen. Head with frontal spots, anterior margin of clypeus, and labrum, rufous; antenna and palpi entirely testaceous to rufous. Pronotum with lateral margin rufous, at least obscurely so along inner margin of bead. Elytron with lateral margin rufous, disc with medial sublateral vitta, and subapical spot well developed. Ventral surface dark rufous to piceous. Legs rufous.

Sculpture of elytron various: meshes rounded, unequal in size but not longitudinally stretched on basomedial portion of disc. Metatibia with coarse setiferous punctures extended entire length of ventral face.

Male metacoxa with small medial longitudinal carina; sternum 6 with numerous coarse longitudinal rugae or striae along posterior margin, without distinct medial longitudinal carina; metatarsus articles 1 to 4 with ridge along dorsal external margin; paramere with small adhesive setae along inner margin; aedeagus as in Figure 219. Female with sternum 6 emarginate medially, and lateral to medial knob of emargination with complete bead although low on some specimens.

*Natural history notes.* – This species inhabits emergent vegetation along the water's edge of shallow warm ponds. In Alberta, overwintering is in both adult and larval stages. Mature adults were collected as early in spring as May 1, and continuously throughout summer to October. On the other hand, most teneral specimens were found between June 20 and July 6, suggesting that either development is very rapid in the spring or that at least some specimens overwinter in immature stages. Balfour-Browne (1950) states that in Britain, these insects oviposit in summer and early autumn, and the larvae overwinter. I have seen a specimen from Manitoba collected at light (July 26).

*Distribution.* – This Holarctic species ranges from Britain to Siberia, and Alaska to Labrador and Newfoundland. In the west, the species occurs south to Colorado and Utah. I examined more than 550 specimens from Alberta localities (map, Fig. 439).

*Ilybius pleuriticus* LeConte, 1850

*Ilybius pleuriticus* LeConte, 1850: 213. (Type locality – Lake Superior). – Melsheimer 1853: 30. – LeConte 1862: 521. – LeConte 1863a: 17. – Gemminger and Harold 1868: 451. – Crotch 1873: 411. – Sharp 1882: 552. – Leng 1920: 80. – Fall 1927b: 282. – Brown 1930b: 237. – Brown 1932b: 201. – Wallis 1939c: 196. – J. Balfour-Browne 1948: 160. – Wallis 1973: 108.

*Ilybius inversus* Sharp 1882: 552. (Type – Male in BMNH labelled as follows: ♂; Type H.T.; Hudson's Bay. Murray 841; Sharp Coll. 1905-313; Type 841 *I. inversus* n. sp., Am. Bor.)

**Diagnosis.** – The largest specimens of *Ilybius* in Alberta belong to this species. Lateral margins of the body are broadly pale. The male is well characterized by the margined metatarsal articles, pale antenna and palpi, and presence of a low keel on sternum 6. The female very closely resembles the female of *I. subaeneus* but lacks an aeneous sheen, has the metatibia less coarsely punctate and marginal bead of sternum 6 disappearing lateral to the external corner of the medial emargination.

**Description.** – Measurements of 20 specimens from 6 mi S Smith, Alberta, are: TL – 10.72 to 12.56 mm ( $\bar{X}$  = 11.75 ± 0.47 mm); MW – 5.76 to 6.96 mm ( $\bar{X}$  = 6.27 ± 0.28 mm); TL/MW – 1.81 to 1.95 ( $\bar{X}$  = 1.88 ± 0.04); WC/WS – 2.39 to 2.73 ( $\bar{X}$  = 2.53 ± 0.10).

Dorsal surface generally black with faint brassy or aeneous sheen on some specimens. Head with frontal spots, most of clypeus, and labrum, rufous; antenna and palpi rufous. Pronotum with lateral margin broadly rufous. Elytron with lateral margin at least basally, and epipleuron, rufous; sublateral and subapical spots evident. Legs rufous to piceous.

Elytron with meshes of sculpture irregular in size and shape; on some males meshes somewhat longitudinal in arrangement basomedially. Metatibia with punctation extended length of ventral face on most specimens, punctures irregular in size and largest basally.

Male metacoxa with small medial carina; sternum 6 nonstriate or with only few weak longitudinal rugae along posterolateral margin, setiferous punctures obvious; medially with short longitudinal carina. Metatarsus with articles 1 to 4 margined externally. Paramere with numerous large adhesive setae along inner margin; aedeagus as in Figure 220.

Female with sternum 6 deeply emarginate posteromedially; sternum beaded inside emargination but bead disappearing at lateral angles of emargination.

**Taxonomic notes.** – Fall (1927) doubted the specific validity of *I. inversus* Sharp. I examined the male holotype and found the genitalia identical to those of Alberta specimens of *I. pleuriticus*. I agree with Fall's suggested synonymy.

**Natural history notes.** – The beetles are most commonly found in mixed forest areas of the province in warm shallow water among emergent *Carex* on silt or clay bottom of beaver ponds, borrow-pits, or roadside ditches. Teneral specimens were collected in July.

**Distribution.** – This species ranges from Newfoundland to the Yukon Territory (Watson L. and Mile 627 Alaska Hwy., CARR!), and south to New York (Wallface Mt., UASM!). It is known from the northern forested portions of Alberta. I examined 132 specimens from Alberta localities (map, Fig. 440).

*Ilybius angustior* (Gyllenhal), 1808

*Dytiscus angustior* Gyllenhal, 1808: 500. (Type locality – unknown to me.). – Sharp 1882: 555. – Horn 1883: 279. – Wickham 1895b: 118. – Zimmermann 1919: 217. – Carr 1920: 4. – Leng 1920: 80. – Fall 1927b: 283. – Brown 1930: 237. – Zimmermann 1935: 85. – Wallis 1939c: 193. – J. Balfour-Browne 1948: 160. – Hatch 1953: 229. – Zaitsev 1953: 280. – Anderson 1962: 70. – Wallis 1973: 108.

*Colymbetes picipes* Kirby, 1837: 17. (Type – ♂ in BMNH labelled as follows: Type H.T.; N. Amer. 5777b; *Colymbet. picipes* Kirby, N. Amer. 5777, Rev. W. Kirby). – LeConte 1850: 213. – Mannerheim 1853: 156. – Melsheimer 1853: 30. – Gemminger and Harold 1868: 452. – LeConte 1857: 11. – LeConte 1862: 521. – LeConte 1863a: 17. – Crotch 1873: 411.

**Diagnosis.** – This small species is best recognized by dark color, infuscation of the apical antennal articles, densely punctate metatibia, margined male metatarsal articles, and complexly sculptured sternum 6.

**Description.** – Measurements of 20 specimens from the vicinity of Manning, Alberta, are: TL – 8.40 to 9.44 mm ( $\bar{X}$  = 8.96 ± 0.30 mm); MW – 4.44 to 5.04 mm ( $\bar{X}$  = 4.75 ± 0.17 mm); TL/MW – 1.82 to 1.93 ( $\bar{X}$  = 1.89 ± 0.03); WC/WS – 2.10 to 2.47 ( $\bar{X}$  = 2.24 ± 0.11).



Body black. Head with frontal spots rufous; anterior margin of clypeus piceous to black; antenna rufous except at least article 11 infuscate apically; palpi rufous except many specimens with terminal article of each palpus infuscate apically. Pronotum with lateral bead piceous to black. Elytron with medial sublateral and subapical pale spots, difficult to see on many specimens without elytron lifted. Ventral surface piceous to black. Legs rufopiceous to piceous.

Elytron with meshes of microsculpture small and irregular, without tendency towards longitudinal stretching. Metatibia with series of coarse setiferous punctures extended length of ventral face.

Male metacoxa with small medial carina; sternum 6 with posterolateral portion coarsely longitudinally rugose or striate, with medial longitudinal carina; metatarsal articles 1 to 4 margined externally; parameres with elongate adhesive setae along inner margin; aedeagus (Fig. 221) slender, simple.

Female sternum 6 shallowly emarginate, completely beaded lateral to emargination.

*Taxonomic notes.* — Adults of the Arctic species, *I. churchillensis* Wallis (1939c), closely resemble those of the boreal *I. angustior* but differ in several characters Wallis (1939c) enumerated. In addition, the aedeagus of *churchillensis* males (Fig. 222) is more slender than that of *angustior* males.

*Natural history notes.* — This species is generally uncommon in the prairie and mountain regions, but in the parkland and boreal areas (including the Cypress Hills) of the province, it is one of the most abundant dytiscids. Specimens were collected from *Sphagnum* bogs, *Carex* marshes, borrow-pits, roadside ditches, beaver ponds and from amongst emergent vegetation along margins of slow-flowing creeks. Teneral specimens were collected from May 17 to August 1, the majority during the first half of July. Overwintering may occur in a larval stage, but hibernation of adults is certainly common, for numerous mature adults were collected early in spring. I have seen two specimens recorded as being collected in a light trap (Ft. Garry, Manitoba, July 26, 1954, UASM), and J. Carr collected a teneral female from a snowfield at 8000' (Tp. 35, Rge. 18 W 5) on July 19, 1973.

*Distribution.* — This Holarctic species ranges from the Scandinavian countries to Siberia, and from Alaska to Newfoundland. The southern limits are unknown but, probably the species is mainly in the cold temperate or boreal portions of the continent. I examined more than 1,400 specimens from Alberta localities (map, Fig. 441).

#### *Ilybius quadrimaculatus* Aubé, 1838

*Ilybius quadrimaculatus* Aubé, 1838, 274. (Type locality — “Amerique septentrionale”). — Mannerheim 1843: 220. — Melsheimer 1853: 30. — LeConte 1857: 11. — LeConte 1862: 521. — LeConte 1863a: 17. — Gemminger and Harold 1868: 452. — Crotch 1873: 412. — Leng 1920: 80. — Fall 1926: 143. — Fall 1927b: 282. — Hatch 1938: 146. — Wallis 1939c: 197. — Hatch 1953: 229. — Leech and Chandler 1956: 321.

*Diagnosis.* — Dark color, sparsely punctate metatibia, margined metatarsal articles of the male, and laterally flanged apex of the aedeagus adequately characterize this species.

*Description.* — Measurements of 10 specimens from southwestern Alberta and southeastern British Columbia are: TL — 10.24 to 11.04 mm ( $\bar{X}$  = 10.70 ± 0.22 mm); MW — 5.36 to 6.00 mm ( $\bar{X}$  = 5.67 ± 0.18 mm); TL/MW — 1.84 to 1.93 ( $\bar{X}$  = 1.89 ± 0.03); WC/WS — 2.48 to 2.68 ( $\bar{X}$  = 2.55 ± 0.07).

Body generally black with anterior margin of clypeus, labrum, frontal spots, narrow lateral margin of pronotum, and legs, dark rufous; palpi rufous; antenna rufous except articles 5 to 11 infuscate apically (palest specimens with at least articles 10 and 11 obviously darkened). Elytron with elongate medial sublateral vitta and subapical spot: some specimens with elytron faintly aeneous or cuprous.

Elytron with meshes of sculpture irregular in shape, not longitudinally stretched. Metatibia with ventral face basomedially with small group of coarse setiferous punctures, otherwise only sparsely micropunctate.

Male metacoxa with low medial longitudinal keel; sternum 6 with short but markedly developed medial keel; laterally hind margin longitudinally rugose; metatarsus articles 1 to 4 margined externally; aedeagus (Fig. 223) apex with strong lateral flanges and spear-shaped in ventral view. Female with sternum 6 emarginate medially.

*Taxonomic notes.* — F. S. Carr (1920: 4) recorded this species from Alberta, probably incorrectly so because his specimens came from the Edmonton area, and because specimens of *I. fraterculus* (UASM) collected and determined by him were identified as *I. quadrimaculatus*.

*Natural history notes.* — I collected a few specimens from among emergent vegetation, usually *Carex*, on a black silt bottom along the margin of foothills or mountain beaver ponds.

*Distribution.* — This species is exclusively western, known from northern California to Alaska and east to western Alberta. I have seen Alberta specimens from only the extreme southwestern portion of the province. Specimens were collected from Revelstoke (CARR) and McBride (UC), British Columbia, so possibly the species may be discovered farther north in Alberta, especially in the Peace River drainage. I examined 4 specimens from Alberta localities (map, Fig. 442).

#### Genus *Coptotomus* Say, 1834

*Coptotomus* Say, 1834: 443. (from LeConte, 1859). (Type species — *Coptotomus serripalpus* Say, 1834, by monotypy.)

This small North American genus contains three or four species whose aggregate range includes most of the United States and southern Canada. The most distinctive feature of the genus is the maxillary and labial palpi, in which the apical article of each palpus is somewhat laterally compressed and notched distally.

Characteristics common to members of the genus are: Colymbetinae of small size; body elongate and narrowly oval. Dorsal surface variously maculate. Clypeal fovea present, limited to anterolateral angle. Antenna simple, slender. Terminal article of each palpus emarginate apically. Pronotum margined laterally. Prosternum markedly produced ventrally between procoxae, medially in same plane with prosternal process, latter elongate and acute, received into V-shaped impression on anteromedial portion of metasternum. Metacoxa very large, metacoxal lobes large, rounded, covering base of metatrochanter. Hind legs without bifid setae; metatibia and metatarsal articles externally with natatorial setae; metatarsal articles with apical margins strongly lobed; metatarsal claws subequal in length, posterior claw broader than anterior. Male with articles 1 to 3 of pro- and mesotarsi narrowly dilated, articles 1 each with two, and articles 2 and 3 each with one transverse row of narrow elongate scales on ventral surface. Male genitalia with parameres symmetrical, about 0.5 length of aedeagus, lobate and bluntly rounded apically with only a few long pale setae at apex; aedeagus simple, lateral margins asymmetrically expanded, dorsal groove asymmetrical. Stylus of ovipositor short, membranous and setose, not adapted for piercing or sawing.

The relationships among the few included species are poorly understood. Young (1954) discusses the variation shown by Florida populations of *C. interrogatus* (F.) and suggests that some of this variation may be ecotypic. Two species are reported from the northern portion of the United States and adjacent Canada. These are *C. interrogatus* (F.), an eastern species, and *C. longulus* LeConte, a species of the prairies and northwest. I have seen very few specimens from eastern North America but I cannot constantly separate the two forms. However, I have followed other authors and assigned Alberta specimens to the species *C. longulus* LeConte. The genus requires revision.

#### *Coptotomus longulus* LeConte, 1852

*Coptotomus longulus* LeConte, 1852: 205. (Type locality — Laramie, "Territorio Missouriensis" (Wyoming)). — Melsheimer 1853: 30. LeConte 1859: 36. — LeConte 1863a: 16. — Gemminger and Harold 1868: 446. — LaRivers 1951: 403. — Hatch 1953: 231. — Leech and Chandler 1956: 321. — Anderson 1962: 71. — Gordon and Post 1965: 22.

*Diagnosis.* — See generic diagnosis and description.

*Description.* — Measurements of 20 specimens from Travers, Alberta, are: TL — 7.44 to 8.00 mm ( $\bar{X} = 7.70 \pm 0.17$  mm); MW — 3.68 to 3.92 mm ( $\bar{X} = 3.79 \pm 0.07$  mm); TL/MW — 1.98 to 2.09 ( $\bar{X} = 2.03 \pm 0.03$ ); WC/WS — 3.45 to 4.80 ( $\bar{X} = 4.29 \pm 0.31$ ).

Head pale rufous except posterior margin behind and between eyes, black; antenna and palpi testaceous. Pronotum testaceous to pale rufous except anterior and posterior margins piceous to black medially. Elytron with irregular lateral margin, basal margin laterally, basal subsutural vitta, and on some specimens narrow vitta along each row of serial punctures, testaceous; medial portion of disc dark piceous to black with numerous irregularly shaped testaceous spots. Ventral surface and legs, rufous.

Dorsal surface finely and irregularly punctate: posterior margin of head and lateral portions of pronotum, irregularly rugose; male with elytron smooth and shiny between punctures, microreticulation absent or highly reduced; female with elytral punctures in short separate longitudinal grooves on basal 0.5 or 0.66 of disc, interspaces between grooves microreticulate.

Male with protarsal claws elongate and slender, subequal in length; each claw with very small tooth or at least suggestion of tooth on medioventral margin. Aedeagus and paramere as in Figure 225.

*Natural history notes.* — This species is locally abundant in permanent prairie lakes, stock

ponds, borrow-pits, roadside ditches, and in slow-flowing weedy creeks. Specimens are occasionally found in temporary meltwater ponds but seldom in large numbers. Young (1960c) found this species in a temporary pond in Indiana but concluded it is more typically a resident of permanent ponds. The beetle does not occur in strongly saline ponds. Beyond the prairie area, occasional specimens are found in warm open ponds north to Lesser Slave Lake. D. Donald collected specimens from several subalpine and alpine lakes in Waterton National Park during the latter portion of July and August. As specimens have not been found in these lakes early in summer, and as none were teneral, it is likely that their presence was due to flight from lower elevations. Teneral specimens were collected from August 8 to September 24.

*Distribution.* — Specimens of *C. longulus* have been collected from Minnesota to British Columbia and south to Utah and California. I examined more than 160 specimens from Alberta localities (map, Fig. 443).

#### Genus *Rhantus* Dejean, 1833

*Rhantus*, emendation of *Rantus* Dejean, 1833: 54. (Type species — *Dytiscus pulverosus* Stephens 1828, designated by Hope, 1838.) (Opinion 289, Bull. Zool. Nom. 8(1954).)

*Nartus* Zaitzev, 1907: 103. (Type species — *Dytiscus grapii* Gyllenhal, by monotypy.)

*Rantogiton* DesGozis, 1911: 40. (Type species — *Dytiscus grapii* Gyllenhal, by monotypy.)

This large genus is represented in all major zoogeographical areas of the world as well as on many oceanic islands. Six species occur in Alberta. Characters common to Alberta members are:

Colymbetinae of moderate size. Color various, body black to mainly testaceous with distinct maculation. Body elongate-oval in outline, dorsoventrally flattened. Head with clypeal foveae present but not prolonged along anterior margin; eye emarginate above base of antenna; palpi with terminal article of each palpus entire, simple. Pronotum with lateral bead clearly delimited or not; prosternal process narrow, bluntly pointed, received into V-shaped impression on anteromedial portion of metasternum. Elytron with sculpture various, on most specimens of fine lines in form of small irregular meshes; sculpture sexually dimorphic in some species. Metafemur without subapical comb; metatibia with bifid setae on dorsal face; female without natatorial setae along posterior margin; metatarsal articles lobed apically, claws unequal. Male with articles 1 to 3 of pro- and mesotarsi slightly dilated; articles 1 each bearing two, and articles 2 and 3 each bearing one transverse row of elongate, adhesive scales on ventral surface; pro- and mesotarsal claws variously modified. Male genitalia with parameres symmetrical, elongate but broad to apex, setose, some species with adhesive setae; aedeagus short, simple. Female with ovipositor short, not strongly sclerotized, setose apically.

Although color and male and female secondary sexual characters generally provide good characters for species recognition, certain species are poorly differentiated. For example, I treated *R. wallisi* and *R. suturellus* as valid species but the characters used to separate the two seem minor; hence I am not convinced that the interpretation presented here is correct. The genus requires revision, with careful attention to intraspecific variation.

The species are widespread in shallow bodies of water in the province with the exception of cold swiftly flowing streams and highly saline lakes. Certain species, *R. frontalis*, for example, include strong fliers and are among the first dytiscids to colonize newly formed ponds. Of the Alberta species, the larvae of *R. binotatus* (James, 1970), and *R. frontalis* (Watts, 1970) have been described.

#### Key to the Alberta species of *Rhantus* Dejean

- 1        Disc of pronotum and elytron black . . . . . *R. sinuatus* (LeConte), p. 379
- 1'       Disc of pronotum pale, with or without medial maculations; elytron testaceous, irrorate with piceous spots . . . . . 2
- 2 (1')   Frons entirely black between eyes, without frontal spots: ventral surface rufous. . . . . *R. consimilis* Motschoulsky, p. 380
- 2'       Frons between eyes with pair of pale spots (united or not medially in form of single transverse mark); at least meso- and metathorax piceous or black . . . . . 3

- 3 (2') Disc of pronotum immaculate medially . . . . . 4  
 3' Disc of pronotum medially maculate . . . . . 5  
 4 (3) Pronotum with basomedial piceous marking truncate laterally, not or only narrowly extended to lateral margin; male anterior protarsal claw 1.25 times or more as long as protarsal article 5, anterior claw distinctly longer than posterior; female with basolateral half of elytron on most specimens with coarse deeply impressed sculpture . . . . . *R. wallisi* Hatch, p. 380  
 4' Basal piceous marking of pronotum broader, medial expansion of border less abruptly delimited laterally, and marking evenly narrowed toward posterolateral angle; male anterior protarsal claw less than 1.25 times length of protarsal article 5; protarsal claws subequal in length; female elytron without coarse sculpture, or restricted to medial sublateral portion of disc . . . . . *R. suturellus* (Harris), p. 381  
 5(3') Pronotal marks pair of medial piceous spots various in size . . . . . *R. binotatus* (Harris)<sup>5</sup>, p. 382  
 5' Pronotum with single medial transverse mark and on some specimens an additional piceous spot each side lateral to medial spot . . . . *R. frontalis* (Marshall), p. 383

*Rhantus sinuatus* (LeConte, 1862)

*Colymbetes sinuatus* LeConte, 1862: 522. (Type locality – "Dacotah"). – LeConte 1863a: 17. – Crotch 1873: 410. – Sharp 1882: 617. – Wickham 1895b: 122. – Blatchley 1910: 228. – Leng 1920: 80. – Zimmermann 1920: 206. – Hatch 1928: 224. – Balfour-Browne 1950: 211. – Wallis 1973: 109.

*Diagnosis.* – This is the only species of *Rhantus* in the Alberta fauna to include black specimens.

*Description.* – Values for measurements of nine Alberta specimens are: TL – 9.20 to 10.00 mm ( $\bar{X}$  = 9.63 ± 0.28 mm); MW – 4.56 to 5.12 mm ( $\bar{X}$  = 4.86 ± 0.15 mm); TL/MW – 1.92 to 2.02 ( $\bar{X}$  = 1.98 ± 0.03); WC/WS – 3.38 to 3.93 ( $\bar{X}$  = 3.70 ± 0.18).

Body black except following. Head with anterior margin of clypeus, piceous; labrum, palpi and antenna rufous. Lateral margins of pronotum and elytron, rufous. Metacoxal process and apical margins of abdominal sterna, piceous. Legs dark rufous.

Sculpture fine, meshes small and irregular in shape over dorsal surface of body; smaller and more or less granulate on elytron. Sculpture similar on both sexes.

Clypeus with anterolateral fovea very close to anterior border. Pronotum with base deeply sinuate laterally, posterolateral angle acute; lateral bead broad, discontinuous before anterior angle.

Male with anterior protarsal claw (Fig. 228) relatively short, moderately dilated; inner margin more or less straight; posterior claw shorter than anterior, narrower and more evenly arcuate. Mesotarsus with anterior claw very broad, little arcuate; posterior claw much shorter, strongly arcuate.

*Taxonomic notes.* – This, and the Old World *R. grapii* (Gyllenhal, 1808) were placed in the subgenus *Nartus* Zaitzev. Together, they differ from the species of *Rhantus s. str.* in that the base of the pronotum is strongly sinuate toward the lateral angles, dorsal surface of the body is generally black, somewhat paler laterally, and the male protarsal characters are relatively poorly developed. This combination of characters is distinctive enough to justify the retention of *Nartus* as a subgenus.

These species are very similar to one another, and should be compared carefully to determine their relative status because published descriptions and illustrations provide no distinguishing characters. However, as I have not examined type specimens or authentic specimens of *grapii*, I have retained the name *R. sinuatus* for North American specimens.

*Natural history notes.* – The few specimens I collected were from small ponds among dense

5. *R. gutticollis* (Say) keys here. I have not seen Alberta specimens but see Taxonomic Notes under *R. binotatus*.

mats of emergent *Carex*, decaying *Carex* stalks, and duckweed, present in shallow water over a bottom of soft black organic mud. *Sphagnum* was present in some of the sites. All sites were in mixed forest.

*Distribution.* — This is incompletely known. The species has been recorded previously from Maine and New York to Minnesota. It is probably widespread in the boreal portions of the continent. I examined 21 specimens from Alberta localities (map, Fig. 444).

*Rhantus consimilis* Motschoulsky, 1859

*Rhantus consimilis* Motschoulsky, 1859: 168. (Type locality — San Francisco, California.) — LeConte 1863a: 17. — Crotch 1873: 410. — Sharp 1882: 823. — Leng 1920: 80. — Hatch 1928: 224. — Hatch 1953: 233. — Leech and Chandler 1956: 321. — Gordon and Post 1965: 22.

*Colymbetes tostus* LeConte, 1866: 366. (Type locality — Missouri.) — Crotch 1873: 410. — Sharp 1882: 620. — Wickham 1895b: 122. — Leng 1920: 80. — Leech and Chandler 1956: 321. — Wallis 1973: 109.

*Rhantus discedens* Sharp, 1882: 615. (Type locality — California.) — Leng, 1920: 80. — Hatch 1928: 224.

*Diagnosis.* — Combination of lack of pale frontal spots on frons, pale pronotal disc, and rufous ventral surface of the body, allows this species to be identified readily.

*Description.* — Measurements of 20 specimens from southern Alberta, are: TL — 9.20 to 9.84 mm ( $\bar{X} = 9.48 \pm 0.17$  mm); MW — 4.88 to 5.32 mm ( $\bar{X} = 5.01 \pm 0.11$  mm); TL/MW — 1.84 to 1.95 ( $\bar{X} = 1.89 \pm 0.03$ ); WC/WS — 3.67 to 4.42 ( $\bar{X} = 3.93 \pm 0.18$ ).

Head with labrum, clypeus and anterior margin of frons, testaceous to rufous; frons black, without pale frontal spots between eyes; antenna rufous with articles 3 or 4 to 11 infuscate apically. Pronotum rufous, immaculate, or some specimens with diffuse anteromedial and posteromedial clouds and rarely with single, small, piceous, medial spot. Elytron testaceous, irrorate with black; impressed lines on female largely black. Ventral surface rufous; metacoxal process and abdominal sterna mediolaterally, darker rufous on some specimens. Legs rufous.

Elytron of male with sculpture of irregular, elongate meshes, latter irregular in shape toward apex, not evidently longitudinally stretched and very finely microreticulate. Female with basic elytral sculpture similar but basal 0.66 to 0.75 of disc with coarse, longitudinal lines.

Male articles 1 to 3 of protarsus with oval scales on ventral surface; scales slightly longer than wide; protarsal claws slender and elongate (Fig. 229).

*Taxonomic notes.* — Specimens from California are characterized by the piceous metasternum and metacoxae, and median black spot on the pronotal disc. Specimens from the northwestern United States and adjacent Canada are entirely pale ventrally and most specimens lack the medial spot on the pronotum. These two color forms intergrade in northern California (Hatch, 1953: J. Zimmerman, 1973, in litt.). The name *R. tostus* (LeConte) applies to the pale northern form, which occurs in Alberta.

*Natural history notes.* — This species is primarily in the prairie and parkland regions of Alberta. The beetles are in warm, weedy ponds which may be either temporary or permanent. Teneral specimens were collected throughout August.

*Distribution.* — The species *R. consimilis* has a wide range, and is recorded from New England to British Columbia, and south to California. I examined more than 230 specimens from Alberta localities (map, Fig. 445).

*Rhantus wallisi* Hatch, 1953

*Rhantus wallisi* Hatch, 1953: 233. (New name for *R. suturellus* Wallis, not Harris.) — Wallis, 1973: 109.

*Rhantus suturellus* Wallis, 1933b: 274-276. Not Harris, 1828.

*Diagnosis.* — Specimens of *R. wallisi* are recognized on pronotal color: rufous with basal and apical borders piceous to black. Extent of the black maculations is not as great as that on the pronotum of the very similar following species, *R. suturellus* Harris.

*Description.* — Measurements of 20 specimens from the Water Valley-Sundre area, Alberta, are: TL — 9.36 to 10.16 mm ( $\bar{X} = 9.85 \pm 0.19$  mm); MW — 5.04 to 5.52 mm ( $\bar{X} = 5.34 \pm 0.12$  mm); TL/MW — 1.79 to 1.91 ( $\bar{X} = 1.85 \pm 0.03$ ); WC/WS — 3.25 to 4.00 ( $\bar{X} = 3.59 \pm 0.19$ ).

Head testaceous to rufous; frons, except for broad anterior margin and pair of frontal spots, black; antenna testaceous, articles 3 or 4 to 11 infuscate apically; palpi testaceous, terminal article of each palpus infuscate apically. Pronotum rufous: anterior margin along emargination, narrowly piceous to black; posterior margin narrowly black along entire length, black area more or less expanded along medial half. Scutellum black. Elytron testaceous, irrorate with black spots, spots larger and more or less contiguous toward apex; epipleuron testaceous. Proepisternum and prosternum and its process, pale rufous, or apex of prosternal process infuscate on some specimens; remainder of ventral surface of body black with metacoxal process, rufous. Legs rufous with hind legs more or less darkened.

Elytron with small meshes of very irregular shape; lines of sculpture deeply impressed; punctures at many intersections obscured; meshes smooth or finely micropunctate basally, with well developed secondary sculpture toward apex. Female with elytron on basolateral half with lines of sculpture deeply impressed, meshes coarse and convex; coarsely sculptured area longitudinally interrupted by several areas of normal sculpture.

Male anterior protarsal claw (Fig. 230) 1.26 to 1.43 times as long as protarsal article 5; anterior claw distinctly longer than posterior claw, broader and more or less inflated along ventral margin near base, ventral margin slightly sinuate. Aedeagus and paramere as in Figure 227.

*Taxonomic notes.* — The species *R. wallisi* and *R. suturellus* are very similar to one another in both morphological features and geographical distribution. However, differences in pronotal maculation, shape of the male protarsal claws, and the development of the roughened elytral sculpture on the female, although slight, appear constant. Also, although the Alberta distribution of the two is similar, there are both habitat and distributional differences. For these reasons, *R. wallisi* and *R. suturellus* are considered valid species. I have not examined type material and have followed Hatch (1953) in the application of names.

*Natural history notes.* — This species occurs in shallow warm ponds in the parkland and forested portions of the province with occasional specimens in ponds on rough fescue prairie. General specimens were collected from July 20 to August 12.

*Distribution.* — Because of confusion surrounding this and the following species in both identification and nomenclature, literature references cannot confidently be used to determine the ranges of these species. Both probably have wide ranges in the boreal portions of North America. I examined specimens of *R. wallisi* from Saskatchewan and Northwest Territories (Simpson Islands, Great Slave L.) and 360 specimens from Alberta localities (map, Fig. 446).

#### *Rhantus suturellus* (Harris, 1828)

*Colymbetes suturellus* Harris, 1828: 164. (Type locality — not given by author.) Not Wallis, 1933. — Zimmermann 1919: 220. — Leng 1920: 80. — Blackwelder 1939: 17. — Hatch 1953: 233. — Zaitsev 1953: 290. — Wallis 1973: 109.

*Rhantus bistriatus* auct. not Bergstrasser, 1778: 42. — Gemminger and Harold 1868: 448. — Crotch 1873: 409. — Sharp 1882: 619. — Wickham 1895b: 122. — Blatchley 1910: 228. — F. Carr 1920: 4. — Hatch 1928: 223. — F. Balfour-Browne 1950: 235.

*Agabus subopacus* Mannerheim 1853: 157. (Type locality — “insula Kadjak”). — Wallis 1933b: 275.

*Rhantus zimmermanni* Wallis, 1933b: 274. (Type locality — Winnipeg, Manitoba.) — Gordon and Post 1965: 22.

*Diagnosis.* — This species is very similar to *R. wallisi* from which it is best separated by characters given in the following description.

*Description.* — Measurements of 20 specimens from various Alberta localities are: TL — 9.44 to 10.48 mm ( $\bar{X} = 9.87 \pm 0.22$  mm); MW — 5.12 to 5.52 mm ( $\bar{X} = 5.32 \pm 0.13$  mm); TL/MW — 1.81 to 1.94 ( $\bar{X} = 1.85 \pm 0.04$ ); WC/WS — 2.83 to 3.25 ( $\bar{X} = 3.01 \pm 0.13$ ).

Very similar in color and structure to *R. wallisi*, differing primarily in following characters: pronotum with mark along posterior margin broader, expanded medial area not abruptly limited anterolaterally but sloped gradually toward hind angle; female with sculpture of elytron similar to that of male, or areas of coarser sculpture in form of one to several longitudinal bands on mediolateral portion of disc not extended medially beyond middle; metasternum relatively broad (see above ratio); male with anterior protarsal claw (Fig. 231) short, 1.07 to 1.21 ( $\bar{X} = 1.15 \pm 0.04$ ) times as long as protarsal article 5, protarsal claws subequal in length, posterior slightly narrower than anterior, anterior claw more or less equal in width throughout middle portion of length; aedeagus and paramere (Fig. 226) similar to that of *R. wallisi*.

*Taxonomic notes.* — (see under *R. wallisi*). F. S. Carr's (1920: 4) record for *bistriatus* (Bergstrasser) refers to this species (based on specimens in UASM). F. Balfour-Browne (1950) considers *R. suturellus* conspecific with *R. bistriatus* but most recent authors have considered the two distinct.

*Natural history notes.* – This species ranges throughout the forested areas of the province with the apparent exception of the Cypress Hills. It is not as common in the parkland regions as is *R. wallisi*. Although found with *R. wallisi* occasionally, this species is the one most frequently collected in cold-water ponds heavily shaded by trees or dense stands of *Carex*. The species is found often in association with *Sphagnum* although not a typical inhabitant of *Sphagnum* bogs. Teneral specimens have been collected during the last week of August and September, and also in April and the first half of May. The species probably overwinters as immature adults.

*Distribution.* – Wallis (1933) recorded this species, under the name *R. zimmermanni*, from Quebec to southeastern British Columbia. The northern and southern limits are not known. I examined more than 115 specimens from Alberta localities (map, Fig. 447).

### *Rhantus binotatus* (Harris, 1828)

*Colymbetes binotatus* Harris, 1828: 164. (Type locality – not stated by author.). – LeConte 1850: 213. – Melsheimer 1853: 30. – LeConte 1858: 30. – LeConte 1859: 36. – LeConte 1862: 523. – LeConte 1863a: 17. – Gemminger and Harold 1868: 448. – Crotch 1873: 409. – Sharp 1882: 614. – Wickham 1895b: 122. – Blatchley 1910: 228. – Zimmermann 1919: 222. – Leng 1920: 80. – Zimmermann 1920: 206. – Hatch 1928: 223. – Brown 1930b: 237. – Wallis 1933b: 272. – Blackwelder 1939: 17. – Hatch 1953: 232. – Leech and Chandler 1956: 322. – Anderson 1962: 72. – Gordon and Post 1965: 22. – Wallis 1973: 109.

*Colymbetes assimilis* Kirby, 1837: 72. (Type – male in BMNH labelled as follows: Type. N. Scotia, ♀ 5778a; *Colymb. assimilis* Kirby, N. Amer. 5778, Rev. Wm. Kirby.). – Horn 1883: 282.

*Colymbetes maculicollis* Aubé, 1838: 248. (Type locality – “Mexique”).

*Colymbetes divisus* Aubé, 1838: 248. (Type locality – “Amerique septentrionale”). – Mannerheim 1843: 219. – Melsheimer 1853: 30. – LeConte 1862: 523. – LeConte 1863a: 17. – Gemminger and Harold 1868: 448. – Crotch 1873: 409. – Sharp 1882: 612. – Hatch 1928: 223.

*Rhantus flavogriseus* Crotch, 1873: 409. (Type locality – not stated by author.). – Horn 1883: 279. – Hatch 1928: 223.

*Rhantus plebeius* Sharp, 1882: 613. (Type – male in BMNH labelled as follows: Hermit Lake ♂ 882; Type 882; Typ; Hermit Lake; N. America; Sharp Coll. 1905-313; *Rhantus plebeius* n. sp. Am. bor.; 54.). – Horn 1883: 279. – Zimmermann 1919: 221.

*Rhantus obscurus* Sharp, 1882: 613. (Type locality – California.). – Horn 1883: 279.

*Rhantus longipes* Sharp, 1882: 613. (Type areas – “Russian America; British Columbia”).

*Rhantus immaculatus* Hatch, 1928: 223. (Type locality – Kodiak, Alaska.)

*Rhantus aequalis* Hatch, 1951: 122. (Type locality – Seattle, Washington.) New synonymy.

*Diagnosis.* – The pronotal disc with a pair of medial spots separated from each other by a pale medial line, is usually sufficient to permit recognition of specimens of this species in the Alberta fauna.

*Description.* – Measurements of 20 specimens from the vicinity of Calgary, Alberta, are: TL – 9.84 to 10.96 mm ( $\bar{X}$  = 10.36 ± 0.25 mm); MW – 4.96 to 5.68 mm ( $\bar{X}$  = 5.33 ± 0.16 mm); TL/MW – 1.87 to 2.00 ( $\bar{X}$  = 1.95 ± 0.03); WC/WS – 2.44 to 3.12 ( $\bar{X}$  = 2.79 ± 0.15).

Head with labrum, clypeus, anterior and anteromedial portion of frons, and two spots on frons between eyes (on many specimens spots fused to form a single transverse bar), testaceous; remainder of frons and ventral surface of head, with exception of lateral lobes of mentum, piceous to black; antennal articles 1 to 2, or 1 to 3 testaceous, remaining articles infusate; palpi pale with terminal article of each palpus infusate apically. Pronotum testaceous except pair of piceous spots medially on disc and basal margin slightly darkened medially; spots of various size and shape but constantly separated from one another by pale area along midline of pronotum. Elytron testaceous with disc densely irrorate with piceous spots; area around each group of serial punctures darkened, hence elytron with several longitudinal rows of larger spots; many specimens with diffuse subapical spot on each elytron. Ventral surface mainly black except prosternum and propisternum rufotestaceous, metacoxal process rufous, abdominal sterna black with at least lateral and on many specimens also apical margins, testaceous, or some specimens with abdomen almost entirely testaceous to rufous. Legs mainly rufotestaceous.

Elytron of male with small very irregularly shaped meshes. Female elytron basally with three longitudinal fields of coarsely impressed sculpture on basic sculpture: each field of coarser sculpture centered along line of serial punctures and on most specimens limited by narrow areas of relatively smooth sculpture.

Pronotum with base slightly sinuate toward lateral margin; lateral bead moderate, continuous to front angles. Metasternal wings relatively broad. Male with protarsal claws (Fig. 232) relatively short; protarsal article 5 with two separate longitudinal rows of setae on ventral surface; anterior mesotarsal claw about twice as long as smaller highly arcuate posterior claw.

*Taxonomic notes.* – This species is highly varied in size, shape (outline of body), shape and

extent of maculation of the pronotum, extent of maculation of elytra, color of abdomen, and degree of development of coarse elytral sculpture of the female. I have not examined sufficient North American material to determine if there is a geographical pattern to this variation.

I examined the type specimens of *R. assimilis* (Kirby) and *R. plebeius* Sharp and found them to be identical to Alberta specimens of *R. binotatus*. On the basis of the original description, I regard *R. aequalis* Hatch as a synonym of *R. binotatus* and this synonymy has been confirmed by Zimmerman (1973, in litt.).

J. Zimmerman (1973, in litt.) informed me that he examined specimens of *Rhantus gutticollis* (Say) from Alberta. This species closely resembles *R. binotatus* but the males can be recognized by their short, distinctly arcuate, anterior protarsal claw. I have not seen specimens of *gutticollis* from the province.

*Natural history notes.* — This species is rather erratic in occurrence; therefore, it is difficult to specify its usual habitat. Many specimens have been collected from flowing water or from pools connected to, or adjacent to, flowing water such as beaver ponds and oxbow ponds. In this form of habitat, the beetles are usually taken from among clean emergent vegetation, that is areas free of large amounts of decaying vegetation, and shelter is provided primarily by living plants. Also, specimens have been taken from springs, some quite cold, in the mountains, especially among stands of *Juncus* or *Carex*. Smith (1973) also records this species from streams and clear, cool water.

General specimens have been collected from July 8 to August 9. A single male specimen has been collected in flight (12:00 a.m., July 7, Edson).

*Distribution.* — The range of this species extends from the Maritime Provinces to British Columbia, south in the western portion of the continent to Mexico and north as far as the MacKenzie Delta, N.W.T. (Aklavik, UASM). The species probably occurs throughout the province but tends to be rather local in occurrence. I examined more than 180 specimens from Alberta localities (map, Fig. 448).

#### *Rhantus frontalis* (Marsham, 1802)

*Dytiscus frontalis* Marsham, 1802: 425. (Type locality — not stated by author.) — J. Balfour-Browne 1944: 354. — Hatch 1953: 232. — Anderson 1962: 72.

*Dytiscus notatus* Fabricius, 1781: 296. (Type locality — not stated by author.) Not Bergstrasser, 1778. — Gemminger and Harold 1868: 449. — Crotch 1873: 410. — Sharp 1882: 618. — Zimmermann 1919: 220. — Carr 1920: 4. — Leng 1920: 80. — Hatch 1928: 223. — Hatch 1933b: 11. — F. Balfour-Browne 1950: 232. — Zaitsev 1953: 289. — Gordon and Post 1965: 22. — Wallis 1973: 109.

*Rhantus sericans* Sharp, 1882: 619. (Type — male in BMNH labelled as follows — ♂; Type 895, TYPE; N. America; Sharp Coll. 1905-313; *R. sericans* n. sp., Brit. Col.).

*Diagnosis.* — Maculation of the pronotal disc is a median transverse piceous bar with, on many specimens, a less distinct spot on each side lateral to the medial bar, and is characteristic of this species.

*Description.* — Measurements of 20 specimens from Lethbridge, Alberta, are: TL — 8.64 to 10.16 mm ( $\bar{X}$  = 9.57 ± 0.34 mm); MW — 4.32 to 5.28 mm ( $\bar{X}$  = 4.97 ± 0.19 mm); TL/MW — 1.84 to 2.00 ( $\bar{X}$  = 1.92 ± 0.04); WC/WS — 3.24 to 3.80 ( $\bar{X}$  = 3.51 ± 0.15).

Frons except for anterior and medial areas, and a pair of frontal spots (often confluent medially and forming a single transverse bar), black; rest of head testaceous; antenna testaceous except articles 4 to 11 infusate apically; palpi testaceous except terminal article of each palpus infusate apically. Pronotum pale with anterior and posterior margins narrowly piceous near middle; disc with single medial transverse spot and on many specimens additional more or less diffuse piceous spot on each side lateral to medial spot. Elytron testaceous; disc irrorate with piceous spots, spots larger and more or less confluent towards apex; most specimens with three narrow longitudinal pale stripes each following row of serial punctures, and short diagonal stripe more or less parallel to scutellar margin. Ventral surface with prosternum and anterior two-thirds of proepisternum, testaceous; proepisternum, proepimeron and sclerites of meso- and metathorax, black; metacoxal process rufous. Male abdomen rufopiceous to piceous except some specimens with posterior margin of each sternum, testaceous. Female with sterna testaceous



except sterna 2 to 5 each with piceous basolateral spot on each side.

Male with lines of sculpture well developed in form of very irregular meshes; somewhat longitudinal basally, more irregular apically; interspaces finely granulate with secondary sculpture. Female sculpture like that of male but elytron basomedially with at least few deep longitudinal impressions or grooves; most specimens with numerous deep grooves more or less confluent on many specimens.

Pronotum with base only slightly sinuate laterally; posterolateral angle obtuse; lateral bead discontinuous before anterolateral angle. Male protarsal claws as in Figure 233. Mesotarsus with anterior claw slender, shallowly and evenly arcuate; posterior claw about 0.5 length of anterior, with apex strongly arcuate.

*Taxonomic notes.* — This species is known as *R. notatus (auctorum)*. However, J. Balfour-Browne (1944) discovered that *Dytiscus notatus* F. is a primary junior homonym of *Dytiscus notatus* Bergstrasser and hence must be suppressed. The first available name for this species is *R. frontalis* (Marsham).

*Natural history notes.* — This is one of the most frequently collected species of dytiscid in the Alberta fauna, occurring in a variety of habitats, from temporary ponds to lakes and slow warm streams. It tolerates distinctly saline water, but not as saline as those occupied by halobiontic members of *Hygrotus*. I have numerous records of daytime flight from April to June. At this time, the species may be found in almost any pond. It is a colonizing species and is one of the first dytiscids into newly formed ponds and is frequently present before aquatic vegetation is established. The insect occurs in both temporary and permanent ponds, but primarily in those exposed and warm situations where the water is not densely choked with decaying or emergent vegetation.

*Distribution.* — This Holarctic species is confined to the northwestern portion of North America, from Kansas and Manitoba to Utah and Alaska. The species occurs throughout Alberta, and I examined 596 specimens from this province (map, Fig. 449).

#### Genus *Neoscutopterus* J. Balfour-Browne, 1943

*Neoscutopterus* J. Balfour-Browne, 1943: 172. (New name for *Scutopterus* Sharp. Type species — *Agabus angustus* LeConte, 1850, by original designation.)

*Meladema* LeConte, 1862: 522. Not Laporte, 1834.

*Scutopterus* Sharp, 1882: 606. Not Aubé, 1836.

*Pseudoscutopterus* Hatch, 1953: 230. (Type species — *Agabus angustus* LeConte, 1850, by monotypy.)

This endemic North American genus contains two large, robust, black species, characterized as follows: Colymbetinae; pronotum without lateral bead; prosternal process well developed, bluntly pointed apically and received by shallow V-shaped impression on anteromedial margin of metasternum; epipleuron of elytron visible to humeral angle in lateral view; sculpture of elytron of large, coarse somewhat rounded meshes; metatarsal claws unequal; pleural striae on abdominal segment 1 not well developed; male protarsal articles 1 to 3 broadly dilated, with round scales beneath; aedeagus long and slender, with apex twisted to right; parameres slender, strongly sclerotized, setose apically; female ovipositor short, blunt, setose and not modified for piercing.

The isolated position of the two included species has long been recognized. However, they do show affinities to *Rhantus* and *Colymbetes* and have been placed close to these genera by all authors.

These beetles occur in the cold waters of swamps and bogs, usually associated with *Sphagnum* moss. The larva has not been described.

#### Key to the Species of *Neoscutopterus* Balfour-Browne

- 1 Pronotum with lateral margin more or less straight or evenly and gently arcuate in side view (Fig. 236); antenna and palpi entirely rufous or at most only vaguely darker apically; abdomen with sternum 2 more or less rufous mediolaterally . . . . . *N. hornii* (Crotch), p. 385
- 1' Pronotum with lateral margin strongly deflected downward near hind angle (Fig. 237); antenna, beginning with article 3 or 4, infuscate; palpi with terminal two articles of each palpus infuscate; abdomen entirely dark piceous to black, without rufous

spots. . . . . *N. angustus* (LeConte), p. 385

*Neoscutopterus hornii* (Crotch, 1873)

*Scutopterus hornii* Crotch, 1873: 405. (Type locality – “Canada”). – Sharp 1882: 606. – Wickham 1895b: 122. – Zimmermann 1919: 224. – Leng 1920: 80. – Wallis 1973: 109.

*Colymbetes (Scutopterus) coriaceus* Horn, 1871: 330. Not Laporte, 1835.

**Diagnosis.** – (Fig. 7). Specimens of *N. hornii* and *N. angustus* are separated on the basis of the characters presented in the key, and in the diagnosis for *R. angustus*.

**Description.** – Large, robust, dorsally convex. Measurements of 20 specimens from various Alberta localities are: TL – 13.76 to 16.64 mm ( $\bar{X} = 15.46 \pm 0.60$  mm); MW – 7.04 to 8.32 mm ( $\bar{X} = 7.80 \pm 0.26$  mm); TL/MW – 1.94 to 2.04 ( $\bar{X} = 1.98 \pm 0.03$ ); WC/WS – 3.68 to 4.37 ( $\bar{X} = 4.06 \pm 0.25$ ).

Color generally black. Head with small V-shaped area on frons between eyes, rufous; labrum and anterolateral portions of clypeus, rufous; antenna and palpi entirely rufous or, at most, antenna with outer articles very slightly darkened. Pronotum and elytron with lateral margins obscurely piceous; anterolateral angle of pronotum rufous. Ventral surface dark piceous to black except prosternum medially, and mediolateral portions of abdominal sterna 2 and 3, rufous to rufopiceous; sterna 4 to 6 also paler laterally but pale areas reduced.

Elytron with very coarse reticulate sculpture similar in both sexes: meshes large, irregular in size but somewhat rounded or very irregularly hexagonal in shape; meshes with variously effaced secondary sculpture.

Pronotum convex, side more or less evenly arcuate laterally or straight before right or acute angled posterolateral angle; base of pronotum more or less straight medially, prolonged posteriorly at lateral angle; lateral margin in side view, more or less straight or very slightly arcuate, not strongly deflected downward anterior to posterolateral angle (Fig. 236).

Male protibia (Fig. 234) broadly expanded distally, with inner basal emargination. Articles 1 to 4 of protarsus relatively widely dilated, together with four transverse rows of round or oval, short stalked scales beneath; protarsal claws little modified, slightly broader than on female. Aedeagus and paramere as in Figure 239.

**Natural history notes.** – The beetles are usually found in small cold pools in moss mats of *Sphagnum* or among emergent *Carex* or detritus along the edge of a *Sphagnum* carpet. Mature adults overwinter and have been taken as early in spring as free water has been found in *Sphagnum* bogs. Teneral specimens have been taken from July 10 to August 8 and specimens have been found in copulation on July 10. Possibly some larvae overwinter. No records of flight are available.

**Distribution.** – The species occurs from Manitoba to Alaska (Circle; Nome; Mi. 1304, Alaska Hwy.; UASM) and has been collected throughout the northern forested portions of Alberta, south to the Bow River drainage. I examined more than 90 specimens from Alberta localities (map, Fig. 450).

*Neoscutopterus angustus* (LeConte, 1850)

*Agabus angustus* LeConte, 1850: 213. (Type locality – not given, probably vicinity of Lake Superior.). – Melsheimer 1853: 30. – LeConte 1862: 522. – LeConte 1863a: 17. – Gemminger and Harold 1868: 447. – Crotch 1873: 404. – Sharp 1882: 606. – Wickham 1895b: 122. – Leng 1920: 80. – Blackwelder 1948: 4. – Hatch 1953: 230. – Malcolm 1971: 28. – Wallis 1973: 109.

**Diagnosis.** – In addition to key characters, this species is best separated from *N. hornii* by smaller size and more slender and flattened shape, broader metasternal wing and lack of rufous spots on the abdomen.

**Description.** – Measurements of 6 specimens from the Junction of the Forestry Trunk Road and James River, Alberta, are: TL – 14.24 to 15.36 mm ( $\bar{X} = 14.82 \pm 0.41$  mm); MW – 6.56 to 7.20 mm ( $\bar{X} = 6.96 \pm 0.24$  mm); TL/MW – 2.09 to 2.19 ( $\bar{X} = 2.13 \pm 0.04$ ); WC/WS – 2.72 to 3.04 ( $\bar{X} = 2.96 \pm 0.12$ ).

Similar in color to *hornii* but differing as follows: antenna with only articles 1 and 2 entirely testaceous or rufous, articles 3 to 11 infusate and usually piceous, at least medially; palpi infusate, outer articles of each palpus piceous; ventral surface of body dark piceous or black, abdominal sterna without mediolateral rufous or rufopiceous areas.

Sculpture of elytron coarse, lines deeply impressed; meshes large and very irregular in shape; secondary sculpture very fine.

Pronotum with lateral margin, in side view deflected downward near posterolateral angle (Fig. 237).

Male inner basal emargination of protibia shallow; tibia less strongly expanded distally than in *N. hornii* (Fig. 235). Male

genitalia as in Figure 240.

*Natural history notes.* — I collected specimens of this species in a beaver pond on the upper reaches of the James River, on May 17 among emergent *Carex* in 6 to 18 inches of water. The specimens were slightly teneral but had probably overwintered as adults. Specimens of *N. hornii* were also taken, but from shallower water and in a mat of *Sphagnum*.

*Distribution.* — The species has been recorded from Maine to southeastern British Columbia. I examined seven Alberta specimens (map, Fig. 451).

#### Genus *Colymbetes* Clairville, 1806

*Colymbetes* Clairville, 1806: 188. (Type species — the Palearctic *Dytiscus striatus* L., designated by Curtis, 1828.)

*Cymatopterus* Boisduval and Lacordaire, 1835: 308. (Type species — the Palearctic *Dytiscus fuscus* Fab., by monotypy.)

This genus includes moderately large, elongate specimens characterized by unique elytral sculpture of closely spaced, parallel, transverse grooves. In addition to characteristics of Colymbetinae, characters common to Alberta members of the genus are:

TL — 14.5 to 20.0 mm. Body elongate-oval, somewhat depressed. Color various, elytron pale except transverse grooves black. Clypeus with small fovea on each side near anterior margin. Palpi slender, terminal article of each palpus entire. Pronotum without lateral bead. Prosternal process rounded and broadly convex medially; apex short and blunt, somewhat deflected upward behind procoxae. Metasternum not or only slightly incised, weakly flattened anteromedially. Elytral disc with numerous transverse grooves; interspaces with variously developed microreticulation. Sternum 2 posterolateral margin with series of short longitudinal ridges (= file of stridulatory organ (Larson and Pritchard, 1974)). Metafemur without linear arrangement of setae near posteroapical angle; metatarsal articles lobed apically; metatarsal claws unequal. Male articles 1 to 3 of pro- and mesotarsi dilated, ventral surface with adhesive hairs, rounded scales, or combination of both. Male genitalia with parameres symmetrical, broad basally and abruptly narrowed medially as long sparsely setose apical stylus; aedeagus long and slender, apex somewhat thickened and on some specimens produced into small hook. Female with apex of ovipositor short and broad, membranous with short setae.

The Albertan species have been assigned to two subgenera: *Cymatopterus*, tarsi ventrally without adhesive scales; and *Colymbetes s. str.*, males with at least some adhesive scales. However, males of the species *C. exaratus* lack scales from the ventral surface of tarsal article 1 while articles 2 and 3 have scales. Because this species is intermediate in the character separating the two subgenera and because of the lack of other morphological features substantiating this subgeneric separation. I choose not to recognize it.

The members of this genus are characteristic pond inhabitants, and one or more species may be found in the zone of emergent vegetation of almost every pond and slow weedy creek. Two species, *C. longulus* and *C. seminiger* are mainly restricted to the cold water of *Carex* marshes or *Sphagnum* bogs. Only one species, *C. sculptilis*, is regularly found in temporary or slightly saline ponds but as the members of this species are strong, active fliers, their presence in many situations is no doubt due to dispersal from some other source. All species apparently overwinter as adults. The larva of one Albertan species, *sculptilis*, has been described (James, 1970; Watts, 1970).

This Holarctic genus contains about 20 species (Zimmermann, 1920) of which seven or eight are North American. The four species known to occur in Alberta are recognized by characters presented in the following key to species.

#### Key to the Alberta Species of *Colymbetes* Clairville

- 1        Legs piceous to black; male protarsus ventrally with adhesive hairs on articles 1 to 3, without scales . . . . . 2
- 1'      Legs generally rufous, femur infusate or piceous medially on some specimens; male protarsus ventrally either with scales alone or scales and adhesive hair . . . . . 3
- 2 (1)   Pronotal sculpture broad irregular meshes with little or no tendency toward transverse arrangement; pronotum generally black with side margin and on many specimens

- also small mediolateral area on disc, rufous; apex of aedeagus (Fig. 241) with acute ventral hook. . . . . *C. longulus* LeConte, p. 387
- 2' Pronotum sculpture narrow irregular meshes markedly transverse on anterolateral portion of disc; pronotum dark rufous except transverse black discal spot; apex of aedeagus somewhat thickened but without acute hook (Fig. 242) . . . . . *C. seminiger* LeConte, p. 388
- 3 (1) Head broad (Fig. 238), frons produced in front of eye and over base of antenna; femora medially and ventrally, piceous; male protarsus with adhesive hairs in addition to larger scales . . . . . *C. exaratus* LeConte, p. 388
- 3' Frons not inflated in front of eye, lateral margins of head straight and uniformly convergent from front of eye to base of clypeus; femora color various, testaceous to rufous or on some specimens infusate medially; male protarsus with scales only . . . . . *C. sculptilis* Harris, p. 389

*Colymbetes longulus* LeConte, 1862

*Colymbetes longulus* LeConte, 1862: 522. (Type areas – "Lake Superior and Methy" (Methy Lake, Saskatchewan?).) – LeConte 1863a: 17. – Gemminger and Harold 1868: 447. – Crotch 1873: 406. – Sharp 1882: 625. – Wickham 1895b: 122. – Leng 1920: 80. – Zimmermann 1920: 212. – Hatch 1928: 225. – Hatch 1953: 234. – Wallis 1973: 109. *Colymbetes paykulli* auctorum, not Erichson 1837: 149. – J. Balfour-Browne 1948: 160, 164. – Zaitsev 1953: 297.

**Diagnosis.** – This and the following species, *C. seminiger*, both have dark legs and males possess adhesive hairs on the ventral surfaces of protarsal articles 1 to 3. Specimens of *C. longulus* differ from those of *C. seminiger* by lacking the stretched meshes of sculpture from the pronotum; and the apex of the aedeagus is acutely hooked.

**Description.** – Measurements of 20 specimens from Winchell Coulee, near Water Valley, Alberta, are: TL – 16.96 to 18.56 mm ( $\bar{X}$  = 18.02 ± 0.39 mm); MW – 8.16 to 9.12 mm ( $\bar{X}$  = 8.57 ± 0.23 mm); TL/MW – 2.02 to 2.19 ( $\bar{X}$  = 2.10 ± 0.04).

Head black except two spots on frons between eyes, labrum, and anterior and lateral margins of clypeus, rufous; antenna piceous with articles 1 and 2 and bases of outer articles, paler; palpi piceous, each article paler basally. Pronotum black except lateral margins and partial transverse band or mediolateral spot, rufous. Elytron brown except transverse grooves and epipleuron black. Ventral surface including legs, dark piceous to black.

Pronotum with meshes of sculpture irregular but on some specimens with slight tendency to transverse arrangement on anteromedial portion of disc and longitudinal arrangement on basolateral portions of disc. Male secondary sculpture of head and pronotum more or less effaced medially, better developed laterally; female secondary sculpture stronger; elytron with secondary sculpture on both sexes.

Head evenly narrowed from anterior margin of eye to base of labrum, not expanded or angulate above antennal socket. Pronotum varied in shape, evenly rounded laterally on some specimens or on others with distinct sinuation near anterolateral angle.

Male articles 1 to 3 of pro- and mesotarsi dilated with dense vestiture of adhesive setae on ventral surface, without scales; anterior protarsal claw broad, evenly arcuate and only slightly notched ventrally at base, apex acute. Aedeagus as in Figure 241: apex moderately produced, with well defined hook.

**Taxonomic notes.** – This species and the Palearctic *C. paykulli* may be conspecific, but this has not been established.

Alberta specimens do not show any pronounced pattern of geographical variation although specimens from the northern part of the province tend to be slightly darker in color.

**Natural history notes.** – This species is in the forested portions of the province, most commonly in cold *Sphagnum* bogs or shallow water of marshes shaded by *Salix*, where emergent species of *Carex* as well as *Sphagnum* form dense mats. A female specimen was captured in flight at 11:30 a.m. on June 7, 1970 (Rich Lake, Alta.). Galewski (1964b) described the larva of *C. paykulli*.

**Distribution.** – This Nearctic species ranges from Newfoundland and Nova Scotia to British Columbia and south to Kansas. In Alberta *C. longulus* occurs throughout the northern part of the province south to the Bow River drainage, and is isolated in the Cypress Hills near Reesor

Lake. I examined 222 specimens from Alberta localities (map, Fig. 452).

*Colymbetes seminiger* LeConte, 1862

*Colymbetes seminiger* LeConte, 1862: 522. (Type locality – “Saskatchewan”). – LeConte 1863a: 17. – Gemminger and Harold 1868: 448. – Crotch 1873: 406. – Sharp 1882: 625. – Wickham 1895b: 122. – Leng 1920: 80. – Zimmermann 1920: 213. – Hatch 1928: 225. – Hatch 1953: 234. – Leech and Chandler 1956: 322.

**Diagnosis.** – Members of this species resemble large pale specimens of *C. longulus* but can be recognized on the basis of the characters presented in the above key to species and in the diagnosis of *C. longulus*.

**Description.** – Measurements of 20 specimens from various localities in northern Alberta, are: TL – 17.28 to 20.00 mm ( $\bar{X} = 18.92 \pm 0.67$  mm); MW – 8.32 to 9.76 mm ( $\bar{X} = 9.23 \pm 0.39$  mm); TL/MW – 1.98 to 2.13 ( $\bar{X} = 2.04 \pm 0.04$ ).

Color resembling that of pale specimen of *C. longulus*, differing as follows: pronotum rufous to dark rufous and large median transverse dark mark on disc (many specimens with additional dark spots lateral and posterior to medial mark); elytron generally light brown with black transverse grooves; epipleuron not entirely black, with at least apical and usually also basal rufous areas; ventral surface, including legs, piceous to black.

Pronotum with lines of primary sculpture dense, in form of narrow stretched meshes strongly transverse in arrangement anteriorly and laterally on disc. Secondary sculpture isodiametric, lightly impressed and body slightly more shiny than that of *C. longulus*.

Head as in *C. longulus*, lateral margin of frons not expanded in front of eye. Pronotum with lateral margin distinctly sinuate near anterolateral angle.

Male with articles 1 to 3 of pro- and mesotarsi broadly dilated, with adhesive hairs on ventral surface, without scales; anterior protarsal claw very broad, more or less spatulate, slightly arcuate and relatively broadly rounded apically, dissimilar in shape to anterior mesotarsal claw, latter narrowed and acute apically. Male genitalia with aedeagus (Fig. 242) thickened apically, but not hooked.

**Taxonomic notes.** – This species bears the same relationship with the Palearctic *C. dahuricus* Aubé that *C. longulus* bears with *C. paykulli*. The apex of the aedeagus of *C. dahuricus* is rounded like that of *C. seminiger*, but the aedeagus is longer and the apex relatively small. F. S. Carr’s (1920: 4) Alberta record for *C. strigatus* LeConte refers to this species (based on specimens bearing F. S. Carr’s determination labels in UASM).

**Natural history notes.** – This species inhabits *Sphagnum* bogs but does not appear to be as restricted to this habitat as is *C. longulus*. Many specimens have been collected in situations where mats of *Sphagnum* were absent but which did contain dense patches of emergent vegetation such as *Carex*, or matted plant debris such as flooded grasses along the margins of beaver ponds, roadside ditches, or along flooding backwaters of creeks and drainage ditches. All collections of this species have been made in forested areas.

**Distribution.** – The range of this species is almost identical to that of *C. longulus*. This species has not been found in the Cypress Hills. I examined 108 specimens of *C. seminiger* from Alberta localities (map, Fig. 453).

*Colymbetes exaratus* LeConte, 1862

*Colymbetes exaratus* LeConte, 1862: 522. (Type locality – “Methy” (= Methy Lake, Saskatchewan?). – LeConte 1863a: 17. – Gemminger and Harold 1868: 447. – Crotch 1873: 505. – Sharp 1882: 627. – Zimmermann 1919: 223. – Leng 1920: 80. – Zimmermann 1920: 210. – Hatch 1928: 225. – Hatch 1953: 234. – Leech and Chandler 1956: 322.

**Diagnosis.** – Specimens of this species are recognized by the largely pale legs of which the medioventral portion of the femora is darkly infuscate, and by the lateral margin of the frons strongly dilated anterior to the eye.

**Description.** – Measurements of 20 specimens from southwestern Alberta, are: TL – 16.80 to 18.40 mm ( $\bar{X} = 17.57 \pm 0.42$  mm); MW – 8.00 to 8.64 mm ( $\bar{X} = 8.34 \pm 0.20$  mm); TL/MW – 2.02 to 2.18 ( $\bar{X} = 2.11 \pm 0.04$ ).

Head black except two spots on frons (often fused into a single transverse bar), labrum, clypeus and anterior and lateral margins of frons, testaceous to rufous; antenna testaceous basally, with outer articles slightly infuscate; palpi pale except terminal article of each palpus infuscate apically. Pronotum testaceous to rufous except medial transverse bar and on many specimens lateral spot on each side of medial bar, piceous to black. Scutellum black basally, piceous apically. Elytron pale

brown except transverse lines black and epipleuron testaceous. Ventral surface piceous to black except apices of abdominal sterna and metacoxal process, rufous. Legs rufous except femora piceous ventrally and medially.

Pronotum with lines of primary sculpture deep and coarse, relatively widely separated and in form of very irregular meshes with only slight tendency toward transverse arrangement anteriorly and laterally. Secondary sculpture fine, obsolete medially on frons and disc of pronotum but well developed on disc of elytron.

Head (Fig. 238) with lateral margin of frons expanded laterally in front of eye. Pronotum with lateral margin evenly rounded.

Male with articles 1 to 3 of pro- and mesotarsi dilated; articles 1 ventral surface each with pad of adhesive setae along posterior margin, articles 2 and 3 each with large scales on ventral surface; anterior protarsal claw strongly arcuate, broad basally and acute apically. Aedeagus (Fig. 243) very elongate, strongly twisted to right; apex with a small but obvious hook.

*Taxonomic notes.* — LeConte's description applies equally well to the large, dark, northern form of *C. sculptilis* and to this species. I have not seen the type and apply the name *C. exaratus* *sensu* Hatch (1953) and Leech and Chandler (1956). On the other hand, Young and Severin (1956) consider the name *C. exaratus* to be a synonym of *C. sculptilis*. If so, *C. exaratus* (auct. not LeC) requires another name, unless it is conspecific with the very similar species *C. inaequalis* Horn, 1871.

In southwestern Alberta, *C. exaratus* and *C. sculptilis* are more or less allopatric. Both are represented in the same general areas but seldom together in the same body of water. In northern and eastern Alberta, *C. exaratus* is less common, but usually is associated with *C. sculptilis*. Over most of their ranges, these two remain morphologically distinct. However, in the Valleyview area, some specimens appear intermediate between these two species. For example, a male (3 mi E Valleyview, July 9, 1970) possesses all of the characters of *C. exaratus* except that articles 1 of the pro- and mesotarsi lack adhesive hairs and instead possess a double row of small oval scales. Four females from the same area show reduced swelling of the frons and approach *C. sculptilis* in head and leg coloration. No specimens from other localities show intermediate conditions. If the Valleyview specimens represent hybrids between *exaratus* and *sculptilis*, this condition is rare and for the most part, isolating mechanisms between these two species are effective. Hybridization and competition with *C. sculptilis* may be important factors limiting the eastern and northern distribution of *C. exaratus* in Alberta.

*Natural history notes.* — This species occurs primarily in the mountain and foothills regions of Alberta, specimens being most frequently collected from areas of dense emergent vegetation such as stands of *Carex* or from among mats of flooded grasses along beaver ponds. I have not seen any records of flight. Teneral specimens have been collected on August 5, 1971.

*Distribution.* — This western Nearctic species ranges from Oregon and perhaps northern California to British Columbia and eastward through the Rocky Mountains and adjacent foothills to north central Alberta, and western Saskatchewan. No specimens have been seen from the North Saskatchewan River drainage. I examined 84 specimens from Alberta localities (map, Fig. 454).

#### *Colymbetes sculptilis* Harris, 1829

- Colymbetes sculptilis* Harris, 1829: 8. (Type locality — Ipswich, Massachusetts.). — LeConte 1850: 213. — Melsheimer 1853: 30. — LeConte 1862: 282. — LeConte 1863a: 17. — Gemminger and Harold 1868: 448. — Crotch 1873: 405. — Sharp 1882: 627. — Horn 1883: 279. — Wickham 1895b: 122. — Zimmermann 1919: 223. — Carr 1920: 4. — Leng 1920: 80. — Zimmermann 1920: 212. — Hatch 1928: 225. — Brown 1930b: 237. — Hatch 1933b: 11. — J. Balfour-Browne 1948: 160. — Young and Severin 1956: 79. — Anderson 1962: 23. — Gordon and Post 1965: 23. — Wallis 1973: 110.
- Colymbetes triseriatus* Kirby, 1837: 73. (Type — male in BMNH labelled as follows: type; N. Amer., ♂ 5779a; *Colymb. triseriatus* Kirby, N. Amer., 5779, Rev. W. Kirby.). — Aubé 1838: 229. — LeConte 1850: 213. — Horn 1883: 282.
- Colymbetes densus* LeConte 1862: 282. (Type locality — "Oregon".) — LeConte 1863a: 17. — Gemminger and Harold 1868: 447. — LeConte 1869: 370. — Zimmermann 1919: 223.
- Colymbetes rugipennis* Sharp, 1882: 628. (Lectotype (here selected) — male in BMNH labelled as follows: Northern bound. Nebraska, Sept. 1874, 916; Type; Sharp Coll. 1905-313; Type 916, *Col. rugipennis* n. sp., Am. bor.). — Leng 1920: 80. — Zimmermann 1920: 212. — Hatch 1928: 225. — Hatch 1953: 234. Leech and Chandler 1956: 322. — Young and Severin 1956: 79-83.

*Colymbetes exaratus* Young and Severin, 1956: 80. Not LeConte, 1862 (see Taxonomic notes under *C. exaratus* LeConte).

**Diagnosis.** — Members of this species are recognized by the following combination: frons not dilated anterior to eye; pronotum with disc largely pale and bearing a medial transverse maculation and on some specimens brown or piceous spots lateral to this; legs mainly testaceous with femora of some specimens variously infusate; male articles 1 to 3 of protarsus with only large adhesive scales on ventral surface.

**Description.** — Habitus, as in Fig. 8. Measurements are: TL — 15.2 to 18.0 mm; MW — 6.8 to 8.5 mm. See Taxonomic Notes below for discussion of geographical variation in measured characteristics.

Head black except two spots on frons (on many specimens spots fused into single transverse bar), labrum, clypeus, antero-lateral margin of frons, and frons medially, testaceous to rufous; antenna testaceous except outer articles slightly infusate on some specimens; palpi testaceous except terminal article of each palpus infusate apically. Pronotum testaceous to rufous except medial transverse mark and on some specimens lateral spot on each side, piceous. Scutellum pale basally, piceous apically. Elytron generally testaceous to pale brown with transverse grooves black. Ventral surface black except apices of metacoxal processes and abdominal sterna, rufous. Legs testaceous to rufous except femora variously infusate medially on some specimens.

Pronotum with lines of primary sculpture deep and coarse, relatively widely separated, in form of very irregular meshes with slight tendency toward transverse arrangement. Dorsal surface with secondary sculpture fine.

Head with frons evenly narrowed from anterior margin of eye to apex of clypeus, frons not dilated anterior to eye. Pronotum with lateral margin evenly arcuate, not sinuate near anterolateral angle.

Male articles 1 to 3 of pro- and mesotarsi dilated, with only large adhesive scales on ventral surfaces; anterior protarsal claw strongly arcuate with apex acute, smaller than claw of *exaratus*. Aedeagus (Fig. 244, 245) relatively short and only slightly twisted; apex with hook.

**Taxonomic notes.** — The following five characters vary: sculpture, color, size, length of aedeagus and width of male protarsus. Sculpture varies in the depth and density of the primary sculpture, but this does not show a definite geographical pattern. On the other hand, variation in the other characters has a geographical basis, not precisely concordant, but parallel, and permits recognition of three forms in the province. Each of these characters is discussed separately below.

a) Color: The pattern of variation is relatively simple. Specimens from the prairie and parkland regions tend to have reduced pronotal maculation and the legs are entirely testaceous or rufous. To the north, in the mixed and boreal forests, the pronotal maculations are more or less expanded and the femora are variously infusate medially, varying individually from pale brown to almost piceous.

b) Size: The length of the left elytron from its apex to the apex of the scutellum is an index of size. Measurements from selected population samples from Alberta, are presented in Table 3. These data were used to calculate the regression of length of elytra on latitude shown in Figure 1. Samples from the extreme ends of this distribution, when compared with each other by means of a t test, differ significantly at the 99% level of confidence. However, adjacent samples do not differ significantly from each other. Hence, the variation in size from north to south appears to be in the form of a uniform cline. In spite of this rather simple overall pattern, several complications are evident. In southern Alberta, in the Lethbridge and Little Bow River samples, the populations contain two forms. If those male specimens possessing short aedeagi (see (c) below) are separated from the rest of the sample, their mean elytral length is 11.38 mm (N = 6, range 11.20 - 11.84 mm), while the mean for the remainder of the sample is 12.25 mm (N = 22, range 11.20 - 12.96 mm); The females cannot be separated into two groups on the basis of size, nor can they be subdivided on the basis of any other single character. In northern Alberta the cline appears to level off at 55-56° latitude, perhaps slightly lower in the east and higher in the west. However, the Peace River specimens are smaller than specimens from the same latitude further east, and are similar to Edmonton specimens.

c) Length of Aedeagus: Data on the length of the aedeagus of specimens from selected population samples is summarized in the form of histograms in Figure 2. This character varies discontinuously, showing three distinct states. In southern Alberta, a form with a very short aedeagus occurs (which corresponds to those specimens with short elytral length) within population

samples which contain specimens possessing aedeagi of medium length. This second form occurs exclusively throughout central Alberta to about the latitude of Cold Lake and the Athabasca River. North of this, specimens with long genitalia become more common and predominate in the area north of Lesser Slave Lake and in the McMurray region.

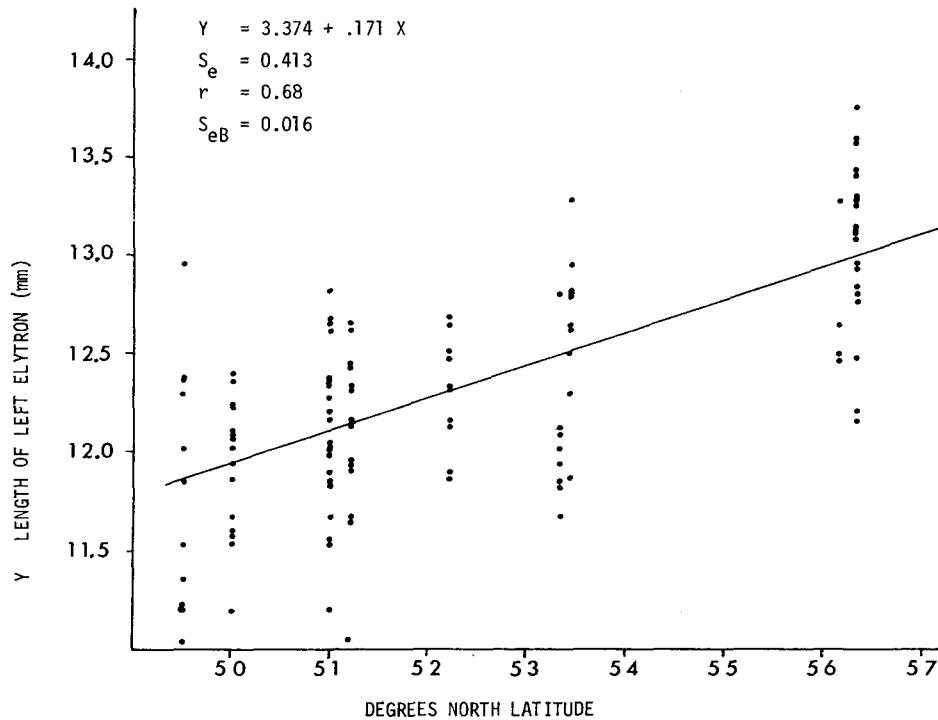


Fig. 1. Regression of length of left elytron on latitude for male specimens of *Colymbetes sculptilis* Harris from selected Alberta localities.

d) Width of Male Protarsus: Populations from the Lethbridge area are dimorphic, containing specimens with narrow protarsi (corresponding to those specimens with short aedeagi) which are restricted to this area, and specimens with very broad protarsi. All specimens from localities farther north show the broad state. However, north of Edmonton, there is a tendency for the tarsi to become narrower.

In summary, the Alberta specimens of *sculptilis* can be divided into three forms on the basis of the above characters, as follows:

- 1) Form A restricted to southern Alberta: color pale, size small, aedeagus short, and male protarsi narrow.
- 2) Form B inhabiting south and central Alberta and part of the Peace River area: color pale to intermediate, body and aedeagus of intermediate length, and male protarsi very broad.
- 3) Form C occurs in northern Alberta: color dark, size large, aedeagus long, and male protarsus narrow.

Forms B and C intergrade in all characters except length of aedeagus. However, as the difference in length of aedeagus is not great, this character may simply be dimorphic. These two



forms are probably ecotypes of the same species, with B being a prairie and parkland form and C being a mixed or boreal forest form. However, the relationship between forms A and B is more obscure. Size overlaps, but on the basis of length of aedeagus and width of male protarsus, both forms are distinct. Form B becomes larger in size in its zone of overlap with form A, just as the width of its protarsus is at its greatest in this area. This could represent two cases of character divergence where two separate although closely related species are sympatric. On the other hand, these two forms could represent two different morphs of the same species. Young and Severin (1956) have suggested that in this species, "there may be a correlation with the chemical composition of the water and the degree of elytral and pronotal sculpturing". Perhaps similar factors could affect other morphological characters. A definitive statement on the status of these various forms and the factors leading to their development and maintenance must wait until detailed taxonomic and ecological studies are made.

Table 3. Data on geographical variation in length of the left elytron (mm) among selected population samples of *Colymbetes sculptilis* Harris.

Locality	Sex	N	Range	Mean	S.D.
Wildhorse	♂	4	11.20 - 11.84	11.52	0.28
Lethbridge	♂	12	11.20 - 12.96	11.82	0.63
	♀	18	11.04 - 13.28	12.18	0.60
Little Bow River	♂	16	11.20 - 12.48	11.94	0.34
Calgary	♂	26	11.20 - 12.80	12.15	0.39
	♀	9	11.20 - 12.96	12.30	0.61
Blood Indian Res.	♂	20	11.68 - 12.64	12.13	0.27
	♀	20	10.72 - 13.12	12.24	0.55
Winchell Coulee	♂	7	11.04 - 12.64	12.09	0.52
Red Deer	♂	9	11.84 - 12.64	12.28	0.30
	♀	4	12.16 - 13.12	12.60	0.40
Edmonton	♂	10	11.84 - 13.28	12.61	0.43
	♀	20	11.36 - 13.28	12.59	0.48
Edson	♂	11	11.84 - 13.28	12.44	0.41
	♀	4	12.96 - 13.12	13.00	0.07
Rock Lake	♂	8	11.68 - 12.88	12.06	0.37
	♀	3	12.48 - 13.20	12.88	—
Peace River	♂	4	12.48 - 13.28	12.72	0.38
	♀	8	11.68 - 13.12	12.54	0.42
Gift Lake	♂	20	12.16 - 13.76	13.10	0.37
Ft. McMurray	♂	3	13.28 - 13.92	13.60	—
Manning	♂	8	12.00 - 13.44	12.85	0.52

I did not dissect the genitalia of Kirby's type of *C. triseriatus* and hence am uncertain of its relationship with the Alberta forms. The lectotype of *C. rugipennis* Sharp is most similar to the large prairie form.

*Natural history notes.* — This species is common in Alberta in almost all warm shallow waters with dense stands or mats of submerged or emergent vegetation. Specimens are occasionally taken in colder, vegetation-choked sites such as *Sphagnum* bogs. James (1970) described the

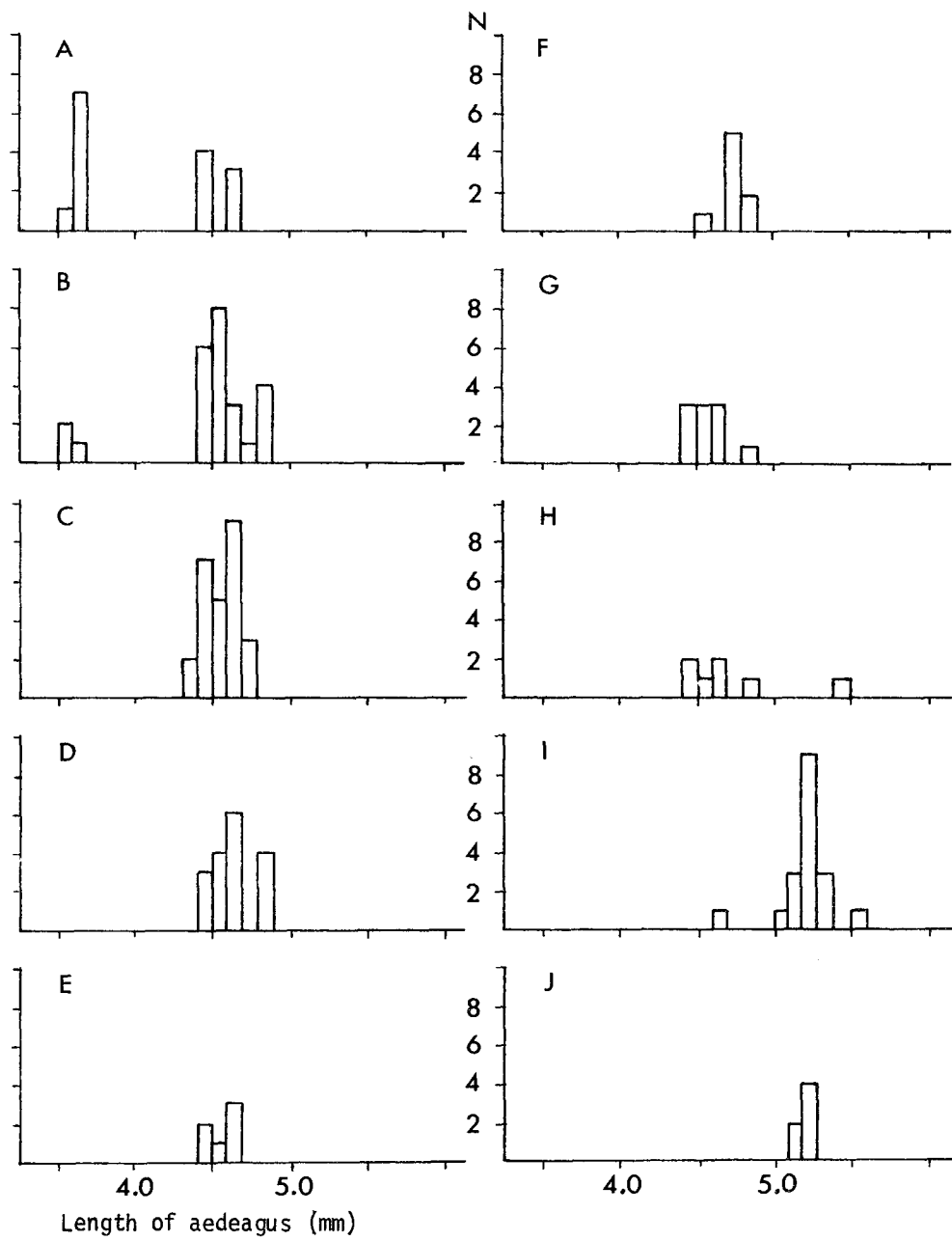


Fig. 2. *Colymbetes sculptilis* Harris. Length of aedeagus for specimens from selected Alberta population samples. A - Lethbridge; B - Little Bow River; C - Calgary; D - Blood Indian Reservoir; E - Red Deer; F - Edmonton; G - Edson; H - Rock Lake; I - Gift Lake; J - McMurray.

larva and the biology of this species in southern Ontario, and Watts (1970) the season of larval occurrence in southern Manitoba. In Alberta, teneral specimens have been collected from July 4 to August 5. Watts (1970) found that adults may leave drying pools during summer, and migrate to more permanent water. Overwintering is in these sites or a return migration takes place in fall when rains raise water levels in smaller sloughs and ponds. Two adults were active under ice of Pine Lake (March, 1970).

Beetles of this species fly readily and many were collected at light during September and October.

*Distribution.* — This species is transcontinental in northern North America, ranging south to California and Nevada. I examined 636 specimens from Alberta localities (map, Fig. 455).

#### Subfamily Dytiscinae

The Alberta members of this subfamily are distinguished by the following combination of characters:

Size large to very large. Eye with anterior margin entire, not emarginate above base of antenna. Pronotum without lateral bead. Scutellum of mesothorax visible. Prosternum and its process in same plane. Metepisternum extended to mesocoxal cavity. Tarsal formula 5-5-5. Metatibia with bifid setae on dorsal face and row of natatorial setae along posterior margin of males and most females (absent on females of *Dytiscus*); metatibial spurs acute or emarginate apically; metatarsal articles slightly lobed apically; metatarsal claws unequal, outer claw shorter than inner. Male with articles 1 to 3 of protarsus broadly dilated and conjointly in form of rounded palette, ventral surface of palette with large adhesive discs and on some specimens also adhesive hairs. Male genitalia with parameres equal, subequal in length to aedeagus, setose apically and united dorsally by membrane for much of their length; aedeagus setose or glabrous on subapical ventral surface. Female with valves of ovipositor elongate, membranous or sclerotized, pointed apically but without dorsal or ventral teeth.

#### Genus *Dytiscus* Linnaeus, 1758

*Dytiscus* Linnaeus, 1758: 411. (Type species — *Dytiscus marginalis* L., designated by Latreille, 1810: 426 (opinion 619, Bull. Zool. Nom. 18 (1961)).)

*Macrodytes* Thomson, 1860: 41. (Type species — *Dytiscus marginalis* by original designation (Leech, 1948: 414).)

*Leionotus* Kirby, 1837: 76. (Type species — *Dytiscus conformis* Stephens (= *D. marginalis* L.) designated by Hope, 1839: 131.)

In addition to characteristics of Dytiscinae, members of *Dytiscus* share the following combination:

TL — 22 to 40 mm; color of dorsal surface dark brown to black, with green sheen on many specimens; clypeus (except for piceous anterior margin), labrum and inverted V-shaped marking on frons (chevron), lateral and on some specimens also basal and apical margins of pronotum, and lateral margin of elytron, yellow; color of ventral surface of body various; spurs of metatibia acute; metatarsus with dorsoapical margin of articles 1 to 4 glabrous, without fringe of short, flattened, golden setae; metatibia of male with row of natatorial setae along posterior margin; setae absent from female; male palette of protarsus article 1 with large posterior and slightly smaller anterior disc, remainder of article 1, articles 2 and 3, and mesotarsal articles 1 - 3 ventral surfaces with numerous small adhesive hairs; aedeagus with subapical ventral surface setose; female with valve of ovipositor elongate, heavily sclerotized.

Two distinct forms of females are represented: a) male-like, with exception of sexual characters and differences in punctuation; and b) those with deeply impressed longitudinal striae on the disc of each elytron. Several Alberta species have females of both types, for example *D. dauricus*, *D. circumcinctus* and *D. alaskanus*. The species *D. fasciventris* has only striate females while all females that I examined of *D. harrisii*, *D. marginicollis* and *D. hybridus* are lacking striae. In only two species, *D. cordieri* and *D. alaskanus*, does the distribution of these two female morphs appear to have a geographical basis. Striate females are consistently more conspicuously punctate than are nonstriate females of the same species, and nonstriate females are in turn more coarsely punctate than males. Presence or absence of striae on the females does not indicate close relationship between any of the species (Balfour-Browne, 1950: 266).

The Alberta species of *Dytiscus* show very little interspecific divergence in external structure.

Males of all Alberta species are distinguished from one another by the shape of the apex of the aedeagus. Differences in configuration of this organ between some species are slight, but appear to be consistent. Within a species, color is generally quite constant and color pattern shows a high degree of concordance with other characters. Because of this, color associates females with males, and is used extensively in the following key to species. Occasional specimens deviate from the normal pattern of the species, hence identifications should be confirmed by examination of the male genitalia. When punctuation is used for identification of species, it is necessary to compare specimens of the same sex and of the same female morph because of the high degree of intraspecific variation this character shows among these classes.

The North American species of *Dytiscus* exhibit patterns of geographical variation not understood at present. Also, the relationship between certain North American and Palearctic species is in doubt. Hence, the genus requires revision.

These insects inhabit shallow portions of ponds, lakes, slow streams and longer-lasting temporary sloughs, usually areas of dense emergent vegetation, and less frequently deeper water among rooted aquatic plants. Larvae are more common in deeper and more open locations than those inhabited by adults. The larvae are large active predators that probably prey on a variety of small animals. However, in the field, I more frequently observed *Dytiscus* larvae holding tadpoles in their mandibles than any other form of prey.

In Alberta, these insects overwinter as adults, and have been found in winter swimming under the ice of large deep lakes. For example, a male of *D. circumcinctus* was collected from a hole in the ice of Pine Lake on February 14, 1970 and a male of *D. alaskanus* was taken from Hastings Lake on March 14, 1964. Presumably, individuals inhabiting ponds that freeze completely during the winter must hibernate at the bottom of these ponds. Many observations of flight have been made during September and October and a few instances of early spring flight have been seen. Flight records are listed separately under each species.

The larvae of the following North American species have been described: *D. verticalis* (Wilson, 1923), *D. fasciventris* (James, 1970; Watts, 1970), *D. dauricus* (Kincaid, 1900; Watts, 1970) and *D. cordieri* (Watts, 1970). The larvae differ principally in coloration, shape of head and distribution of spines and setae on the tarsus.

#### Key to the Alberta species of *Dytiscus* Linnaeus<sup>6</sup>

- |        |   |  |
|--------|---|--|
| 1      | Metacoxal process rounded apically (Fig. 246-250), apex not acuminate. . . . .  | 2  |
| 1'     | Metacoxal process with apex sharply pointed, more or less acuminate (Fig. 251-253)  | 13   |
| 2 (1)  | Clypeus with anterior margin shallowly but distinctly bisinuate . . . . .   | <i>D. harrisii</i> Kirby, p. 397                 |
| 2'     | Clypeus with anterior margin straight or slightly concave . . . . .   | 3  |
| 3 (2') | Males . . . . .   | 4  |
| 3'     | Females . . . . .   | 9  |
| 4 (3)  | Mesotarsus articles 2 and 3 with median longitudinal glabrous area on ventral surface . . . . .   | 5  |
| 4'     | Mesotarsus ventral surface of articles 2 and 3 uniformly setose, without median longitudinal glabrous area . . . . .                            | 6  |
| 5 (4)  | Pronotum basal margin broadly bordered with yellow medially, maximum width of basal border subequal to maximum width of apical border . . . . . | <i>D. marginicollis</i> LeConte, in part, p. 398 |

6. F. S. Carr (1920: 4) recorded *D. marginalis* from Alberta, almost certainly in error. The species is not definitely known from North America and has not been included in the key.

- 5' Pronotum base not or at most very narrowly bordered with yellow. . . . .  
 . . . . . *D. hybridus* Aubé, in part, p. 398
- 6 (4') Ventral surface more or less evenly dark rufous to piceous in color; elytron with  
 yellow subapical transverse fascia. . . . . *D. verticalis* Say\*, in part
- 6' Ventral surface mainly testaceous or testaceous with distinct piceous pattern; ely-  
 tron without subapical transverse fascia, apex irrorate with yellow or not . . . . 7
- 7 (6') Frons with lateral arm of pale chevron extended to pale anterolateral angles; clypeus  
 with posterior margin raised as low ridge anterior to anterolateral impressions of  
 frons; pronotum basal margin distinctly bordered with yellow; elytron with serial  
 punctures traceable to apex, not obscured by densely punctate apex; ventral sur-  
 face entirely testaceous . . . . . *D. cordieri* Aubé, in part, p. 400
- 7' Without above combination of characters: frons with pale chevron not extended  
 to pale anterolateral angles; elytron with at least apical third densely punctate . 8
- 8 (7') Elytron with dense punctation more or less restricted to apical half of disc, basal  
 half of disc finely and sparsely punctate; anterior protarsal claw slightly shorter  
 than protarsal article 5: aedeagus as in Figure 257 . . . . .  
 . . . . . *D. fasciventris* Say, in part, p. 399
- 8' Elytron with dense punctation extended well onto basal half of disc; anterior pro-  
 tarsal claw subequal in length to protarsal article 5; aedeagus as in Figure 258 . .  
 . . . . . *D. hatchi* Wallis\*, p. 400
- 9 (3') Frons with anteromedial portion immediately posterior to clypeal suture, coarsely  
 punctate; elytron with yellow subapical transverse fascia. . . . .  
 . . . . . *D. verticalis* Say\*, in part
- 9' Frons with anteromedial portion impunctate or at most very finely and sparsely  
 punctate . . . . . 10
- 10 (9') Metafemur with anteromedial portion of ventral face very densely punctate, punctures  
 separated by less than their own diameters; pronotum with basal margin not or only  
 obscurely bordered with yellow. . . . . *D. fasciventris* Say<sup>7</sup>, in part, p. 399
- 10' Metafemur with ventral face relatively sparsely punctate, punctures separated by  
 several times their own diameter; pronotum with basal margin yellow or not . . 11
- 11(10') Elytron with basolateral punctation behind shoulder much denser than punctation  
 toward apex of elytron: pronotum with basal margin not or only very narrowly  
 bordered with yellow . . . . . *D. hybridus* Aubé, in part, p. 398
- 11' Elytron behind shoulder impunctate or with very small punctures; pronotum with  
 basal margin distinctly bordered with yellow; elytron smooth or striate . . . . . 12
- 12(11') Abdominal sterna mainly infuscate, dark rufous to piceous; many specimens with  
 sternum 1 and lateral and apical portions of sterna 2 to 6, testaceous; elytron with  
 basomedial portion of disc on most specimens with at least some finely impressed  
 anastomosing lines . . . . . *D. marginicollis* LeConte, in part, p. 398
- 12' Abdomen with sterna entirely testaceous or pale rufous, at most sternal sutures  
 slightly darker; elytron without fine anastomosing lines . . . . .  
 . . . . . *D. cordieri* Aubé<sup>7</sup>, in part, p. 400
- 13 (1') Eye ringed with yellow, or some specimens with yellow ring narrowly broken near  
 inner posterior angle of eye: abdominal sterna entirely testaceous or pale rufous,

\* Species is not known from Alberta.

7. Females of *D. hatchi* key to *D. fasciventris* or *D. cordieri* but *D. hatchi* is not known from Alberta.

- except basal margins of sterna 1 to 3 narrowly black . . . . .  
 . . . . . *D. circumcinctus* Ahrens, p. 401
- 13' Eye not ringed with yellow, or on some specimens anterolateral yellow spot on frons shortly produced along anterior inner margin of eye; abdominal sterna 2 and 3 with expanded basolateral piceous areas . . . . . 14
- 14(13') Male with apex of aedeagus as in Figure 261; female with posteromedial margin of clypeus distinctly raised above level of frons along clypeal suture; TL – 30.0 to 35.0 mm . . . . . *D. dauricus* Gebler, p. 402
- 14' Male with apex of aedeagus as in Figure 262; female with clypeus and frons in same plane medially along clypeal suture; TL – 22.5 to 30.5 mm . . . . .  
 . . . . . *D. alaskanus* J.Balfour-Browne, p. 404

*Dytiscus harrisii* Kirby, 1837

*Dytiscus harrisii* Kirby, 1837: 76. (Holotype – male in BMNH labelled as follows: – Type; N. Amer., ♂ 5784a; *Dytiscus harrisii* Kirby; N. Amer. 5784, Rev. W. Kirby.). – LeConte 1850: 202. – Melsheimer 1853: 29. – LeConte 1859: 36. – LeConte 1863a: 18. – Gemminger and Harold 1868: 462. – LeConte 1869: 370. – Crotch 1873: 407. – Sharp 1882: 646. – Wickham 1895c: 151. – Roberts 1905: 106. – Blatchley 1910: 232. – Leng 1920: 81. – Zimmermann 1920: 242. – Hatch 1928: 227. – Hatch 1953: 238. – Gordon and Post 1965: 25. – Wallis 1973: 110.

*Diagnosis.* – Very large size and distinctive color of the ventral surface are usually sufficient to permit ready recognition of this species. In addition, the anterior margin of the clypeus is bisinuate.

*Description.* – Measurements of 4 specimens from northern Alberta and Hay River, N.W.T. are: TL – 32.4 to 36.0 mm ( $\bar{X}$  = 34.0 mm); MW – 17.2 to 19.2 mm ( $\bar{X}$  = 18.0 mm); TL/MW – 1.87 to 1.90 ( $\bar{X}$  = 1.88).

Dorsal surface of head, disc of pronotum and disc of elytron, piceous to black with dark green cast on some specimens. Anterolateral margin of frons above base of antenna and small chevron between eyes, rufous; antenna testaceous; palpi testaceous except terminal article of each palpus infusate apically; ventral surface of head testaceous. Pronotum with apical and basal margins distinctly bordered with yellow. Elytron with narrow transverse subapical fascia continuous with lateral margin. Prosternum pale laterally, piceous medially. Mesepisternum and anterior margin of metacoxa, testaceous; metacoxal process rufous; otherwise ventral sclerites of meso- and metathorax dark piceous or black. Abdomen with sternum 1 testaceous medially, margins black; sterna 2 to 5 dark rufous medially with apical and laterobasal areas piceous; sternum 6 generally piceous, paler medially and apically. Proleg with anterior face rufous, posterior face piceous; meso- and metafemora anteriorly, trochanters and mesocoxa, rufous; otherwise middle and hind legs piceous.

Striate female not seen. Female with head virtually impunctate or at most with scattered small punctures along hind margin; pronotum with numerous very fine punctures scattered more or less evenly over disc; elytron distinctly punctate, small discal punctures deeper and denser toward apex and intermixed with much larger and deeper punctures; metacoxa and metafemur very finely and sparsely punctate; metatibia smooth and shiny with few widely spaced, minute punctures on ventral face. Male sculptured as above but with punctures smaller and finer.

Body large and relatively broad, lateral margins of elytron more or less expanded. Head with labrum only slightly concave medially; clypeus with apical margin bisinuate. Metacoxal process rounded apically (Fig. 246). Male with anterior and posterior rows of setae bordering basolateral smooth area of protibia clearly separated from each other dorsally: articles 2 and 3 of mesotarsus uniformly setose beneath. Male genitalia with aedeagus as in Figure 254.

*Taxonomic notes.* – I have seen too few specimens to make a definite statement about patterns of variation. However, 5 specimens seen from eastern North America (Ontario and Wisconsin) are larger (mean TL – 37.4 mm) and broader (mean ratio TL/MW – 1.77) than the Alberta specimens. Some authors recorded the occurrence of striated females, but neither Hatch (1953) nor I have seen them.

Thomson (1860) divided *Dytiscus* into two genera, *Dytiscus s. str.* and *Macrodytes* Thomson, primarily on shape of the labrum and lateral dilation of the elytra. Thomson left the species *D. latissimus* L. in *Dytiscus* and placed all other European species, including *D. marginalis* L., in *Macrodytes*. However, as *D. marginalis* is type species of both *Dytiscus* and *Macrodytes*, these generic names are synonymous. Various authors assigned *D. harrisii* to *Dytiscus sensu* Thomson as it resembles the Palearctic species *D. latissimus* in its shallowly emarginate labrum and laterally broadened elytra. F. Balfour-Browne (1950) discussed the characters used by

Thomson and concluded that the division of *Dytiscus* into two genera or subgenera is not merited.

*Natural history notes.* — I collected two females of *harrisii* from amid emergent *Carex* growing along the margins of beaver ponds on brown-water streams in northern Alberta. J. Carr (pers. comm.) found a very teneral female in its pupal cell under a log near the edge of a *Sphagnum*- and *Carex*-ringed lake on September 3, 1961. A specimen was collected in flight on June 2, 1964 (Hay River, N.W.T., UC).

*Distribution.* — This species ranges widely in the forested regions of northern North America, from Quebec and Wisconsin (UASM) to British Columbia, and north to at least Great Slave Lake (UC). The species is uncommon in Alberta and I examined only 3 Alberta specimens from the localities indicated in Figure 456.

#### *Dytiscus hybridus* Aubé, 1838

*Dytiscus hybridus* Aubé, 1838: 116. (Type locality — “Etats-Unis d’Amerique”). — Melsheimer 1853: 29. — LeConte 1863a: 18. — Gemminger and Harold 1868: 462. — Crotch 1873: 408. — Sharp 1882: 637. — Wickham 1895c: 152. — Roberts 1905: 106. — Blatchley 1910: 231. — Zimmermann 1919: 233. — Leng 1920: 80. — Zimmermann 1920: 248. — Hatch 1928: 226. — Hatch 1933b: 11. — Wallis 1950: 51. — Gordon and Post 1965: 24. — Wallis 1973: 110.  
*Leionotus compar* Melsheimer, 1844: 26. (Type area — “Pennsylvania and Massachusetts”.)

*Diagnosis.* — This species is characterized by the following combination: metacoxal processes rounded apically; basal margin of pronotum not or only narrowly bordered with yellow; abdominal sterna dark rufous to piceous; male articles 1 to 3 of mesotarsus each with longitudinal glabrous area on ventral surface; and female with elytron behind shoulder densely punctate.

*Description.* — Measurements of one female specimen from Medicine Hat, Alberta, are: TL — 26.15 mm; MW — 13.85 mm; TL/MW — 1.89.

Dorsal surface piceous to black with very faint green sheen. Head with small chevron between eyes, anterior and lateral portions of frons, and frons along inner margin of eye to about level of posterior inner angle, rufous; clypeus and labrum testaceous; antenna with articles 1 and 2 testaceous, outer articles progressively darker; palpi pale except terminal article of each palpus infuscate apically. Pronotum with lateral margins broadly yellow; anterior margin narrowly but distinctly bordered with yellow; basal margin piceous or on some specimens narrowly yellow. Elytron with lateral margin yellow; apex irrorate with yellow. Ventral surface rufous to piceous except prothorax and legs slightly paler.

Female without elytral striae. Female with head finely and sparsely punctate; pronotum coarsely punctate laterally, punctures more or less confluent in form of short irregular lines; disc medially with punctures much smaller and sparser; elytron basolaterally behind shoulder finely and densely punctate, punctures sparser both medially and apically; metacoxae, metatibiae and metafemora very sparsely and finely punctate. Male with punctation sparse and fine.

Metacoxal process (Fig. 247) broadly rounded apically. Female with hind margin of sternum 6 more or less produced apically.

Male with outer apical series of protibial setae in contact dorsally. Mesotarsus articles 1 to 3 each with medial longitudinal glabrous area. Aedeagus (Fig. 255) with apex long and slender in lateral view; apex produced as small rounded plate.

*Distribution.* — This eastern species ranges west to about the eastern edge of the Great Plains. It is tempting to regard the single female from Alberta (Medicine Hat; Sept. 23, 1939; F. S. Carr; UASM) as mislabelled, but a large number of F. S. Carr’s distribution records, no matter how improbable they may initially appear, have been confirmed by subsequent collectors. Also, Hatch (1928) recorded the species from Alberta but did not mention if he examined actual specimens. The Alberta specimen was probably an accidental migrant into the province as September is a peak dispersal period for many species of *Dytiscus*. The Alberta locality record is indicated in Figure 457.

#### *Dytiscus marginicollis* LeConte, 1845

*Dytiscus marginicollis* LeConte, 1845a: 201. (Type locality — “In flumine Missouri”). — LeConte 1845b: 209. — Melsheimer 1853: 29. — LeConte 1859: 36. — LeConte 1863a: 18. — Crotch 1873: 408. — Sharp 1882: 638. — Zimmermann 1919: 233. — Leng 1920: 280. — Zimmermann 1920: 252. — Hatch 1928: 226. — Hatch 1933b: 11. — Leech 1941b: 290. — Leech 1948b: 414. — LaRivers 1951: 404. — Hatch 1953: 238. — Leech and Chandler 1956: 323. — Anderson 1962: 73.

*Diagnosis.* — This distinctively colored species is recognized by the broad yellow border of the pronotal base, darkened abdominal sterna, and bluntly pointed metacoxal processes.

*Description.* — Measurements of 22 Alberta specimens are: TL — 27.6 to 31.1 mm ( $\bar{X}$  = 29.7 ± 0.8 mm); MW — 13.4 to 15.4 mm ( $\bar{X}$  = 14.7 ± 0.5 mm); TL/MW — 1.9 to 2.1 ( $\bar{X}$  = 2.0 ± 0.05).

Dorsal surface of head and disc of pronotum piceous to black; disc of elytron rufous to piceous with metallic green reflection. Head with large medial chevron, anterior margin of frons, clypeus, labrum, palpi, ventral surface of head and on some specimens, frons medially to eye, testaceous; antenna testaceous basally, terminal articles rufous. Pronotum broadly bordered with yellow; basal border narrow laterally, broadly and abruptly expanded medially. Scutellum pale medially, margins piceous. Elytron with yellow lateral margin narrowed toward apex, and discontinuous before posterior apical angle, apex irregularly irrorate with yellow. Ventral surface varied in color: metasternum medially, posterior margin of metacoxa, metacoxal process and abdominal sterna 2 to 6 (except for narrow apical and lateral margins), dark rufous to piceous; remaining portions of abdomen pale. Front and middle legs and metafemora, testaceous to pale rufous; many specimens with posterior surface of tibiae, piceous; metatibia and tarsi dark rufous, except piceous medially.

Male with fine sparse punctation. Female nonstriate; punctation of head fine and sparse; pronotum with small punctures over entire surface but on most specimens, punctation conspicuously larger and denser laterally on disc; elytron with punctation fine basally, larger and more conspicuous toward apex; punctation of ventral surface fine and sparse. Most females with system of finely impressed anastomosing lines on basomedial portion of elytron.

Metacoxal process (Fig. 248) elongate and bluntly pointed apically, not acuminate.

Male with basolateral flattened area of protibia completely surrounded with setae; articles 2 and 3 of mesotarsus with medial longitudinal glabrous area on ventral surface. Aedeagus (Fig. 256) with apex slender and elongate, not distinctly modified.

*Natural history notes.* — In Alberta, this relatively uncommon species is known only on the prairies of the southern portion of the province, in *Typha* marshes or in mats of *Juncus* sp. where this forms dense emergent stands along the edges of probably permanent prairie sloughs. One record of flight has been seen for this species (Lethbridge, 1.x.1929, H. Seamans, CNC).

*Distribution.* — *D. marginicollis* ranges from Baja California to Alaska and east to Alberta. I examined 38 specimens from Alberta localities (map, Fig. 458).

#### *Dytiscus fasciventris* Say, 1824

*Dytiscus fasciventris* Say, 1824: 270. (Type locality — "Lake Superior"). — LeConte 1850: 212. — Melsheimer 1853: 29. — LeConte 1859: 177. — LeConte 1863a: 18. — Gemminger and Harold 1868: 461. — Crotch 1873: 408. — Sharp 1882: 636. — Wickham 1895c: 151. — Roberts 1905: 106. — Blatchley 1910: 231. — Zimmermann 1919: 233. — Leng 1920: 80. — Zimmermann 1920: 248. — Hatch 1928: 226. — Wallis 1950: 51. — Hatch 1953: 237. — James 1970: 77-84. — Wallis 1973: 110.

*Dytiscus carolinus* Aubé, 1838: 120. (Type locality — "Etats Unis d'Amerique".)

*Diagnosis.* — Members of this species possess the following distinctive combination: ground color of dorsal surface brown to piceous, basal margin of pronotum not or only narrowly bordered with yellow, apex of metacoxal process rounded, metafemur with anteroventral surface relatively densely punctate, and abdomen largely testaceous with piceous marks. Male with apical third of elytron densely punctate. Female striate. Specimens of this species are very similar to specimens of *D. hatchi*, from which they may be distinguished by characters present in the diagnosis of *hatchi*.

*Description.* — Measurements of 26 Alberta specimens are: TL — 24.8 to 27.9 mm ( $\bar{X}$  = 26.6 ± 0.5 mm); MW — 12.3 to 14.6 mm ( $\bar{X}$  = 13.4 ± 0.2 mm); TL/MW — 1.9 to 2.1 ( $\bar{X}$  = 2.0 ± 0.05).

Head dark brown to black, with distinct green sheen; disc of pronotum and elytron brown to light piceous, with faint green reflection. Frons with median chevron, anterolateral angles and on some specimens, inner margin of eye, rufous; antenna testaceous basally, outer articles darker and infuscate apically on some specimens; clypeus, labrum and ventral surface of head testaceous. Pronotum bordered laterally and anteriorly with yellow; basal margin colored as disc or obscurely paler, especially medially, only rarely distinctly but narrowly bordered with yellow. Scutellum piceous, slightly paler at base and apex. Ventral surface testaceous to rufotestaceous except metasternum medially and margins of metasternum and metacoxa piceous, metacoxal process dark rufous; abdominal sterna with basal and apical margins piceous, basal margin with distinct mediolateral piceous spot on segments 2 and 3 and on many specimens also on segments 4 and 5, piceous spots continuous with basal margin of sternum. Legs testaceous except pro- and mesofemora darker dorsally and metatarsi rufous to piceous.

Male dorsal surface finely punctate, elytron with apical 0.33 with relatively large and dense punctures; metacoxa



finely punctate; metafemur sparsely and finely punctate on posterior half, anteromedial portion more densely punctate; metatibia finely micropunctate. Female striate; head smooth, lightly and sparsely punctate; pronotum with lateral areas densely punctate, punctures sparser and shallower medially; elytron with ridges finely punctate basally, punctures denser and intermixed with coarser punctures toward apex; metacoxa deeply punctate laterally, less strongly so medially; ventral face of metafemur strongly punctate over entire surface, punctures more or less confluent anteromedially; metatibia with ventral face micropunctate.

Clypeal suture fine, evenly but slightly convex medially. Antenna with articles 3 to 5 broad, outer articles progressively narrower. Metacoxal process with apex broadly rounded (Fig. 249). Female with sternum 6 coarsely and irregularly rugose along posterolateral margin.

Male with outer distal rows of protibial setae separated dorsally on most specimens. Anterior protarsal claw slightly shorter than protarsal article 5. Mesotarsus with articles 1 to 3 uniformly setose beneath. Aedeagus (Fig. 257) with apex long and slender, recurved ventrally; apex narrowly flanged laterally.

*Taxonomic notes.* — Although Say's type is lost, there appears to be little doubt that he applied the name *D. fasciventris* to the present species. His statements that the female was striate, "dark olivaceous-brown", and "venter black, with yellow bands, terminating each side in triangles of the same color" fit this species better than any other North American species. The species *D. hatchi* Wallis is very closely related to *D. fasciventris*, which it replaces in southwestern British Columbia and northwestern United States.

*Natural history notes.* — James (1970) described the larvae of this species and commented briefly on its ecology in southern Ontario. In Alberta, specimens of *D. fasciventris* were most frequently collected in vegetation-choked pools and sloughs of parkland and mixed forest areas. The two prairie collections were at light, and along the shore of a large deep reservoir, suggesting that the insects had arrived there by recent flight and probably had not bred in that site. A teneral female was collected July 18 at Brownvale. I have seen flight records for September and October 3.

*Distribution.* — This Nearctic species ranges from New Jersey (UASM!) and Ontario (!, UASM; James 1970) to eastern and northern British Columbia (!, CARR, UASM, UC; Hatch, 1953). I examined 28 specimens from Alberta localities (map, Fig. 459).

#### *Dytiscus hatchi* Wallis, 1950

*Dytiscus hatchi* Wallis, 1950: 50. (Type locality — pond north of Bethel, Washington.). — Hatch 1953: 237. — Leech and Chandler 1956: 323.

*Diagnosis.* — Specimens are extremely similar to those of *D. fasciventris*, and females of the two species are not separated in the key to species. Specimens of *D. hatchi* differ from those of *D. fasciventris* in the following ways: pronotum with basal margin distinctly but narrowly bordered with yellow; abdomen with dark marks in form of somewhat indefinite blotches evidently separated from posterior margins of segments; male with protarsal claws subequal in length to protarsal article 5 and elytron densely punctate on apical 0.5 to 0.66 of disc; aedeagus with apex less abruptly bent ventrally and more broadly rounded (Fig. 258).

This species is exclusively western, ranging from California to southern British Columbia, and has not been collected in Alberta. However, as specimens were taken at Creston, British Columbia, the species may at least stray into the southwestern part of Alberta, especially in the Crownsnest Pass region.

#### *Dytiscus cordieri* Aubé, 1838

*Dytiscus cordieri* Aubé, 1838: 108. (Type locality — Boston, Mass.). — LeConte 1850: 212. — Melsheimer 1853: 29. — LeConte 1863a: 18. — Gemminger and Harold 1868: 461. — Crotch 1873: 408. — Sharp 1882: 773. — Leng 1920: 80. — Zimmermann 1920: 246. — Wallis 1950: 51. — Hatch 1953: 238. — Gordon and Post 1965: 25. — Wallis 1973: 110. *Dytiscus sublimbatus* LeConte, 1857: 34. (Type locality — "Prairie Paso"). — LeConte 1863a: 18. — Gemminger and Harold 1868: 461. — Sharp 1882: 638. — Wickham 1895c: 122. — Leng 1920: 80. — Hatch 1928: 226.

*Diagnosis.* — In the Alberta fauna, specimens of this species are separated from the group of species which possess rounded metacoxal processes by the entirely yellow abdominal sterna and reduced punctuation of the metafemur.

*Description.* — Measurements of 25 Alberta specimens are: TL — 26.3 to 32.5 mm ( $\bar{X}$  = 29.0 ± 1.2 mm); MW — 13.6 to 16.0 mm ( $\bar{X}$  = 14.6 ± 0.6 mm); TL/MW — 1.9 to 2.1 ( $\bar{X}$  = 2.0 ± 0.1).

Dorsal surface piceous to black; head, disc of pronotum, and on some specimens elytron, with green sheen. Head with medial chevron large, lateral arms extended to relatively large anterolateral pale areas of frons, these on some specimens extended posteriorly along inner margin of eye to about level of posterior inner angle; antenna with articles 1 and 2 testaceous, outer articles darker, rufous; palpi, mouthparts and ventral surface of head testaceous. Pronotum with all margins distinctly bordered with yellow. Scutellum dark basally, piceous apically. Elytron without subapical transverse fascia but apex irrorate with yellow. Ventral surface entirely testaceous except metasternum medially, metacoxal process and abdominal sterna slightly darker, rufous, and posterior margin of metacoxa with small elongate piceous spot. Legs testaceous except meso- and metatibia, and tarsi, rufous, and pro- and mesofemora infuscate dorsally and apically on many specimens.

Male with punctuation sparse and fine. Female with head finely and sparsely punctate, punctures best developed posteriorly on vertex; pronotum with lateral margins and lateral portions of disc with small but deep punctures, punctures finer and smaller medially; elytron basally with sparse fine punctures, larger and denser toward apex; metacoxa, metafemur and metatibia all finely and sparsely punctate. Striate female with similar pattern of punctuation but punctures larger and more numerous.

Posterior margin of clypeus arcuate, slightly produced medially onto frons; slightly raised and well delimited from frons anterior to frontal fovea, less so medially and laterally. Metacoxal process (Fig. 250) rounded apically, bluntly pointed. Male protibia with external lateral rows of setae separated basally; articles 1 to 3 of mesotarsus uniformly setose beneath, without median glabrous area; apex of aedeagus elongate, simple (Fig. 259).

*Taxonomic notes.* — Specimens from eastern North America resemble Alberta specimens in color, sculpture and most structural features. However, they differ by larger size (9 specimens from Prince Edward Co., Ontario, UASM, have a mean length of 32.6 mm (30.5 to 34.2 mm)) and the striate form of female appears to predominate. In Alberta, specimens of the striate female morph are rare (only one of the 27 females that I examined was striate).

*Natural history notes.* — Specimens were collected from a variety of habitats including permanent and temporary bodies of water, natural ponds and dugouts, and *Typha*, *Carex* and bullrush marshes. Most locality records are represented each by a single specimen and I have not seen a series of more than three specimens in the province. These observations suggest that either the species occurs at very low densities in a wide variety of habitats or that most collections represent accidental occurrences and that the true habitat of the species has not been discovered. Two specimens were taken at light on October 2, 1970 (Cereal, UC).

*Distribution.* — This transcontinental species ranges from New York State (UASM) to British Columbia (Hatch, 1953). The northern and southern limits are not known. In Alberta, specimens have been collected north to Ft. McKay. However, the species has been collected most frequently on the prairies. I examined 45 specimens from Alberta localities (map, Fig. 460).

#### *Dytiscus circumcinctus* Ahrens, 1811

- Dytiscus circumcinctus* Ahrens, 1811: 55. (Type locality — not known to me.). — Gemminger and Harold 1868: 461. — Sharp 1882: 641. — Wickham 1895c: 150. — Zimmermann 1920: 233. — Leng 1920: 81. — Hatch 1928: 227. — F. Balfour-Browne 1950: 275. — LaRivers 1951: 404. — Hatch 1953: 238. — Zaitsev 1953: 331. — Gordon and Post 1965: 25.
- Dytiscus ooligbukii* Kirby, 1837: 74. (Lectotype — here selected, female in BMNH labelled as follows: type (label inverted); N. Amer. ♂, 5783a; *Dytiscus ooligbukii* Kirby, N. Amer., 5783 Rev. Wm. Kirby; Lectotype, *Dytiscus ooligbukii* Kirby, selected D. Larson.) Not J. Balfour-Browne 1948. NEW SYNONYMY.
- Dytiscus anxius* Mannerheim, 1843: 218. (Type locality — Sitka Island, Alaska.). — Melsheimer 1853: 29. — LeConte 1858: 30. — LeConte 1859: 36. — Motschoulsky 1859: 166. — LeConte 1863: 18. — Gemminger and Harold 1868: 461. — Crotch 1873: 408. — Sharp 1882: 773. — Horn 1883: 281. — Zimmermann 1920: 244. — Leng and Mutchler 1927: 18. — Leech and Chandler 1956: 323. — Wallis 1973: 110.
- Dytiscus albionicus* Motschoulsky, 1859: 166. (Type locality — St. (San) Francisco, California.)
- Dytiscus fuscostriatus* Motschoulsky, 1859: 167. (Type locality — "Col. Ross?"). — LeConte 1863a: 18. — Gemminger and Harold 1868: 461. — Sharp 1882: 774. — Horn 1883: 281.
- Dytiscus dauricus* Anderson 1962: 73, not Gebler 1832. (Old World Synonymy omitted.)

*Diagnosis.* — The combination of yellow inner margin of eye, almost entirely yellow abdomen, and acuminate metacoxal process allow specimens of this species to be readily recognized.

*Description.* — Measurements of 66 Alberta specimens are: TL — 27.5 to 34.0 mm ( $\bar{X} = 31.2 \pm 1.2$  mm); MW — 13.0 to 17.1 mm ( $\bar{X} = 15.8 \pm 0.7$  mm); TL/MW — 1.8 to 2.1 ( $\bar{X} = 2.0 \pm 0.05$ ).

Color of dorsal surface brown to piceous or black, with green sheen on some specimens. Head with inner margin of eye entirely ringed with yellow, or yellow margin narrowly broken near inner posterior angle of eye on some specimens. Pronotum with all margins bordered with yellow. Elytron with yellow lateral margin narrowed toward apex, not or only narrowly in contact with apex, latter irrorate with yellow or some specimens with vague subapical transverse yellow fascia. Ventral surface rufotestaceous except metasternum medially and metacoxal process, darker rufous, margins of some thoracic sclerites narrowly piceous; abdominal sterna entirely pale with basal margins of sterna 1 to 3, narrowly piceous. Legs testaceous or rufotestaceous except posterior dorsal surface of pro- and mesofemora, and on some specimens pro- and mesotibia internally, piceous, and metatarsi infusate.

Female striate or nonstriate. Nonstriate female head with small deep sparse punctures medially, punctures more distinct behind; pronotum more or less evenly covered with small punctures; disc smooth and shiny medially with numerous minute punctulae, dull laterally with very fine microreticulation; elytron with sparse fine puncture basally, punctures deeper and denser toward apex and intermixed with large coarse punctures; metacoxa, metafemora and anterior margin of metatibia with sparse coarse punctures. Striate females with similar pattern of sculpture but punctures much larger and denser, especially on pronotum and elytron. Male pattern of sculpture similar to that of nonstriate female, but punctures finer and sparser.

Metacoxal process (Fig. 251) with apex sharply pointed, acuminate. Female with clypeus and frons on same plane or clypeus very slightly raised in form of low but sharp ridge.

Male with anterior and posterior series of exterior lateral protibial setae separated from each other by distinct gap. Mesotarsus articles 1 to 3 uniformly setose beneath. Aedeagus (Fig. 260) with apex elongate and narrow in lateral view; in ventral view decidedly flared and spear-shaped.

*Taxonomic notes.* — Kirby's description of *D. ooligbukii* was based on two female specimens, one each of *D. circumcinctus* and *D. dauricus*. The "male" of *D. ooligbukii* (here selected as lectotype) is actually a nonstriate female of *D. circumcinctus* which has lost most of its legs and all of its tarsi. J. Balfour-Browne (1948) interpreted *D. ooligbukii* as conspecific with *D. alaskanus* Balfour-Browne.

The relationship between the specimens described here and the old world specimens of *D. circumcinctus* Ahr. is uncertain. Many authors regard the North American form as a separate species, but other authors follow Sharp (1882) and consider the two geographical groups as conspecific, as I do. Also, the North American form is northern and transcontinental as are many Holarctic species. If it is shown that the Old and New World forms are distinct, the name *D. ooligbukii* Kirby has priority over the widely applied name *D. anxius* Mannerheim.

*Natural history notes.* — This species has very wide range of ecological tolerance, for specimens occur in permanent fresh water as well as in temporary ponds and slightly alkaline or saline sloughs. Teneral specimens were collected during the latter half of July indicating that the immature stages are passed in spring and early summer. Several records of these insects coming to street lights are available between September 15 and October 14. A series of 10 specimens collected from a narrow strip of open water between a sandy beach and the main ice pack of Great Slave Lake, N.W.T. (Hay River, June 2, 1964, UC) suggests that these insects flew into this site in the spring. A single specimen was collected while it was swimming under 2.5 feet of ice (Pine L., Alta., February 14, 1970, UC).

*Distribution.* — This Holarctic species ranges in North America, from Newfoundland to British Columbia, and from California to Alaska. I examined 110 specimens from Alberta localities (map, Fig. 461).

#### *Dytiscus dauricus* Gebler, 1832

*Dytiscus dauricus* Gebler, 1832: 39. (Type locality — unknown to me.). — Gemminger and Harold 1868: 461. — Sharp 1882: 643. — Wickham 1895c: 151. — Kincaid 1900: 370. — Schwarz 1904: 176. — Roberts 1905: 106. — Zimmermann 1919: 233. — Leng 1920: 81. — Zimmermann 1920: 247. — Hatch 1928: 227. — Brown 1930b: 237. — Hatch 1933b: 11. — Hatch 1953: 238. — Zaitsev 1953: 331. — Leech and Chandler 1956: 323. — Wallis 1973: 110.

*Dytiscus confluens* Say, 1834: 440. (Type locality — Maine.). — Melsheimer 1853: 29. — LeConte 1859: 554. — LeConte

1863a: 18. – Gemminger and Harold 1868: 461. – Crotch 1873: 407.

*Dytiscus franklinii* Kirby, 1837: 77. (Lectotype – male in BMNH labelled as follows: type; N. Amer. ♂, 5785 a; *Leionotus franklinii* Kirby, N. Amer. 5785 Rev. Wm. Kirby; Lectotype, *Dytiscus franklinii* Kirby, selected D. Larson.). – Melsheimer 1853: 29.

*Dytiscus confluentus* LeConte 1850: 212.

*Dytiscus diffinis* LeConte, 1850: 212. (Type locality – Eagle Harbor, Lake Superior.). – Melsheimer 1853: 29.

*Dytiscus ooligbukii* LeConte, 1850: 212. Not Kirby, 1837.

*Dytiscus ventralis* Motschoulsky, 1855: 79. (Type locality – not known to me.)

*Dytiscus vexatus* Sharp, 1882: 643. (Type – male in BMNH labelled as follows: Type; Russian America; Sharp Coll. 1905-313; *Dytiscus vexatus* Sharp, type; Russian America? *anxius* var., 946 Type mihi.) NEW SYNONYMY.

**Diagnosis.** – The acuminate metacoxal process, lack of yellow inner margin around the eye, and basolateral piceous margins on the abdominal sterna, separate specimens of this species from all other North American members of *Dytiscus* except those of *D. alaskanus* Balfour-Browne. Large size, short broad apex of the aedeagus and raised posterior clypeal margin of the female are generally reliable characters for separating specimens of *D. dauricus* from those of *D. alaskanus*.

**Description.** – Values for measurements of 28 Alberta specimens are: TL – 30.0 to 35.0 mm ( $\bar{X}$  = 32.9 ± 1.3 mm); MW – 15.5 to 18.2 mm ( $\bar{X}$  = 16.9 ± 0.7 mm); TL/MW – 1.86 to 2.03 ( $\bar{X}$  = 1.93 ± 0.04).

Frons, disc of pronotum and elytron, black with green reflection. Head with frons black along inner margin of eyes; antenna testaceous basally, outer articles darker rufous and each with distinct apical infuscation. Pronotum with all margins distinctly bordered with yellow. Scutellum black, apex piceous. Marginal band of elytron narrowed behind and not quite in contact with sutural angle, apex of elytron irrorate with yellow; striate females with striae rufous or piceous, intervening ridges black. Ventral surface predominantly rufotestaceous to rufous except metasternum piceous medially, metacoxal process rufous, abdominal sterna lined with black anteriorly and posteriorly and each sternum basolaterally with piceous or black maculation, largest on sterna 2 and 3, smaller but evident on sterna 4 to 6. Legs mainly testaceous to rufous.

Nonstriate female with head evenly and moderately punctate, punctures deeper and more distinct toward hind margin; disc of pronotum densely and more or less evenly punctate or with punctures somewhat sparser on mediolateral portion; disc of elytron very finely punctate basally, punctures larger and denser toward apex; metacoxa evidently but finely and sparsely punctate; metafemur with punctures fine but distinct. Striate female with similar pattern of punctation but punctures larger and denser on comparable portions of body. Male with punctation much finer and sparser than on nonstriate female.

Metacoxal process (Fig. 252) sharply pointed, acuminate apically. Male with anterior and posterior rows of external protibial setae separated by distinct gap dorsally; articles 1 to 3 of mesotarsus uniformly setose beneath; aedeagus (Fig. 261) with apex short and blunt, broadly flanged laterally. Female with posterior margin of clypeus raised above level of frons in form of distinct ridge.

**Taxonomic notes.** – I examined the type of *D. franklinii* Kirby and agree with the synonymy proposed by LeConte (1863). The specimen described by Kirby as the female of *D. ooligbukii* belongs to this species. See under “Taxonomic Notes” of *D. circumcinctus* for further details.

The type specimen of *D. vexatus* Sharp is small for this species, but the apex of the aedeagus is of the same shape as that of typical specimens of *D. dauricus*. This name is not a synonym of *D. marginicollis* LeConte as Hatch (1928) indicated.

I have not noticed any pronounced pattern of variation in this species. Both striate and nonstriate females appear to occur in about equal frequency in Alberta.

**Natural history notes.** – This species is primarily in the forested portions of the province. However, specimens were collected along the eastern and southern limits of the parkland. Most specimens collected by me were among emergent *Carex* or in flooded grasses along margins of beaver ponds, slow brown water streams, and other bush- or tree-ringed permanent ponds and lakes. Teneral specimens were collected from August 5 to 18. A male was taken at light on September 28 (Calgary) and I saw a female specimen from Carlton Co., Minnesota (A. Raske Collection) collected at light on April 22.

**Distribution.** – This Holarctic species is transcontinental in North America, from New Hampshire to Alaska and south to northern California, and is in the eastern Palearctic region. I examined 45 specimens from Alberta localities (map, Fig. 462).

*Dytiscus alaskanus* J. Balfour-Browne, 1944

*Dytiscus alaskanus* J. Balfour-Browne, 1944: 356. (New name for *parvulus* Motschulsky.)

*Dytiscus parvulus* Motschulsky, 1852: 77. (Type locality – “insulae Kadjak”, Alaska) (not seen, from J. Balfour-Browne, 1944.). Not Muller, 1776 et al. – Mannerheim 1853: 154. – LeConte 1863a: 18. – Gemminger and Harold 1868: 462. – LeConte 1869: 370. – Sharp 1882: 642. – Leng 1920: 81. – Zimmermann 1920: 253. – Hatch 1928: 227. – Brown 1930b: 237. – Wallis 1973: 110.

*Dytiscus ooligbuckii* J. Balfour-Browne, 1948: 161. Gordon and Post 1965: 25.

*Dytiscus ooligbuckii* Hatch, 1953: 238.

*Dytiscus ooligbuckii* Anderson, 1962: 73. Not Kirby 1837: 74.

**Diagnosis.** – Members of this species closely resemble specimens of *D. dauricus* but usually can be recognized by smaller size, and less broadly expanded dark marks on the abdominal sterna. Females of the two species are consistently separated by the structure of the clypeus: on specimens of *D. dauricus*, the hind margin of the clypeus is raised above the level of the anterior margin of the frons throughout its length, while on specimens of *alaskanus* the clypeus and frons medially are in the same plane and meet without formation of a definite ridge. Males are best separated by differences in form of the apex of the aedeagus.

**Description.** – Measurements of 75 specimens from George L., Alta., are: TL – 22.6 to 30.2 mm ( $\bar{X} = 27.4 \pm 1.3$  mm); MW – 11.5 to 15.0 mm ( $\bar{X} = 13.7 \pm 1.0$  mm); TL/MW – 1.8 to 2.1 ( $\bar{X} = 2.00 \pm 0.06$ ).

Frons, disc of pronotum and disc of elytron, piceous to black, with faint green reflection on many specimens. Frons with anterolateral angles above base of antenna and chevron between eyes, testaceous; arms of chevron on some specimens extended to anterolateral pale areas; antenna testaceous basally, outer articles darker; palpi pale except apex of terminal article of each palpus infuscate; head with ventral surface testaceous. Pronotum with all margins broadly bordered with yellow. Elytron with yellow lateral border not attaining apex; apex irrorate with yellow; striate female with striae yellow, ridges dark. Ventral surface testaceous except sclerites of thorax with margins narrowly black, metasternum dark rufous to piceous medially, metacoxal process rufous, abdominal sterna with basal and apical margins narrowly black, and sterna 2 and 3 each with distinct dark basolateral mark. Legs mainly testaceous to rufous.

Punctuation of body similar to that of *D. dauricus*. Female with disc of pronotum more or less evenly punctate and elytron smooth or striate.

Frons separated from clypeus medially by distinct suture and frons and clypeus on same plane along suture, union between them smooth. Metacoxal process (Fig. 253) with apex sharply pointed. Aedeagus similar to that of *D. dauricus* but apex more produced and slenderer (Fig. 262).

**Taxonomic notes.** – J. Balfour-Browne (1944) showed that the name *Dytiscus parvulus* was a junior homonym several times over, and proposed the replacement name *D. alaskanus* for this well known species. Later, he stated that *alaskanus* was a junior synonym of *D. ooligbuckii* Kirby, and since that date, (1948), *D. ooligbuckii* (or some misspelt form of this name) was applied to this species. Neither of the Kirby type specimens belong to this species. Therefore, *D. alaskanus* is the oldest available name for this species.

Over most of the range of *D. alaskanus*, females are constantly striate. However, nonstriate females are represented from the following localities: Alberta, Hwy. 35, 5.6 mi S Alta. – NWT border; NWT, Simpson Islands, Great Slave Lake; Yukon, Chappie L., 65°47' N, 134°56' W. Perhaps this morph is restricted to the northwestern portion of the species range. A similar pattern of variation was observed for *D. lapponicus* Gyllenhal in Europe (F. Balfour-Browne 1950: 280).

**Natural history notes.** – This species occurs throughout the province in both prairie and forest zones. Specimens of *D. alaskanus* are usually in warm, exposed permanent ponds and sheltered lake margins, most often in water 10 to 18 inches deep and near the outer limit of the zone of emergent plants. About half the localities are represented by single specimens, but I collected many long series also. This is the only species of *Dytiscus* that I have found regularly in loose aggregations.

Specimens were found in copulation from May 3 to May 31. Teneral specimens were collected from July 3 to October 13. A single male was collected when it swam through a hole in the ice of Hastings Lake on March 19. The only flight record that I have seen is May 3 (Severin Creek

Reservoir, UC).

*Distribution.* — This Nearctic species ranges from Newfoundland (UASM) to Alaska and south to South Dakota and Utah, and throughout the province. I examined 256 specimens from Alberta localities (map, Fig. 463).

#### Genus *Hydaticus* Leach, 1817

*Hydaticus* Leach, 1817: 69. (Type species — the Palearctic *Dytiscus transversalis* Pontoppidan, designated by Curtis, 1825).

The North American members of this genus are separated from members of other genera of Dytiscinae by moderate size, subparallel shape, acute metatibial spurs and straight anterolateral margin of the metasternal wing.

Characteristics of the genus are: Dytiscinae of moderate size; body elongate-oval in outline, evenly rounded anteriorly and posteriorly with side margins almost parallel at middle; dorsal surface distinctly convex; color and sculpture various, female with elytron not longitudinally sulcate or striate; metasternal wing with anterolateral margin straight; metatibia with spurs acute; female metatibia with natatorial setae along posterior margin; male palette of protarsus and articles 1 to 3 of mesotarsus with numerous round discs on ventral surface, without adhesive hairs; male protarsal article 2 with dorsal surface densely pitted in form of file of stridulatory organ (Larson and Pritchard, 1974); male genitalia membrane uniting dorsal margins of parameres with medial sclerite; paramere subequal in length to aedeagus; female with valve of ovipositor elongate, laterally compressed, sclerotized.

This genus includes a large number of described species which in aggregate have an almost world-wide distribution. Between three to five species occur in North America north of Mexico. However, the limits of the species are not understood and the genus requires revision.

Watts (1970) described larvae of the single Alberta species.

#### *Hydaticus modestus* Sharp, 1882

*Hydaticus modestus* Sharp, 1882: 650. (Type — male in BMNH labelled as follows: Type H.T.; 1295; Am. bor. 1037 *modestus*; Sharp coll. 1905-313.). — Horn 1883: 280. — Wallis 1939a: 126. — Blackwelder 1939: 16. — Hatch 1953: 235. — Leech and Chandler 1956: 322. — Anderson 1962: 73. — Gordon and Post 1965: 23. — Wallis 1973: 110.

*Hydaticus americanus* Sharp, 1882: 651. (Lectotype (here selected) — female in BMNH labelled as follows: Type H.T. (label reversed); Red River, Am. bor. 1035 *americanus*; Sharp Coll. 1905-313). Horn 1883: 280.

*Dytiscus stagnalis* auctorum, not Fabricius 1781: 191. — Crotch 1873: 404. — Sharp 1882: 652. — Wickham 1895: 150. — Blatchley 1910: 232. — Zimmermann 1919: 225. — Leng 1920: 81. — Zimmermann 1920: 226. — Wallis 1939a: 127. — F. Balfour-Browne 1950: 300. — Zaitsev 1953: 307. — Watts 1970: 727.

*Hydaticus laevipennis* Blatchley, 1910, not Thomson 1867: 88.

*Hydaticus bimarginatus* Wickham, 1895c, not Say, 1834: 556.

*Diagnosis.* — (Fig. 9). The single Alberta species is recognized by characters presented in the key to genera and in the generic description.

*Description.* — Measurements of 40 specimens from various Alberta localities are: TL — 12.40 to 13.76 mm ( $\bar{X}$  = 13.20 ± 0.40 mm); MW — 6.64 to 7.60 mm ( $\bar{X}$  = 7.06 ± 0.20 mm); TL/MW — 1.81 to 1.96 ( $\bar{X}$  = 1.87 ± 0.04).

Head black except labrum, clypeus, anterior portion of frons and two small spots between eyes, rufous; antenna testaceous except outer articles infusate; palpi pale. Pronotum rufous except broad piceous or black band along basomedial margin. Scutellum piceous. Male elytron black except lateral margin and on some specimens a narrow sub-basal transverse band, testaceous to rufous. Female elytron various, darkest specimens similar to male but most specimens with five or six longitudinal pale vittae on disc of each elytron. Ventral surface piceous to black except epipleuron and ventral portions of prothorax, testaceous to rufous, and abdominal sterna 2 to 5 each with small lateral rufous spot. Prolegs and mesofemora rufous, otherwise legs piceous to black.

Male elytron with coarsest punctures (other than longitudinally arranged serial punctures) small and shallow, interspaces very finely but densely micropunctate and entire disc with fine isodiametric sculpture. Female with sculpture of elytron similar to that of male or many specimens with deep irregular grooves on basal and lateral portions of elytron and also on lateral portions of pronotum.

*Taxonomic notes.* — Wallis showed that this species is distinct from *H. stagnalis* Fabricius and that the latter does not occur in North America. Wallis suggested that *H. cinctipennis* Aubé (1838: 191) may be conspecific with *H. modestus* but because of lack of sufficient evidence, he regarded each as a distinct species. The status of these is still undecided. If both

names apply to the same species, the name *H. cinctipennis* has priority.

Blatchley's description of *H. laevipennis* does not differentiate it from males or non-vittate females of *H. modestus*, hence it seems likely that he assigned vittate females to *H. stagnalis* and males and non-vittate females to *H. laevipennis*. No other author has recognized *laevipennis* Thomson from North American and the name *H. laevipennis* is now regarded as a junior synonym of the name *H. stagnalis*.

I examined the types of Sharp's species and agree that *H. americanus* is a lightly sculptured female of *H. modestus* on which the pale elytral vittae are exceptionally well developed. The single male type of *H. modestus* is identical to Alberta specimens.

*Natural history notes.* — This species occurs throughout the province and while it is not common anywhere, it was more frequently collected in forested areas than on the prairies. Most specimens were amid very dense detritus or emergent vegetation, usually *Carex*, along margins of small ponds. Many teneral specimens were collected from August 29 to September 15. I have not seen records of flight.

*Distribution.* — This transcontinental species ranges from New England to British Columbia and south to Utah and California. I examined 176 specimens from Alberta localities (map, Fig. 464).

#### Genus *Graphoderus* Dejean, 1833

*Graphoderus* Dejean, 1833: 61. (Type species — *Dytiscus cinereus* L. (Opinion 619, Bull. Zool. Nom. 18, 1961).)

*Graphoderes* Thomson, 1860: 38.

This genus of moderate sized species is widely distributed in the Holarctic region. Four or five species occur in North America, of which three are in Alberta. The habitus of these insects is distinctive and separates them from members of all other Alberta genera except *Acilius*. The beetles are broadly oval in outline and strongly dorsoventrally flattened.

Characters common to the three Alberta species are: — Dytiscinae of moderate size, TL — 11.1 to 15.0 mm; body broadly oval in outline, rarely almost subparallel medially; dorsoventrally flattened; punctation of dorsal surface generally fine and sparse; female with elytron not longitudinally sulcate or striate; metacoxal wing with anterolateral margin arcuate; metatibia with spurs finely emarginate at apex; male pallete of protarsus with number of large rounded discs on ventral surface; mesotarsal articles 1 to 3 with discs or not; paramere subequal to or longer than aedeagus; female with valves of ovipositor short, pointed and strongly sclerotized.

The larva of a Manitoban species (probably *G. perplexus* Sharp) has been described by Watts (1970).

Various authors considered one or more of the North American species conspecific with various Old World species. However, Wallis (1939b) reviewed the North American species and concluded that they are distinct from Palearctic species. His history of the various proposed synonymies is reproduced here. The following key to Alberta species is based on Wallis' key to the North American species.

#### Key to the Alberta Species of *Graphoderus* Dejean

- 1        Pronotum without distinct black markings . . . . . *G. liberus* (Say), p. 407
- 1'       Pronotum with anterior and posterior transverse black marks . . . . . 2
- 2(1')   Pronotum with anterior and posterior marks separated from margins by distinct testaceous or rufous borders; male articles 1 to 3 of mesotarsus with adhesive discs on ventral surface. . . . . *G. perplexus* Sharp, p. 407
- 2'       Pronotum with anterior and posterior transverse marks continuous with front and hind margins respectively; male mesotarsus without adhesive discs on ventral surface . . . . . *G. occidentalis* Horn, p. 408

*Graphoderus liberus* (Say, 1825)

*Dytiscus liberus* Say, 1825: 160. (Type area – New York and Massachusetts.) – Melsheimer 1853: 30. – LeConte 1863a: 17. – Gemminger and Harold 1868: 466. – Crotch 1873: 403. – Sharp 1882: 692. – Wickham 1895c: 152. – Blatchley 1910: 235. – Zimmermann 1919: 231. – Leng 1920: 81. – Wallis 1939b: 130. – Hatch 1928: 229. – Hatch 1953: 237. – Wallis 1973: 111.

*Dytiscus thoracicus* Harris, 1828a: 156. (Type locality – not stated.)

*Colymbetes rugicollis* Kirby, 1837: 73. (Type locality – Nova Scotia.)

*Hydaticus brunnipennis* Aubé, 1838: 203. (Type locality – United States.)

**Diagnosis.** – The combination of relatively small size and the entirely testaceous to rufous head and pronotum make this one of the most distinctive dytiscid species in the fauna.

**Description.** – Measurements of five Saskatchewan and Northwest Territories specimens are: TL – 11.15 to 11.90 mm ( $\bar{X} = 11.54 \pm 0.30$  mm); MW – 6.40 to 7.00 mm ( $\bar{X} = 6.80 \pm 0.20$  mm); TL/MW – 1.61 to 1.75 ( $\bar{X} = 1.70 \pm 0.05$ ).

Head testaceous except basal half of frons rufous; antenna pale except outer articles, article 3 of most specimens included, infusate, at least apically; palpi pale except terminal article of each palpus infusate apically. Pronotum testaceous laterally, disc rufous. Elytron testaceous except vermiculate dark mark, medially on disc maculations fused but with network of irregularly shaped pale meshes. Ventral surface and legs, testaceous to pale rufous.

Elytron finely but densely punctate, punctures dual, larger ones sparse and shallow, difficult to see on some specimens and separated by numerous smaller punctures.

Male pallete of protarsus with three large basal and about seventeen or eighteen smaller, adhesive discs on ventral surface; mesotarsus articles 1 and 2 together with six small adhesive discs on ventral surface; protarsal claws subequal in length, similar in shape. Aedeagus short and broad, apex very shallowly bisinuate but not strongly trilobed; paramere subequal in length to aedeagus, apex broadly rounded or obliquely truncate in lateral view.

**Taxonomic notes.** – LeConte (1859) suggested the synonymy presented above.

**Natural history notes.** – This is one of the most uncommon species of dytiscids in the fauna, with only two Alberta specimens known. Two specimens that I collected at Simpson Is., Great Slave L., N.W.T. were amid aquatic vegetation along a steep shoreline of a small brown-water lake. Saskatchewan specimens, as well as the two Alberta specimens, were also taken from small permanent lakes situated in forested areas. The Northwest Territories specimens were teneral (August 10).

**Distribution.** – This transcontinental species ranges from New York and Nova Scotia to British Columbia and north to Great Slave Lake. The species is apparently much more common in the east and the west than in Alberta. I examined two Alberta specimens from the following localities (Fig. 465).

Lost L., W Calgary (D. Carr, CARR); Winchell Coulee nr. Water Valley (CARR).

*Graphoderus perplexus* Sharp, 1882

*Graphoderus perplexus* Sharp, 1882: 695. (Type – ♀ in BMNH labelled as follows: Lectotype: Type (label inverted); U.S., E.D.; Sharp Coll. 1905-313; U.S. Am. bor. E. Doubleday, 994, *perplexus*.) – Leng 1920: 81. – Wallis 1939b: 130. – Blackwelder 1948: 4. – Hatch 1953: 236. – Anderson 1962: 74. – Gordon and Post 1965: 24. – Wallis 1973: 111.

*Graphoderus elatus* Sharp, 1882: 695. (Type locality – Red River, North America.)

*Graphoderus cinereus* Horn, 1883: 280. Not Linnaeus, 1758.

*Graphoderus zonatus* Zimmermann 1919: 231. Not Hoppe, 1795.

*Graphoderus zonatus* Hatch, 1928. Not Hoppe, 1795.

**Diagnosis.** – The black pronotal fasciae which are separated from anterior and posterior margins of the pronotum by well defined testaceous or rufous areas, characterize this species.

**Description.** – Measurements of 20 specimens from pooled Alberta localities are: TL – 14.00 to 15.00 mm ( $\bar{X} = 14.65 \pm 0.30$  mm); MW – 8.25 to 8.80 mm ( $\bar{X} = 8.50 \pm 0.15$  mm); TL/MW – 1.66 to 1.78 ( $\bar{X} = 1.72 \pm 0.03$ ).

Head testaceous to yellow except frons with posterior margin, an anterior prolongation of basal margin along inner margin of each eye, and inverted V-shaped maculation medially on frons, piceous to black; antenna pale except articles 5 to 11 infusate apically; palpi testaceous except terminal article of each palpus infusate apically. Pronotum testaceous except two transverse piceous fasciae submarginally to anterior and posterior borders respectively: neither fascia in contact with border of pronotum but separated by evident testaceous or rufous band. Elytron testaceous except disc with vermiculate black marks laterally, medially marks coalescent in form of black mesh-work enclosing rounded pale spots. Ventral surface pale rufous. Legs testaceous to pale rufous except metatarsi and also metatibia on some specimens darker, rufous to piceous.

*Quaest. Ent.*, 1975, 11 (3)



Elytron with small more or less evenly scattered punctures; interspaces finely and densely micropunctate with fine shallowly impressed reticulate sculpture.

Pronotum with posterolateral angle relatively shortly produced, broadly rounded. Male palette of protarsus with three large and 25-35 smaller rounded adhesive discs on ventral surface; mesotarsus articles 1 to 3 dilated and together with 13-17 adhesive discs; protarsal claws short, arcuate, similar in shape but anterior claw slightly longer than posterior. Aedeagus with apex strongly trilobed in ventral view; aedeagus narrow, relatively long; paramere longer than aedeagus, with apex bluntly pointed and bearing dense, short setae on inner margin.

*Taxonomic notes.* — Wallis (1939) showed that this species is distinct from the eastern North American *G. fascicollis* (Harris) and from the Palearctic species *G. zonatus* (Hoppe).

*Natural history notes.* — Specimens of *G. perplexus* are in the zone of emergent vegetation of warm exposed ponds throughout the province. This species and *G. occidentalis* frequently occur together, but *G. perplexus* inhabits cooler water and more shaded situations. Teneral specimens of *G. perplexus* were collected from July 22 to September 3 suggesting that the life cycle is completed earlier in the season than the life cycle of *G. occidentalis*.

*Distribution.* — This species is restricted to northwestern North America, from Manitoba to Utah and British Columbia and north to at least Great Slave Lake (UC). I examined more than 300 specimens from Alberta localities (map, Fig. 466).

#### *Graphoderus occidentalis* Horn, 1883

*Graphoderus occidentalis* Horn, 1883: 281. (Type area — “California and Washington Territory”). — Leng 1920: 81. — Hatch 1928: 227. — Wallis 1933b: 278. — Wallis 1939b: 130. — Hatch 1953: 236. — Leech and Chandler 1956: 322. — Anderson 1962: 74. — Gordon and Post 1965: 24. — Wallis 1973: 111.

*Diagnosis.* — Specimens resemble those of *G. perplexus* but are smaller, the black pronotal fasciae attain the front and hind margins of the pronotum, the male protarsal claws are very dissimilar in shape, and the male mesotarsus lacks adhesive discs on its ventral surface.

*Description.* — Measurements of 20 specimens from Finnegan, Alberta, are: TL — 11.15 to 13.75 mm ( $\bar{X}$  = 12.65 ± 0.60 mm); MW — 6.45 to 7.80 mm ( $\bar{X}$  = 7.05 ± 0.35 mm); TL/MW — 1.73 to 1.84 ( $\bar{X}$  = 1.79 ± 0.03).

Color similar to that of *G. perplexus* but differing as follows: head with black markings more expanded, lateral wings of V-shaped mark on frons in contact with anterior mark along inner margin of eye enclosing pair of isolated rufous spots on frons; many specimens with pair of small dark spots on anteromedial portion of frons; pronotum with transverse fasciae broad, anterior and posterior fasciae contiguous with front and hind margins of pronotum respectively.

Punctuation of elytron coarser than in specimens of *G. perplexus*, disparity in size between larger and more numerous small punctures less distinct; interspaces with fine reticulate sculpture.

Pronotum with posterolateral angle prolonged posteriorly, acute but narrowly rounded apically. Male palette of protarsus with 14-15 large rounded adhesive discs on ventral surface; mesotarsus articles 1 to 3 not dilated, without adhesive discs beneath; protarsal claws dissimilar in size and shape; posterior claw about two thirds length of anterior, narrower, sinuate ventrally and arcuate in dorsal view. Aedeagus with apex shortly trilobed in ventral view; median lobe narrow but short; paramere longer than aedeagus; evenly narrowed and sharply pointed apically; internal subapical margin very inconspicuously setose.

*Taxonomic notes.* — Horn’s original description was very explicit and there has been no subsequent confusion regarding the recognition of this species.

*Natural history notes.* — Adults live in the emergent vegetation zone of warm exposed ponds both permanent and temporary, as well as slow, weedy creeks throughout the province, but most abundantly in prairie and parkland regions. The majority of the northern records are from collections made in artificial habitats such as borrow-pits, roadside ditches and drainage ditches. Numerous teneral specimens were collected during September and October but a few slightly teneral individuals were taken in May and June. These latter specimens probably overwintered as adults but either emerged late in the fall or were slow to mature.

*Distribution.* — The known distribution of the species includes much of western North America, from Minnesota (Raske, UC) and Manitoba to Utah and northern California, and north at least to Hay River, N.W.T. I examined more than 340 specimens from Alberta localities (map, Fig. 467).

Genus *Acilius* Leach, 1817

*Acilius* Leach, 1817: 69, 72. (Type species – *Dytiscus sulcatus* Linnaeus (Opinion 619, Bull. Zool. Nom. 18 (1961)).

This small genus has an Holarctic distribution, with three species in the Old World, and six described and several undescribed species in North America (Hilsenhoff, 1975). None of the species are Holarctic.

Members of this genus closely resemble specimens of *Graphoderus*, differing primarily in sexual characters. The three Alberta species possess the following combination of characters: Dytiscinae of moderate size; body broadly oval in outline, strongly dorso-ventrally flattened; dorsal surface distinctly punctate; female with elytron longitudinally sulcate, sulci with numerous suberect setae; metacoxal wing with anterolateral margin arcuate; metatibia with spurs finely emarginate apically; male pallete of protarsus with large anterobasal disc, two small postero-basal discs, and two dense patches of adhesive setae on distal portion of ventral surface; mesotarsus without adhesive scales or hairs but ventral apical angle of each of articles 1 to 3 with tuft of setae; male genitalia with parameres subequal in length to aedeagus; female with ovipositor greatly elongate, not strongly sclerotized.

Wilson (1923) and James (1970) described the larva of *A. semisulcatus* Aubé.

Key to Alberta Species of *Acilius* Leach

- 1 Ventral surface of meso- and metathorax and abdominal sterna, at least medially and basally, piceous to black . . . . . *A. semisulcatus* Aubé, in part, p. 409
- 1' Ventral surface testaceous to rufous, at most sutures between sclerites piceous to black and some specimens with basal margin of each abdominal sternum, piceous . . . . . 2
- 2 (1') Elytron with pale subapical transverse fascia, latter broken and somewhat indistinct on some specimens; aedeagus with apex not produced into rounded crest (Fig. 265); female elytron with sulci with dark brown or piceous setae . . . . . *A. abbreviatus* Mannerheim, p. 410
- 2' Elytron without pale subapical transverse fascia; aedeagus with ventral surface of apex produced as prominent, rounded crest (Fig. 266); female elytron with sulci with golden or pale brown setae . . . . . *A. athabascae* new species, p. 410

*Acilius semisulcatus* Aubé, 1838

*Acilius semisulcatus* Aubé, 1838: 132. (Type locality – “Etats-Unis”). – LeConte 1850: 212. – LeConte 1863a: 17. – Crotch 1873: 401. – Sharp 1882: 674. – Horn 1883: 280. – Wickham 1895c: 151. – Blatchley 1910: 233. – Zimmermann 1919: 232. – Carr 1920: 4. – Leng 1920: 81. – Brown 1930b: 237. – Hatch 1933b: 11. – J. Balfour-Browne 1948: 161, 164. – LaRivers 1951: 404. – Hatch 1953: 236. – Young 1954: 119. – Leech and Chandler 1956: 322. – Anderson 1962: 73. – Gordon and Post 1965: 23. – Malcolm 1971: 30. – Wallis 1973: 110.

*Acilius abbreviatus* auctorum, not Mannerheim, 1853.

**Diagnosis.** – Diagnostic characteristics are in the key to species.

**Description.** – Measurements of 30 specimens from various localities in northern Alberta, are: TL – 12.00 to 14.24 mm ( $\bar{X}$  = 13.32 ± 0.50 mm); MW – 7.04 to 8.56 mm ( $\bar{X}$  = 7.81 ± 0.40 mm); TL/MW – 1.76 to 1.88 ( $\bar{X}$  = 1.83 ± 0.03).

Head testaceous to pale rufous except posterior margin and M-shaped maculation on frons, brown to piceous; antenna yellow except articles 4 or 5 to 11 each with apex infusate; palpi yellow except terminal article of each palpus with apex piceous. Pronotum with disc yellow to testaceous except two medial transverse piceous or black vittae; anterior vitta longer than posterior, with lateral arms reflexed posteriorly, parallel with lateral margin of pronotum and extended to about level of lateral portions of posterior vitta; vittae separated, or on some specimens very narrowly united along mid-line and also between posterolateral angle of anterior vitta and lateral portion of posterior vitta; punctures on pale portions of disc not or only faintly infusate. Elytron testaceous, irrorate with brown or piceous spots; irrorations larger and denser medially and apically on disc and fused as more or less continuous dark areas, especially anterior to and posterior to subapical transverse pale fascia; latter narrow, anterior border more or less evenly arcuate, strongly delimited and clearly evident on most specimens; female with setae of elytral sulci piceous. Ventral surface mainly black: sclerites of pterothorax and abdominal sterna, at least medially and basally, piceous to black. Legs mainly yellow except metatibia and metatarsi darker, rufous to brown on most specimens.

Body densely punctate. Elytron with large punctures distinctly crescent-shaped, at least basally.

*Quaest. Ent.*, 1975, 11 (3)

Pronotum with base sinuate laterally; posterolateral angle acutely produced but with apex narrowly rounded. Mesotibia with posterior (longer) spur shorter than combined length of mesotarsal articles 1 to 3.

Male with claws of pro- and mesotarsi short (Fig. 263); anterior protarsal claw longer and broader than posterior but otherwise similar in shape. Mesotarsus articles 1 to 3 each with tuft of stiff setae on posteroapical angle of ventral surface; setal tufts smaller than those of *A. athabascae*. Aedeagus as in Fig. 265, without apical ventral crest; paramere with spines on inner dorsal surface very small and sparse.

*Taxonomic notes.* — Various authors have regarded *A. semisulcatus* as a widespread varied polytypic species, including forms named *A. abbreviatus* and *A. latiusculus* LeConte. However, Hilsenhoff (1975) showed that this taxon is actually a complex, with the forms named as *A. abbreviatus* Mannerheim, *A. latiusculus* LeConte and *A. sylvanus* Hilsenhoff being specifically distinct from one another and from *A. semisulcatus*. When so restricted, *A. semisulcatus* is a rather homogeneous species.

Within Alberta, *A. semisulcatus* and *A. abbreviatus* are allopatric, with populations of the latter restricted to the southwestern portion of the province and those of the former occupying the remaining forested regions, including the Cypress Hills. Some specimens from the northern headwater regions of the Old Man River and the Porcupine Hills appear to be intermediate in color between the two species, but the length of sulci on the female elytra indicates they are best assigned to *A. abbreviatus*. Nevertheless, Hilsenhoff records the two species as sympatric at Fairbanks, Alaska.

*Natural history notes.* — This species inhabits permanent ponds in or near forested regions, usually fairly open vegetation in water depths of up to several feet. Beetles are often active during the day and many specimens were captured after they were observed swimming. The larva and life history have been well described by James (1970). The larvae are more or less pelagic, and during June and July are seen in many ponds where they form loose associations swimming in open water adjacent to beds of aquatic plants. Teneral specimens were collected between July 13 and September 1.

*Distribution.* — This species is transcontinental, ranging from Newfoundland (CNC) to Alaska (Kenai Peninsula, CNC) and south to California. The species occurs throughout the forested portions of Alberta. I examined 195 specimens from Alberta localities (map, Fig. 468).

#### *Acilius abbreviatus* Mannerheim, 1843

*Acilius abbreviatus* Mannerheim, 1843: 219. (Type locality — not stated, probably Sitka). — Aubé 1838: 132 (*nomen nudum*). — Crotch 1873: 401. — Hatch 1953: 236. — Hilsenhoff 1975: 273.

*Acilius oregonensis* Crotch, 1873: 402. (Type locality — “Oregon”). Hilsenhoff 1975: 271.

*Diagnosis.* — The diagnostic features are presented in the key to species.

*Description.* — Very similar to *semisulcatus* in size and general appearance, but differing in the following ways: subapical transverse fascia of elytron broader with anterior margin projecting slightly forwards laterally to suture; abdominal sterna entirely testaceous or narrowly black along basal margin; female with elytral sulci longer than those of *semisulcatus*, the middle two sulci originating on basal 20th of elytron, sulci with setae dark brown to piceous; male with anterior protarsal claw slightly longer and less arcuate than that of *semisulcatus*; male genitalia very similar, parameres with spines on inner dorsal margin longer, darker and more numerous.

*Taxonomic notes.* — See *A. semisulcatus*.

*Natural history notes.* — Specimens of this species were collected most frequently from the emergent zone of beaver ponds.

*Distribution.* — Hilsenhoff (1975) records this species from Alaska to California and east to Alberta, Wyoming and Colorado. In Alberta, specimens were collected from only the headwaters of the Old Man River in the southwest. (Fig. 468).

#### *Acilius athabascae* new species

Holotype — ♂, Prince Albert National Park, Saskatchewan (53°55'30" N, 106°33'15" W);

June 30, 1972: R. Hare, A. Kooyman, D. Mayhood and R. Saunders; type no. 13033, CNC. Allotype — ♀, Hwy. 63, 14 mi S McMurray, Alberta; June 10, 1970; D. J. and D. N. Larson; CNC.

Paratypes — 3 specimens from the following localities: ALBERTA — Hwy. 57, 7.5 mi W Alsike; Sept. 15, 1973; C. D. Bird (1 ♂). NORTHWEST TERRITORIES — Fort Smith; June 2, 1950; J. B. Wallis (1 ♀). ONTARIO (?) — Pembroke Lake (Grand Etang); Sept. 2, 1917; F. Johansen (1 ♂).

*Diagnosis.* — The diagnostic characteristics of this species are summarized in the preceding key to species.

*Description.* — Measurements of 4 specimens are: TL — 13.76 to 14.56 mm ( $\bar{X}$  = 14.18 mm); MW — 8.32 to 8.52 mm ( $\bar{X}$  = 8.41 mm); TL/MW — 1.66 to 1.71 ( $\bar{X}$  = 1.69).

Head testaceous except narrow margin around eye, inverted V-shaped area medially on frons, small oval spot on frons inside posterior inner margin of eye, and posterior margin, piceous to black; antenna yellow except articles 6 or 7 to 11 lightly infuscate apically; palpi yellow except terminal article of each palpus with apex infuscate. Disc of pronotum testaceous with two transverse piceous fasciae; anterior fascia about one third length of pronotum behind anterior margin, subequal in length to width of anterior pronotal emargination; posterior fascia situated halfway between anterior fascia and basal margin, not so broad as anterior nor extending as far laterally, lateral portion shortly reflexed backwards; fasciae very narrowly contiguous along midline, otherwise completely separated, disc submarginally to fasciae with punctures infuscate. Scutellum testaceous to rufous medially, outer margins piceous. Elytron pale yellow with sutural margin narrowly piceous; disc irrorate with piceous to black spots, these partly confluent (more so medially and apically on disc) in form of vermiculate marks; pattern of markings on disc more or less uniform, without or with only slightest tendency toward formation of postmedial darkened area due to fusion of vermiculate markings; without pale crescentic subapical fascia. Ventral surface testaceous or with lightly infuscated area on mediolateral portions of sterna 2 to 6. Legs testaceous to pale brown except metatibia and metatarsi slightly darker.

Head with larger punctures best defined laterally inside eyes, punctures sparser and shallower medially; interspaces with numerous small irregularly shaped punctulae (probably situated at intersections of lines of obsolete microsculpture) medially in form of irregular grooves or rugae, deeper punctures obscured. Pronotum irregularly punctate, punctures various in size and density over disc but sparser than those of *A. semisulcatus*; interspaces micropunctate, with only faintest rudiments of microsculpture. Elytron of male with numerous coarse setiferous punctures on disc, each puncture with very short inconspicuous dark brown or piceous seta; punctures more or less evenly distributed, smaller basally and separated by more than their diameters, larger and closer medially; interspaces with about equally numerous small non-setiferous punctures and also micropunctate; large punctures irregularly rounded or somewhat truncated anteriorly, with no or only slight tendency toward crescentic shape; microsculpture obsolete or with reticulations very fine. Female elytron with four broad longitudinal sulci, origin of latter near base of elytron and continued almost to apex; each sulcus with numerous coarse setiferous punctures, each with long semierect golden or pale brown seta; setae laterally compressed at base; costae between sulci densely but finely punctate, with only very irregular sparse larger punctures; basal margin of elytron basal to sulci with scattered large and small punctures, larger punctures not crescentic in shape; microsculpture obsolete. Metacoxal plates coarsely and densely punctate, punctures isolated and separate medially but with tendency to transverse confluency laterally. Metafemur ventral face with very small scattered punctures; metatibia with reduced punctation, only few coarse setiferous punctures toward base in addition to fine sparse micropunctuation.

Pronotum with hind angle only slightly produced posteriorly, base of pronotum very broadly and shallowly bisinuate. Posterior mesotibial spur elongate, subequal in length or longer than combined length of mesotarsal articles 1 to 3.

Male with claws of pro- and mesotarsi very elongate (Fig. 264): anterior protarsal claw conspicuously longer and somewhat stouter than posterior; mesotarsal articles 1 to 3 with dense brush of elongate stiff setae on posteroapical ventral surface; mesotarsal claws similar in shape to protarsal claws but shorter. Aedeagus (Fig. 266) with pronounced ventral crest or hook at apex.

Female with anterior protarsal claw elongate, longer than maximum length of protarsal article 5.

*Taxonomic notes.* — The species *A. semisulcatus* and *A. athabasca* differ from the Old World species *A. canaliculatus* and *A. sulcatus* in shape of the aedeagus. In the Old World species, the basal orifice is at an angle of about 45° to the longitudinal axis of the aedeagus and the apex is laterally produced, while in the North American species, the basal orifice is more or less horizontal to the longitudinal axis of the aedeagus and the apex is truncate or produced medially. Also, males of *A. canaliculatus* and *A. sulcatus* have adhesive scales or discs on the ventral surface of mesotarsal articles 1 and 2 while these are lacking from males of all North American species of *Acilius*. These facts suggest that these North American species are more closely related to one another than is any to the Old World species.

*Etymology.* — The name is derived from the Cree Indian word Athabasca which means

“where there are reeds” (Kroetsch, 1968), and refers to the zone of emergent vegetation which is the habitat of the species.

*Natural history notes.* – The holotype was collected during a Canadian Wildlife Service survey of aquatic habitats in Prince Albert National Park, Saskatchewan, from Lake No. 601, a small circular lake of 9.2 hectares in surface area with a maximum depth of 1.5 meters, surrounded by a floating mat of *Carex* and situated in flat country forested with aspen and pine. Water samples taken during August and September gave a pH of 8.4 and a conductivity of 280 micromhos/cm with the major cation Ca and the major anions CO<sub>3</sub> and HCO<sub>3</sub>.

The allotype was collected from a patch of *Typha* growing in a recently dug borrow-pit situated in an area of mixed forest.

The specimen from Pembroke Lake, collected September 2, is very teneral.

*Distribution.* – This species is known only from the type material. The label of the specimen from Pembroke Lake is without indication of state or province. I have tentatively accepted the locality as Pembroke Lake, Sudbury District, Ontario. Alberta collection localities are indicated in Fig. 469.

#### ZOOGEOGRAPHY

The history of the fauna of a region is reconstructed by integrating inferences based on geographical and ecological distribution of extant species with information about geological climatic and floristic history. The dytiscid fauna of Alberta is diverse, and enough is known to permit an initial attempt to reconstruct its history. However, data are so incomplete for some species that they are excluded from the analysis.

Fossil evidence for tracing changes in the ranges of these beetles, is not available. Past movements must be inferred on the basis of other evidence. This requires several assumptions:

- a. each species has continued to occupy the same type of habitat in which it is currently found and geographical changes in the distribution of a species' habitat have similarly affected the possible range of the species;
- b. the non-glaciated portion of the range presently occupied by a species corresponds to the general area (refugium) in which that species passed the glacial maximum; and
- c. the presence of vicarious species, subspecies or morphologically defined geographical races of a species indicates past geographical separation of the forms and their divergence in isolation (Mayr, 1963).

Temperate and arctic dytiscid faunas of North America are probably of relatively recent origin. The majority of genera of these regions are Holarctic as are some of the species. Much of the temperate Holarctic fauna was developed through exchanges between North America and the Old World (Darlington, 1957), with faunal exchanges between eastern and western North America being important in development of cold temperate and arctic Nearctic fauna (Ross, 1958). Most taxa of the present North American fauna probably originated prior to late Pleistocene time. Nevertheless, the catastrophic and disruptive effects of the Pleistocene glaciation had an overriding effect in shaping the distributional history of the present-day fauna. Because the last of the major glacial advances, the Wisconsinan, virtually eliminated the Pleistocene fauna of Alberta and obscured the effects of previous glaciations, the extant faunal assemblages originated with the beginning of the Wisconsinan retreat.

To trace the post-glacial history of the extant fauna, it is necessary to review the major events of the Wisconsinan glaciation and their effects on distribution of the broader types of Holocene habitats in Alberta.

The major events of the Pleistocene history of Canada were documented by Flint (1957) and Prest (1968, 1969), and the glacial history of western Canada was summarized by McPhail

and Lindsey (1970) and Nimmo (1971). Rate of retreat of the Wisconsin Laurentide Ice Sheet and associated climatic conditions are discussed by Andrews (1973). However, certain biologically important information is not complete such as boundaries and extent of refugial areas, climatic conditions, and periglacial effects on the biota.

In general, the Wisconsin Period began about 50,000 years before present, and attained its maximum extent in western Canada about 17,000 years B.P. At that time, almost all of Alberta was covered with ice: westerly areas by the eastern edge of the Cordilleran ice mass; and the remainder of the province, excepting the Cypress Hills and an area in the foothills of southwestern Alberta, by the southwesterly advance of the Laurentide ice sheet (Prest, 1968). On the other hand, Reeves (1973) postulates that in late Pleistocene time, the Laurentide and Cordilleran ice sheets did not coalesce to form a broad expanse of solid ice, but rather "in the last 100,000 years or so, this so-called barrier probably consisted of the coalescence during a few thousand years of a few mountain piedmont lobes with the Laurentide ice sheet for relatively short distances. Large ice-free areas continued throughout the late Quaternary that presented no physiographic barriers to human movement". Reeves did not speculate on the environment of this corridor.

Prest (1968) points out that events and chronology of the Pleistocene in the southern Canadian plains are not well known. Some authors place the southern limit of the Classical Wisconsin advance south of 49°N, while others suggest that it is well north of the Cypress Hills. Prest (1968, 1969) suggests that at about 17,000 years B.P. the glacial limit was south of 49°N in Alberta, except for an area along the foothills which included the Porcupine Hills. By about 12,500 years B.P., the glacial limit was in central Alberta, and by 10,000 years B.P. the ice margin had retreated to the northeast and most of Alberta, the southern two-thirds of Saskatchewan, and the southern half of Manitoba were ice-free.

At maximum extent of glaciation, the environment of most of Alberta was unsuitable for most plant and animal life, hence the present biota is the result of post-glacial dispersal from ice-free areas (refugia). If the dates presented by Prest (1968) are correct, the present Alberta biota colonized most of the province within the last 17,000 years.

The principal refugium for North American organisms during the Wisconsinan was south of the maximum ice advance. Movements of the biota during the glacial advance are not completely known, but good evidence is available for a southward shift in the ranges of many species (Martin, 1958; Terasmae, 1973). Löve (1959) suggests that the Laurentide ice mass separated the true tundra from the boreal flora and thus the southern edge of the advancing ice was not preceded by a true tundra zone in central North America. This was substantiated by Ritchie (1969) and Wright (1970). Löve suggests that the advance was rapid enough to permit the ice to override previously existing floras and that there was not a southern shift of floral zones ahead of the advancing ice, in this respect agreeing with Hultén (1937) in his contention that the glacial advance resulted in extermination rather than a shift in the biota. This may have resulted in the close juxtaposition of glacial ice with a temperate flora such as Lindroth (1965) described. Löve believes that the Laurentide ice reached the prairie grasslands without the development of an intermediate band of forest, thereby dividing the eastern and western remnants of the boreal coniferous forest and producing a bicentric refugial distribution for those species associated with this flora (Moss and Pegg, 1962). On the other hand, Bryson and Wendland (1967) suggest that a mobile phase of the boreal forest occupied a low belt across the present prairies during the Wisconsinan although the climate associated with this forest was more "droughty" than that associated with the boreal forest at present, and therefore the more xeric floristic elements probably predominated. Wright (1970) concludes that closed spruce forest had a widespread distribution in the eastern and northern portions of the plains, southern Canada to Kansas and Missouri and east to the Appalachian Mountains, in late Wisconsin time.

Whether such a forest developed coincident with the glacial advance or after, is not known.

Deglaciation resulted in newly exposed areas of land colonized by expansion of ranges of species which survived in refugial areas. Eastern and western coniferous forests expanded into the newly opened areas; however, Löve suggests that they did not establish on much of the area that is presently prairie. Recent pollen studies by Ritchie (1969) and Ritchie and DeVries (1964) indicate that a forest dominated by *Picea-Shepherdia canadensis-Salix-Artemisia* lived in southern portions of the prairie provinces during the early stages of glacial retreat (ca 11,600 - 10,500 years B.P.), and probably represents a northward migration of the forest described by Bryson and Wendland (1967) and Wright (1970). This forest, of uncertain origin and affinities, disappeared from the southern portions of the prairie provinces about 11,500 years B.P., and was probably the precursor of part of the present flora now isolated on the Cypress Hills. Bird (1962), studying Bryophytes, and Yeatman (1967), studying pines, show that the Cypress Hills flora has its principal affinities with the Rocky Mountains, indicating that the early Holocene forest in southern Alberta and Saskatchewan had a Cordilleran aspect and was derived principally from the west, in this respect agreeing with Rowe (1956) and Löve (1959) in their ideas of direction of flora movement across the southern Prairie Provinces. Rowe and Löve postulated forests of western origin extending along coulee systems into southern Manitoba. Perhaps the origin and distribution of the early Holocene forest was as outlined by Löve but its distribution on the prairies was more widespread than she claimed. Lichti-Federovich (1970) records white spruce (*Picea glauca*) as the dominant tree in central Alberta between 11,000 and 9,000 years B.P., and suggests that "development of extensive peat bogs with black spruce would be unlikely so recently after deglaciation". If this is correct, perhaps peat bogs and the fauna and flora associated with them were not a feature of the migratory early Holocene coniferous forest, but rather developed after the boreal forest attained approximately its present position, through dispersal of various constituents of the extant biota from the east.

On the basis of post-Wisconsin climatic reconstructions and pollen data, Bryson and Wendland (1967) suggest that about 8,000 years B.P., the boreal forest was reduced and grasslands extended "nearly to the ice front in the Prairie Provinces". Since that time, prairie was reduced, the Laurentide ice mass completely disappeared, and the boreal forest occupied a broad relatively stable belt across the northern portions of the Prairie Provinces.

In conclusion, the history of the boreal forest of the Prairie Provinces has been one of broad latitudinal migrations, possible loss and acquisition of elements, and perhaps one or more complete or nearly complete east-west divisions, resulting from either glacial advance (Löve, 1959) or expansion of grasslands (Löve, 1959; Bryson and Wendland, 1967).

The distributions of many taxa presently show signs of an east-west zonation. For species in habitats such as peat bogs within the boreal forest, possible mechanisms by which this zonation came about were described above. However, some species occupying a variety of forest habitats or not restricted to the boreal forest, also show evidence of this zonation. For certain species, increased effectiveness of the Rocky Mountains as a barrier due to lowered temperatures, development of extensive mountain glaciers and expansion of forests into lower areas in response to cooler, moister conditions during the glacial maximum, may have separated eastern and western population segregates as Freitag (1965) postulated for tiger beetles.

McPhail and Lindsey (1970) suggest that for fishes (this probably applies to other animals restricted to water for dispersal), the area south of the continental ice sheets formed three principal refugia: the Pacific (west of the continental divide); the Mississippi comprised of the Missouri River and Upper Mississippi River subunits; and the Atlantic. With the northeasterly retreat of the Wisconsin Laurentide ice sheet, a series of large lakes were formed along the southern and western margins of the ice. During this period, direction of drainage underwent

considerable modification. For example, the Prince George Basin (presently in the Fraser River watershed) drained north and east into the Peace River; lakes in the present Mackenzie drainage discharged south and east into the Hudson Bay system; and glacial Lake Agassiz drained sometimes into the Mississippi, sometimes to the northwest, and sometimes into Lake Superior. Hence, since the Wisconsin maximum completely aquatic organisms, such as fish, were able to pass between the Mississippi, Great Lakes, Hudson Bay, Mackenzie River and Fraser River watersheds. This resulted in some intermixing of the faunas of the various southern refugial areas. Dadswell (1974) demonstrated that the present distribution of certain crustaceans and fishes in eastern North America is closely correlated to the distribution of post-glacial lakes. However, important as these changing lake and drainage patterns may be to certain aquatic organisms, they are probably relatively unimportant to the dispersal of water beetles which rely primarily on flight, and whose habitats are principally small bodies of water which lack drainage outlets. In spite of this, the vast area of central Canada flooded in post-Wisconsin time demonstrates the poor drainage characteristics of the country, and is an indicator of the abundance of aquatic habitats across the boreal portions of this region.

In addition to the unglaciated portion of North America south of the maximum glacial advance, a large non-glaciated area in Alaska served as an important refuge for a variety of organisms (Ball, 1963). Several authors postulated refugia in the vicinity of the Mackenzie River and in the Arctic Archipelago. However, if refugia existed in these latter areas, it is unlikely that they had any significance in the recolonization of Alberta for this province shares very few species of water beetles with the true Arctic.

Although non-glaciated areas that could have been refugia persisted in Alberta during the Wisconsin glaciation (for example, the Cypress Hills, the Cordilleran-Laurentide Corridor, and nunatak areas in the Rocky Mountains (Bird and Hong, 1969)), it is not known if beetles survived there. No endemic dytiscids are known from Alberta except for *Agabus margareti* and *Hydroporus carri* – species whose habitats, distributions and appearances suggest that they occur elsewhere but have been overlooked. However, certain species of dytiscids are good prospects for survival in small ice-free areas with standing water, such as those whose ranges extend far into the Arctic Archipelago (Young, 1960a; Oliver, 1963), and those adapted to low temperatures and short seasons. At present, two species, *Hydroporus griseostriatus* and *Agabus tristis*, occupy small ponds in terminal moraine of Athabasca Glacier, and another species, *Hydroporus laevis*, lives in cold water with glacial silt. *A. tristis* is isolated in cold springs in the Cypress Hills but its presence is most likely due to post-glacial dispersal. This species exhibits marked variation over its range and careful study may shed light on relationships of the various populations and their post-glacial history. As there are no distinctive populations of water beetles associated with possible refugia in the province, I conclude that dytiscids present no concrete evidence for refugia within this area.

Although the Beringian Refugium (unglaciated portions of Alaska, and adjacent portions of Siberia) was important for a variety of plants and animals (Hultén, 1937; Ball, 1963; McPhail and Lindsey, 1970), Dytiscidae of the area are too poorly known to assess their importance in post-glacial colonization of Alberta. Alaska now contains many dytiscids transcontinental in boreal North America or with wide distributions in the western mountains. Whether survival was in the Alaska refugium, the southern refugium, or both, is not known for most species. Certain species with arctic distributions most likely did survive in the Alaska refugium (or a Mackenzie or Arctic Archipelago refugium), for example, *Hydroporus lapponum* (Gyllenhal), *H. polaris* Fall, *H. subvirescens* Fall, *Agabus moestus* Curt., *A. coxalis* Sharp, *A. hudsonicus* Leech, *A. browni* Leech, *A. colymbus* Leech, *A. solus* Leech, *A. verus* Brown and *A. elongatus* Gyllenhal. Except for *A. elongatus*, these arctic species are not part of the Alberta fauna, probably because of lack of suitable habitat, but also, ice sheets developed in a way which tended



to separate the arctic fauna from the fauna to the south (Löve, 1959), with the only connection being the possible non-glaciated corridor along the Rocky Mountain foothills. The presence of *A. elongatus* in central Alberta may be due to recent dispersal from the north, or the population may be relict on the north slope of the Swan Hills, having entered Alberta via the Cordilleran-Laurentide Corridor in glacial time or may have come in during the initial stages of glacial retreat. The exceptionally large size of the two Alberta specimens is noteworthy, and while perhaps indicative of environmental conditions, could have a genetic basis suggesting some degree of genetic isolation from northern populations.

The species *Hydroporus depressus* has a northern boreal range in both the Old World and northwestern North America, where it replaces its southern vicar, *H. elegans*. *H. depressus*, known in North America from only northwestern Alberta and the District of Mackenzie, Northwest Territories, may have extended its range south and east from an Alaskan refugium. The species *Dytiscus alaskanus* is widespread in the boreal region of North America. Over most of its range, female elytra are striate; but in the northwest, many females have smooth elytra indicating presence of a genetic character lacking from populations from the remainder of the species' range. Probably non-striate elytra are characteristic of a population that survived in the Alaskan refugium, and of populations arising from this source. If so, most populations of *D. alaskanus* in Alberta were derived from the southern refugium, while those in the extreme northern part of the province dispersed from the Alaskan refugium.

The majority of the Alberta fauna is almost certainly derived from species which passed the glacial maximum in the southern portion of the continent. However, the exact source area differs for different groups of species. Many species, especially those which occupy widespread habitats and are widely distributed at present, could have survived in a transcontinental belt at a lower latitude than they occupy at present. In the cold temperate portion of the continent, a large percentage of the fauna has a transcontinental distribution and probably during the glacial maximum ranges of these species were shifted southward. Some Alberta species with this form of distribution pattern are: *Laccophilus biguttatus*, *Liodessus affinis*, *Hygrotus sayi*, *H. turbidus*, *H. suturalis*, *H. impressopunctatus*\*, *Hydroporus planiusculus*, *H. notabilis*, *H. striola*\*, *H. criniticoxis*, *H. tenebrosus*, *H. elegans*\*, *H. griseostriatus*\*, *H. scitulus*, *Agabus bifarius*\*, *A. pseudoconfertus*, *A. ambiguus*, *A. ajax*, *Ilybius subaeneus*\*, *I. angustior*\*, *Rhantus binotatus*, *Colymbetes sculptilis*, *Dytiscus alaskanus*, *D. cordieri*, *D. circumcinctus*\*, *Hydaticus modestus* and *Graphoderus liberus*. Most of the species also occur in Alaska and the southern Yukon, and some (those indicated with an asterisk) also in the Palearctic region. The members of this group are in both prairie and forest habitats and for this reason they presently occupy, and during the glacial maximum probably did occupy, a continuous transcontinental belt south of the ice, and some with isolates in the Beringian refugium.

Several species or pairs of closely related species show the above pattern of distribution, but have differentiated into eastern and western forms. Examples are: *Laccophilus maculosus maculosus* (eastern) and *L. m. decipiens* (western); *Agabus seriatus seriatus* (eastern) and *A. s. intersectus* (western); *Coptotomus interrogatus* (eastern) and *C. longulus* (western); *Graphoderus fascicollis* (eastern) and *G. perplexus* (western). The zone of contact between the eastern and western form is Manitoba: Alberta has only the western form. The latter probably originated in the Cordillera and subsequently expanded its range to meet its vicar on the eastern margin of the Great Plains.

Another group of species live in a transcontinental band in the boreal forest, or at least occupy the northern forested portion of the continent east of the Rocky Mountains. The majority of species in *Sphagnum* bogs belong to this group. Examples are: *Hygrotus picatus*, *Hydroporus undulatus*, *H. dentellus*, *H. melsheimeri*, *H. paugus*, *H. stagnalis*, *H. signatus*, *H. fuscipennis*, *H. glabriusculus*, *H. morio*, *H. tartaricus*, *H. despectus*, *H. rectus*, *Agabus pseudoconfertus*,

*A. kenaiensis*, *A. semipunctatus*, *A. anthracinus*, *A. confinis*, *A. congener*, *A. phaeopterus*, *Ilybius discedens* and *I. pleuriticus*. These exhibit a variety of distribution patterns and could have survived in several different refugia. Species with transcontinental ranges but not differentiated geographically probably survived in a transcontinental band of forest or in both western and the eastern forest refugia. On the other hand, a number of species attain their most westerly limits in the boreal portions of Alberta or northeastern British Columbia. These species probably originated in an eastern boreal refugium and dispersed north and west. Only one of the species of this group, *Colymbetes longulus*, is presently isolated in the Cypress Hills. The species *Neoscutopterus hornii* which basically shows this pattern, also occurs in Alaska, and here it probably survived, as well as in an eastern refugium. The species is presently lacking from southern British Columbia and southwestern Alberta and does not appear to have survived here. Two of the species that show the transcontinental boreal pattern of distribution have western populations morphologically distinct from eastern populations. The species *Hygrotus picatus* contains females dimorphic in elytral sculpture in the east, but females of only one morph (those with male-like sculpture) are in southwestern Alberta and southern British Columbia, indicating that Alberta populations were derived from an eastern and a western source. The population in the Cypress Hills is dimorphic and for this reason is probably derived from the east. Similarly, specimens of *Acilius semisulcatus* have largely piceous ventral surfaces to the body over their range across eastern North America to northern Alberta and British Columbia and Alaska. Populations from southern British Columbia, southwestern Alberta and south to California are largely testaceous on the ventral surface. This may indicate that northern Alberta populations are derived from an eastern North American or Alaskan source while those in southwestern Alberta are derived from a source west of the continental divide. The Cypress Hills population has the characteristics of the northern and eastern form. A similar pattern is shown by the two Alberta species of *Laccornis* where divergence between the eastern (*L. conoideus*) and the western (*L. pacificus*) populations is at the specific level.

Whether divergence between the eastern and western populations of the species mentioned above took place during Wisconsinan or earlier cannot be determined. Freitag (1965) suggests that divergence that finally gave rise to the eastern *Cicindela duodecimguttata* Dejean and western *C. oregona* LeConte began during mid-Pleistocene time and developed during the intermittent periods of isolation associated with the various glacial advances. At any rate, this divergence probably occurred during or prior to the Wisconsinan and the presence of two recognizable entities in the province, be they full species or merely color forms of one species, indicates the dual origin of the Alberta populations.

The extent to which western species have invaded Alberta differs from species to species. Some barely extend into Alberta, being restricted to the southwestern corner of the province. *Hydroporus angustior* has not been found in Alberta although it occurs in the Elk River in the western approach to the Crowsnest Pass. The species *Laccornis pacificus*, *Hydroporus tademus*, *Agabus inscriptus smithi* and *A. pisobius* just enter southwestern Alberta in the Castle and Crowsnest River drainages. *Agabus verisimilis*, *A. hypomelas* and *Ilybius quadrimaculatus* extend slightly farther east but still not beyond the Old Man River drainage. Many western species of higher plants are known in Alberta from only this area (Ogilvie, 1962).

A large group of western species occurs throughout the Alberta Rocky Mountains and adjacent foothills. Most are widespread in the western North American mountains and the present range of many includes both the Alaskan refugium and western portions of the southern North American refugium. Hence, Alberta populations may have a dual origin. A few of these species are transcontinental in the boreal region, although they are generally rare and sporadic east of the Rocky Mountains. Species with this distribution pattern are: *Hydroporus edwardsi*\*, *H. compertus*, *H. mannerheimi*, *H. occidentalis*, *H. despectus*, *H. striatellus*\*, *H. quadrimaculatus*,

*H. snoqualmie*, *H. alaskanus*, *H. rivalis*, *H. congruus*, *H. crassulus*\*, *Agabus bjorkmanae*, *A. austinii*\*, *A. strigulosus*\*, and *A. tristis*\*. The species marked with an asterisk have populations in the Cypress Hills which may be more or less isolated. All appear to have continuous ranges along the eastern slope of the Rocky Mountains. A few species, however, may be discontinuously distributed on the eastern slope, with populations in the southwestern corner geographically isolated from populations in the upper reaches of the Alberta portion of the Peace River area. Good candidates for this distribution pattern are: *Colymbetes exaratus*, *Hydroporus spenceri*, *H. quadrimaculatus* and *Ilybius quadrimaculatus*. Although *I. quadrimaculatus* has not been found in the Peace River area of Alberta, it occurs in the northern Fraser River drainage in adjacent British Columbia (McBride, UC). *Colymbetes exaratus* has been included in this pattern for the following reasons: the species has not been collected in the North Saskatchewan drainage; and the northern population hybridizes with *C. sculptilis* whereas no sign of hybridization has been observed in the southern population, indicating that the two Alberta populations are somewhat different genetically. The discontinuous ranges of *H. spenceri* and *H. quadrimaculatus* may simply be an artifact of collecting as the ranges of both are very poorly known. Several other species of animals have entered Alberta around the northern end of the Rocky Mountains. Examples of these are: *Amphizoa insolens* LeConte (which also occurs in southwestern Alberta but not intermediate localities) (J. Carr, pers. comm.); *Salmo gairdneri* (MacCrimmon, 1971); *Ptychocheilus oregonensis* Richardson and *Catostomus macrocheilus* Girard (Paetz and Nelson, 1970). No western species of dytiscid is known in Alberta from only the Peace River area.

Unfortunately, the fauna of much of eastern British Columbia is not well known. Nevertheless, evidently two major pathways through the Rocky Mountains were used for the eastward movement of western species: Crowsnest Pass; and Upper Peace River regions. The Peace River appears to be an important route for eastern species which have expanded their ranges westwardly. Hatch (1953) records many eastern species from only northeastern British Columbia. I know of no examples of eastern boreal species that have entered British Columbia through the Crowsnest Pass. Ross (1958) pointed out the tendency for western species to extend their ranges east during the Cenozoic and the lack of a major reciprocal movement on the part of the eastern fauna.

Another western group is a Great Basin assemblage. These species inhabit open dry country and have their center of distribution west of the Rocky Mountains, in or near the Great Basin. They probably reached the Great Plains south of Alberta, and extended their ranges north on the prairies. Species with this form of distribution are: *Hygrotus semivittatus*, *H. tumidiventris*, *H. masculinus*, *Hydroporus pervicinus*, *Agabus nectris*, *A. lutosus* and *A. approximatus*. *Hygrotus masculinus* and *H. salinarius* are closely related. The species *H. salinarius* is restricted to the northern Great Plains whereas *H. masculinus* occurs both on the Great Plains and in the dry interior of the Cordillera. Possibly a common widespread halophilic ancestor diverged into a western and an eastern species. The western species, *H. masculinus*, has apparently reinvaded the prairies.

A portion of the prairie and parkland fauna consists of a northern Great Plains element. These species occupy the northern portion of the Great Plains west of the Mississippi River and east of the Rocky Mountains. Examples of species showing this distribution are: *Hygrotus canadensis*, *H. patruelis*, *H. sellatus*, *H. dentiger*, *H. punctilineatus*, *H. salinarius*, *Agabus triton* and *A. margareti*. These species probably entered Alberta from the south and at present are common only on the southern prairie and parkland regions.

Ross (1970) studying grasshoppers and leafhoppers concluded that the fauna of the Great Plains "is not a distinctive ecological unit but has strong ecological affinities with all the surrounding biomes" and that few species of these insects are prairie endemics. He concluded that

at least a portion of the Great Plains fauna evolved in subclimax grass communities of other biomes and subsequently became able to live in the prairies. The species *Agabus punctulatus*, an eastern species that is largely limited to the prairie and southern parkland regions of Alberta, and *Hygrotus sellatus* appear to be isolated in the Peace River area. Isolated populations of prairie species of plants in the Peace River area, for example *Opuntia fragilis*, is of interest to Alberta botanists. Hansen (1949) suggested that the Peace River grasslands may be relics of a postglacial expansion of prairies during a warm dry period about 8,000 to 4,000 years B.P. Moss (1952) presented some substantiating evidence, but on the other hand he noted the lack of native populations of *Festuca scabrella*, characteristic of the northern portion of the prairies further to the south, as well as the fact that many species found in the Peace River grasslands are characteristic of woodland farther south. These observations support Raup (1934) who suggests that these grasslands developed from tundra through a grass-sedge stage. Recently Lichti-Federovich (1970) presented pollen stratigraphy evidence substantiating Raup's conclusion. The restricted prairie element in the Peace River dytiscid fauna does not contradict the possibility that this grassland developed independently of the more southerly prairie. The prairie species could have entered the area through long-range dispersal or their populations could be of relatively recent origin. Development of roads through northern Alberta was accompanied by building of numerous borrow-pits which structurally resemble exposed prairie ponds and could act as corridors along which prairie species could disperse.

In conclusion, Alberta's present fauna of dytiscid beetles is of diverse origins, with species exhibiting a wide variety of distributional patterns and histories. In post-glacial time, important faunal elements have entered Alberta from the south, east, west and northwest in response to changing vegetational patterns or factors related to this.

#### FAUNISTIC AREAS

The preceding section examined the probable geographical history of individual species of Alberta Dytiscidae. In this section, the distribution of the dytiscid fauna as a whole is examined to see if similarities in distribution among species produce broad faunal patterns that can be correlated with geographic factors.

The form of analysis was as follows. The province was divided into a number of small geographical areas. The dytiscid fauna of each area was tabulated and compared with that of every other area by a Jaccard coefficient of similarity. The resulting matrix was used in a group average single linkage cluster analysis which ranked the various faunal zones in a similarity dendrogram.

The province was divided into 20 zones (Fig. 3), for the most part, corresponding to Strickland's (1938, 1951) faunal zones of Alberta (as refined by Sharplin, 1966). The boundaries were modified only slightly, primarily to pool similar neighbouring zones where the total number of collection sites was too few to permit an accurate evaluation of faunal composition.

This procedure introduces a bias into the analysis, but is justified because Strickland established these zones on the basis of criteria independent of the distributional pattern of aquatic organisms or habitat types: agricultural practices, soil types and principal forms of terrestrial vegetation. If these zones are artificial, the following conditions would be expected:

- a. If too narrow, zones would be grouped with neighbouring zones at a high level of similarity indicating relatively little difference between contiguous zones, but major faunal differences, would be apparent between groups of zones; or
- b. If too wide and hence heterogeneous, all zones would tend to resemble each other at a high level of similarity without a hierarchy of similarity between zones. Non-adjacent zones may show higher levels of similarity than adjacent zones hence giving a mosaic

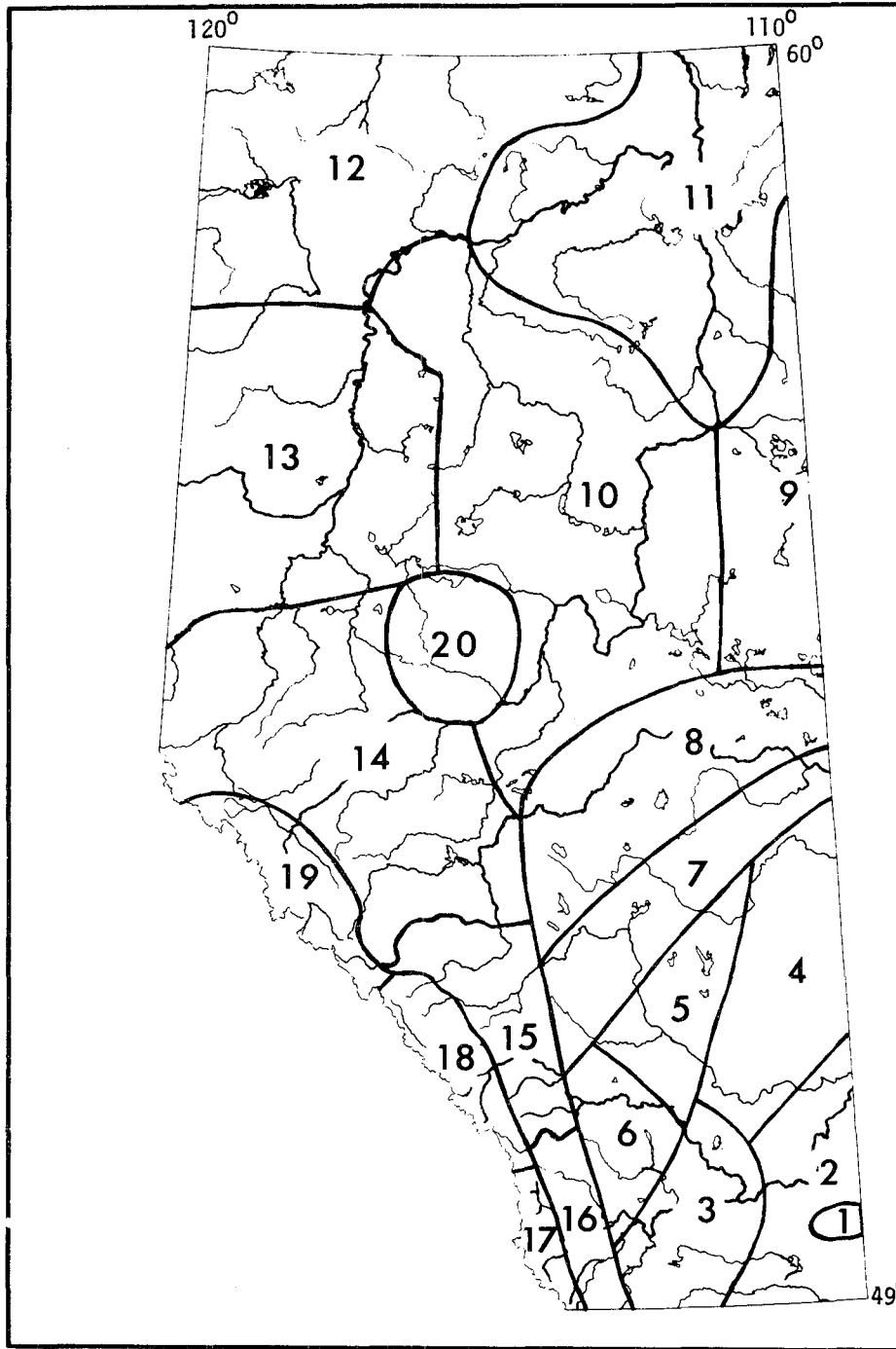


Fig. 3. Faunal zones of Alberta (modified after Strickland, 1951).

pattern rather than a contiguous pattern.

A primary disadvantage with this form of analysis is that it is one dimensional indicating only overall similarity of a given zone with only one other zone or group of zones. Thus introgression of faunal elements from one zone into another affect the latter's similarity coefficient, but the coefficient still shows only that zone's greatest overall similarity and does not indicate minor similarities or influences. Hence, the factors causing divergence of zones within a group must be determined by other means. In this study, it was done by referring back to the species list for each zone.

## Results

The dendrogram (Fig. 4) shows a relatively high degree of interdependence among zones. All clusters unite at the 40% level of homogeneity indicating that a major element of the province's dytiscid fauna is in all faunal zones. Above this level, are two major groups. One, consisting of zones 1 to 7 and 16 contains only zones from the southern and eastern portion of the province, characterized by prairie or parkland with less than 50% tree cover. The other, more heterogeneous, major group contains those zones in western and northern Alberta characterized by extensive tree cover.

The prairie group includes two principal subgroups which join at the 63% level of similarity. Zones 1 and 16 differ from the others by inclusion of a number of species whose distribution is primarily western, or for some species in zone 7, northern, thus reducing their overall faunal similarity with the neighbouring prairie zones. Nevertheless, the majority of their fauna resembles that of the neighbouring prairie zones. In zones 2 to 7, reduction in prairie elements from south to north and an incursion of boreal forms into zones 7 and 4, produces a similarity gradient.

The forest group, is less homogeneous than the prairie group. Zone 19 is associated with the other zones of this group at a relatively low level of similarity (42%), suggesting a unique faunal composition. However, this zone is the most poorly collected in the province, and its isolation from contiguous areas is almost certainly an artifact. At the 50% level of similarity, two subgroups form: northern or boreal subgroup (zones 8-13 and 20) and a mountain subgroup (zones, 14, 15, 17, 18 and probably 19).

The boreal subgroup shows a high level of similarity between zones 9, 10 and 13. Zones 11 and 12 are similar to one another and unite with the previous cluster at 69% level of similarity. A higher level of similarity probably exists but collections in some of these zones, especially 11 and 12, are limited. Zones 8 and 20 are somewhat isolated from the main clusters of the boreal group. Zone 8 shows diminution of boreal elements and presence of some prairie elements. Zones 7 and 8 represent transitional steps between prairie and boreal faunas. On the other hand, although included in the boreal subgroup, zone 20 shows affinities with zone 14 of the mountain subgroup.

In the mountain subgroup, zones 14 and 15 resemble one another at a high level of similarity (80%) and these in turn cluster with zones 17 and 18 at a relatively low level (60%). The fauna of zones 14 and 15 is largely transitional, primarily montane but also a large number of boreal forms and lesser number of prairie elements are present. Zones 17 and 18 cluster at the 68% level of similarity, a relatively low level for contiguous and physiographically similar areas. However, a major factor for the low similarity between these zones is a southwestern element which attains its northern distribution in zone 17, and does not enter zone 18. Similarly, zone 18 includes some boreal elements not southward in 17. Ogilvie (1962) notes a parallel distribution pattern for higher plants in this region.

In summary, Alberta includes three distinguishable faunas: prairie, boreal, and cordilleran. Prairie and boreal dytiscid faunas were previously recognized by Rawson and Moore (1944).

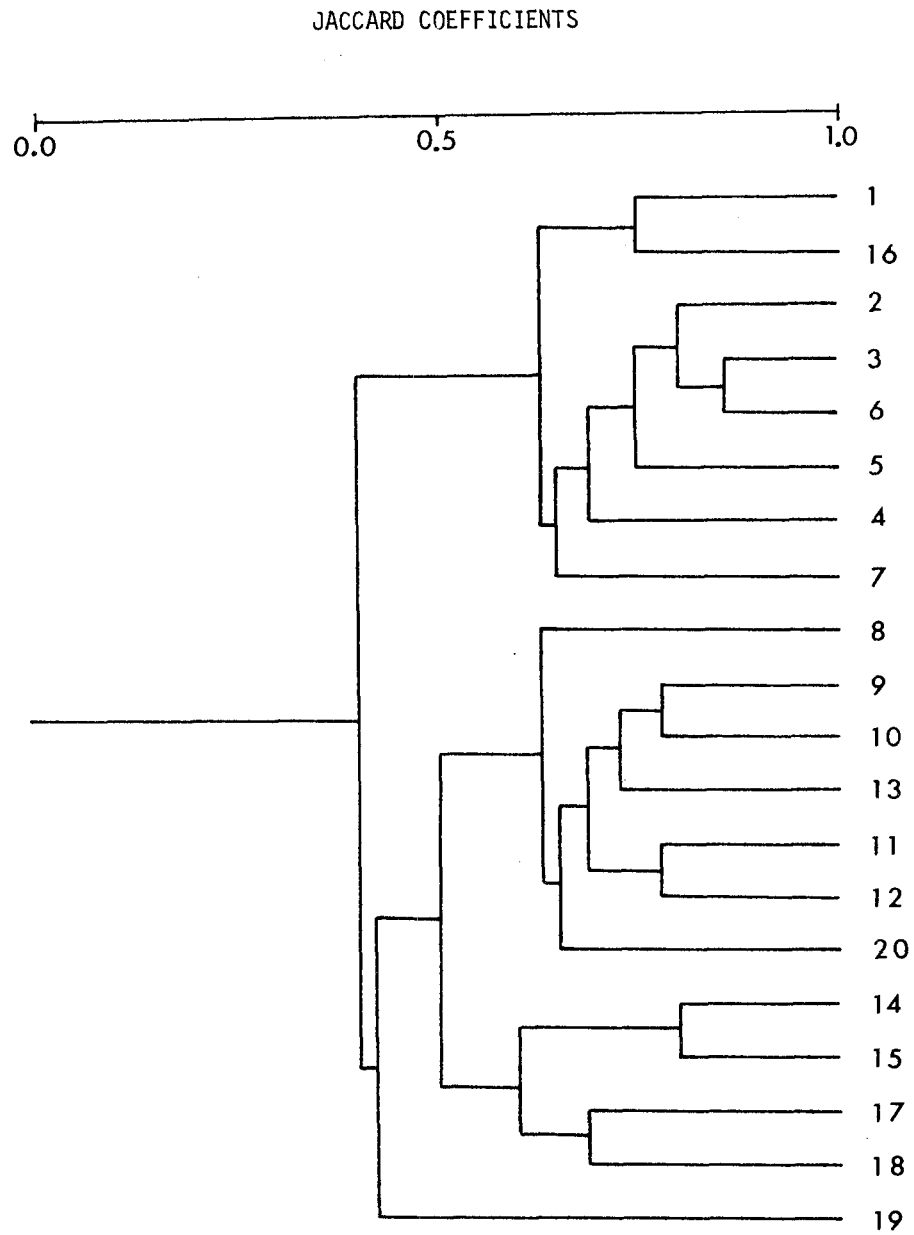


Fig. 4. Dendrogram prepared by the group average method of cluster analysis showing similarities among Strickland's (1951) faunal zones of Alberta.

None of these is well delimited but each tends to intergrade with the others. Primary areas of transition are the Cypress Hills (1) and southwestern foothills (16) (prairie - cordilleran transition); parkland (7 and 8, prairie - boreal transition); the Swan Hills (20, boreal - cordilleran transition); and the northern foothills (14 and 15, prairie - cordilleran - boreal transition).

Kaiser et al. (1972) used a similar approach to define faunal provinces, concluding that Canada could not be divided into clear-cut faunistic provinces but that there were a few areas of relatively high homogeneity. The same conclusion must be drawn for the Alberta dytiscid fauna. The cluster analysis indicates three major areas of faunal homogeneity as evidenced by the three cluster nuclei (zone 19 omitted for reasons given above). However, these nuclei intergrade with each other over broad areas and faunal zones cannot be sharply defined. The preceding zoogeography section shows that the fauna of each portion of the province was derived from several sources. This coupled with the poor definition of the faunal zones suggests that the provincial fauna does not consist of definite associations, but rather recognition of faunal zones results from similarities in range ends of species which otherwise show diverse distribution patterns.

Table 4 summarizes numbers of species in each of Strickland's faunal zones. Zone 15 contains 81% of the provincial species, with other zones of high diversity being 14 (72%) and 17 (66%), representing major transition areas. Zones 14 and 15 are transitional between the boreal, cordilleran and prairie faunas so that the total species list is enriched by elements of each of these faunal assemblages. Zone 17 is more complex, containing primarily a cordilleran fauna with prairie elements as well as a number of marginal western elements. According to Figure 8 of Kaiser et al. (1972), the area roughly corresponding to zones 14 and 15 (with the western portions of 7 and 8 included) also includes the most diverse mammalian and avian faunas of any portion of Canada. These areas fit Durden's (1974) definition of zones of high extrinsic diversity.

Just as zones 14, 15 and 17 are areas of high species diversity, the entire province of Alberta is a meeting ground of several major North American faunas: transcontinental-temperate, boreal, cordilleran, and great plains.

#### CONCLUSIONS

1. Although Alberta's dytiscid fauna is of recent origin (developed since the Wisconsinan maximum), it is very rich in species.
2. This fauna is derived from a variety of sources: southern North America, Cordillera, Great Plains, eastern boreal, eastern North America, Alaska and Arctic.
3. Within Alberta, three major faunas are represented; prairie, boreal and cordilleran. Each is of composite origin and is generally defined by similarities in range ends rather than associations of species forming discrete faunal units. A number of species are common to all faunal regions.
4. The Cypress Hills fauna is derived chiefly from the surrounding prairie augmented by a number of Cordilleran elements and a very few boreal elements.
5. The Swan Hills fauna is boreal with Rocky Mountain elements.
6. The areas with the most diverse faunas are transitional. Zone 15, transitional between prairie, boreal, and cordilleran faunas, includes the highest number of species of any faunal zone in the province. Faunal diversity is related to recent extensive movements which have allowed species from a variety of geographical sources to colonize this area.



Table 4. Comparison of number of species of dytiscid beetles in Strickland's faunal zones of Alberta (Fig. 3).

Zone No.	No. of Species	% of Total Fauna
1	70	48
2	56	38
3	57	39
4	45	31
5	53	36
6	60	41
7	50	34
8	68	47
9	72	49
10	83	57
11	71	49
12	63	43
13	75	51
14	105	72
15	118	81
16	68	46
17	96	66
18	79	54
19	51	34
20	72	49

#### ACKNOWLEDGEMENTS

This study has been aided by a number of people. To all who have assisted, I express my sincerest thanks.

G. Pritchard, acting as my thesis supervisor, assisted in many ways, including reading and criticizing the manuscript. C. D. Bird, J. B. Cragg, R. Hartland-Rowe and L. V. Hills of the University of Calgary, G. E. Ball of the University of Alberta, and F. N. Young of Indiana University, read and criticized the manuscript and provided numerous suggestions.

Special thanks are due to Mr. and Mrs. J. L. Carr, Calgary, for loan of their extensive collection, the information they have supplied freely, companionship in the field, and many stimulating discussions.

My wife, Margaret, assisted in all facets of the work and provided constant encouragement throughout the study. My brother, Donald N. Larson, accompanied me in the field for one summer and his zealous approach to collecting provided many thousands of specimens.

B. Fitch, Department of Civil Engineering, was most helpful in the operation of the scanning electron microscope. E. Scheinberg provided advice and assistance in computer programming. D. Hauft assisted in the preparation of the plates. The base map used for plotting species distributions was kindly provided by J. R. Harrower, Alberta Department of Lands and Forests, Edmonton. V. Preuter typed the manuscript.

R. Gordon, United States National Museum, H. B. Leech, California Academy of Sciences, F. N. Young, Indiana University and J. Zimmerman, New Mexico State University, identified specimens or checked identifications for me. G. E. Ball, University of Alberta; J. M. Campbell

and A. Smetana, Canadian National Collection, Ottawa; and H. B. Leech, California Academy of Sciences, kindly loaned me water beetle material in their care.

I thank P. M. Hammond and R. B. Madge for the hospitality they showed me during my visit to the British Museum (Natural History).

Many people collected specimens for me or passed on specimens that they picked up incidentally in their work. The following provided many valuable records: C. D. Bird, D. Donald, D. Elliott, R. H. Gooding, R. Hartland-Rowe, H. A. Hall, P. N. Hills, P. Kuchar, T. Leischner, R. B. Madge, W. Matthey, A. Raske and D. Wales.

I gratefully acknowledge the financial assistance provided during the course of my studies at the University of Calgary by a Province of Alberta Graduate Scholarship, a National Research Council of Canada Scholarship and through National Research Council of Canada grant A-376 held by J. B. Cragg. G. Pritchard in various ways supported my research and transportation costs through National Research Council of Canada grant No. A-4902. The scanning electron microscopy was supported by the University of Calgary through the University Grants Committee grant number 9272 held by G. Pritchard.

Publication costs were met by a special grant from the University of Alberta, including funds from the office of the President, and from the Dean, Faculty of Agriculture and Forestry.

#### REFERENCES

- \*Ahrens, A. 1811. Beiträge zu einer Monographie der deutschen Rohrkäfer-Arten. Neue Schriften der Naturforschenden Gesellschaft zu Halle 1: 43-67.
- Anderson, R. D. 1962. The Dytiscidae (Coleoptera) of Utah: keys, original citation, types and Utah distribution. Great Basin Naturalist 22: 54-75.
- Anderson, R. D. 1967. Proposed faunal affinities of Utah Dytiscidae with the emphasis on the genus *Hygrotus* Stephens. Proceedings of the Utah Academy of Sciences 44: 358-365.
- Anderson, R. D. 1971. A revision of the Nearctic representatives of *Hygrotus* (Coleoptera: Dytiscidae). Annals of the Entomological Society of America 64: 503-512.
- Andrews, J. T. 1973. The Wisconsin Laurentide ice sheet: dispersal centers, problems of rates of retreat, and climatic implications. Arctic and Alpine Research 5: 185-199.
- Arnett, R. H. 1963. The beetles of the United States. Catholic University of America, Washington. 1112 pp.
- Aubé, C. 1836. Iconographie et histoire naturelle des coléoptères d'Europe. V. Paris 416 pp.
- Aubé, C. 1838. Spécies général des coléoptères de la collection de M. le comte Dejean. VI. Paris. 804 pp.
- \*Babington, C. C. 1841. Dytiscidae darwinianae; or, descriptions of the species of Dytiscidae collected by Charles Darwin, Esq., M.A., Sec. G.S. & C., in South America and Australia, during his voyage in H.M.S. Beagle. Transactions of the Entomological Society of London 3: 1-17.
- Balduff, W. V. 1935. The bionomics of entomophagous Coleoptera. John S. Swift, New York. 220 pp.
- Balfour-Browne, F. 1934a. The proventriculus in the Dytiscidae (Col.) as a taxonomic character. Stylops 3: 241-244.
- Balfour-Browne, F. 1934b. Systematic notes upon British Coleoptera. Part III. Entomologists' Monthly Magazine. London 70: 175-180.
- Balfour-Browne, F. 1935. The proventriculus in the Dytiscidae (Col.) as a taxonomic character. Second note. Stylops 4: 191.

\* References not seen.

- Balfour-Browne, F. 1940. British water beetles. Volume I. Ray Society, no. 127. London. 375 pp.
- Balfour-Browne, F. 1950. British water beetles. Volume II. Ray Society, no. 134. London. 394 pp.
- Balfour-Browne, J. 1943. A new generic name in the Dytiscidae (Coleoptera). Proceedings of the Royal Entomological Society of London (B) 12: 172.
- Balfour-Browne, J. 1944. New names and new synonymies in the Dytiscidae (Col.). Annals and Magazine of Natural History 78: 346-359.
- Balfour-Browne, J. 1948. The aquatic Coleoptera of Newfoundland and Nova Scotia. Canadian Entomologist 80: 156-165.
- Ball, G. E. 1963. The distribution of the species of the subgenus *Cryobius* (Coleoptera, Carabidae, *Pterostichus*): with special reference to the Bering Land Bridge and Pleistocene refugia. pp. 133-151. In Gressitt, J. L. (Editor), Pacific Basin biogeography. Tenth Pacific Science Congress. Bishop Museum Press. Honolulu.
- Bertrand, H. 1918. Les larves et nymphes des Dytiscides, Hygrobiides et Haliplides. Encyclopedie Entomologique 10: 1-366.
- Bird, C. D. 1962. Bryophytes of the Cypress Hills Provincial Parks, Alberta and Saskatchewan. Canadian Journal of Botany 40: 573-587.
- Bird, C. D. and Won Shic Hong. 1969. Hepaticae of southwestern Alberta. Canadian Journal of Botany 47: 1727-1746.
- Bird, R. D. 1961. Ecology of the aspen parkland of western Canada in relation to land use. Canada Department of Agriculture, Publication 1066.
- Blackwelder, R. E. 1939. Fourth Supplement 1933 to 1938 (inclusive) to the Leng Catalogue of Coleoptera of America, north of Mexico. J. D. Sherman, Jr., Mount Vernon, New York. 146 pp.
- Blackwelder, R. E. 1948. Fifth Supplement 1939 to 1947 to the Leng Catalogue of Coleoptera of America, north of Mexico. J. D. Sherman, Jr., Mount Vernon, New York. 87 pp.
- Blatchley, W. S. 1910. The Coleoptera or beetles of Indiana. Bulletin of the Indiana Department of Geology and Natural Resources, no. 1. 1385 pp.
- Boisduval, J. B. A. and J. T. Lacordaire. 1835. Faune entomologique des environs de Paris: Ou espèces général des insectes qui se trouvent dans un rayon de quinze a vingt lieues aux alentours de Paris. Volume I. Paris. 696 pp.
- Böving, A. G. 1913. Studies relating to the anatomy, the biological adaptations and the mechanism of ovipositor in the various genera of Dytiscidae. Internationale Revue der Gesamten Hydrobiologie und Hydrographie. Biologische Supplemente 5: 1-29.
- Brown, W. J. 1930a. New species of Coleoptera I. Canadian Entomologist 62: 87-92.
- Brown, W. J. 1930b. Coleoptera of the north shore of the Gulf of the St. Lawrence. Canadian Entomologist 62: 231-237.
- Brown, W. J. 1931. New species of Coleoptera II. Canadian Entomologist 63: 115-122.
- Brown, W. J. 1932a. New species of Coleoptera III. Canadian Entomologist 64: 3-12.
- Brown, W. J. 1932b. Additional notes on the Coleoptera of the north shore of the Gulf of the St. Lawrence. Canadian Entomologist 64: 198-209.
- Brown, W. J. 1933. New species of Coleoptera IV. Canadian Entomologist 65: 43-46.
- Brown, W. J. 1937. The Coleoptera of Canada's eastern arctic. Canadian Entomologist 69: 106-111.
- Bryson, R. A. and Wendland, W. M. 1967. Tentative climatic patterns for some late-glacial episodes in Central North America, pp. 271-297. In Mayer-Oakes, W. J. (Editor), Life, land and water. University of Manitoba Press, Winnipeg.
- Cairns, J. Jr. and Kaesler, R. L. 1969. Cluster analysis of Potomac River survey stations based

- on protozoan presence-absence data. *Hydrobiologia* 34: 414-432.
- Cairns, J. Jr., Kaesler, R. L. and Patrick, R. 1970. Occurrence and distribution of diatoms and other algae in the upper Potomac River. *Notulae Naturae* 436: 1-12.
- Carr, F. S. 1920. An annotated list of the Coleoptera of northern Alberta. Alberta Natural History Society, Red Deer. 8 pp.
- Carr, F. S. 1930. New Canadian Coleoptera – I. *Canadian Entomologist* 62: 278-279.
- Carr, J. L. and Leech, H. B. 1966. The rediscovery of *Agabus audeni* Wallis, and a note on *Agabus coxalis* Sharp (Coleoptera: Dytiscidae). *Canadian Entomologist* 98: 544-550.
- Chandler, H. P. 1941. New species of Coleoptera from Utah. *Great Basin Naturalist* 2: 99-104.
- \*Clairville, J. P. 1806. *Entomologie helvétique*. Volume 2. Zürich. 247 pp.
- Crotch, G. R. 1873. Revision of the Dytiscidae of the United States. *Transactions of the American Entomological Society* 4: 383-424.
- Crotch, G. R. 1874. Descriptions of new species of Coleoptera from the Pacific Coast of the United States. *Transactions of the American Entomological Society* 5: 73-80.
- \*Curtis, J. 1835a. *British Entomology; being illustrations and descriptions of the genera of insects found in Great Britain and Ireland*. Volume 12. London. pls. 530-577.
- \*Curtis, J. 1835b. Appendix, Natural history section, p. LX. *In* Ross, J., *Narrative of a second voyage in search of a North-West Passage, etc.*
- Dadswell, M. J. 1974. Distribution, ecology and post glacial dispersal of certain crustaceans and fishes in eastern North America. National Museums of Canada, Publications in Zoology, No. 11. 110 pp.
- Darlington, P. J. 1957. *Zoogeography: The geographical distribution of animals*. John Wiley and Sons, New York. 675 pp.
- \*Degeer, C. 1774. *Mémoires pour servir à l'histoire des insectes*, 7. Stockholm. 950 pp.
- Dejean, P. F. M. A. 1833. *Catalogue des coléoptères de la collection de M. le comte Dejean*. Livre 1 and 2. Paris. 176 pp.
- Durden, C. J. 1974. Biomerization: an ecologic theory of provincial differentiation. Society Economic Paleontologists and Mineralogists, Special Publication No. 21. pp. 18-53.
- Erichson, W. F. 1837. *Die käfer der Mark Brandenburg*. Berlin. 740 pp.
- Erichson, W. F. 1840. *Genera Dyticeorum*. Berlin. 48 pp.
- Erwin, T. L. 1970. A reclassification of bombardier beetles and a taxonomic revision of the North and Middle American species (Coleoptera: Brachinida). *Quaestiones entomologicae* 6: 4-215.
- \*Fabricius, J. C. 1775. *Systema entomologiae*. Lipsiae. 832 pp.
- \*Fabricius, J. C. 1777. *Genera insectorum*. Chilonii. 310 pp.
- \*Fabricius, J. C. 1781. *Species insectorum*, Volume 1. Kilonii. 522 pp.
- Fall, H. C. 1917. New Dytiscidae. *Journal of the New York Entomological Society* 25: 163-182.
- Fall, H. C. 1919. *The North American species of Coelambus*. Mount Vernon, New York. 20 pp.
- Fall, H. C. 1922. A review of the North American species of *Agabus*. Mount Vernon, New York. 36 pp.
- Fall, H. C. 1923. A revision of the North American species of *Hydroporus* and *Agaporus*. Privately printed. 129 pp.
- Fall, H. C. 1926. A list of the Coleoptera taken in Alaska and adjacent parts of the Yukon Territory in the summer of 1924. *Pan-Pacific Entomologist* 2: 127-154.
- Fall, H. C. 1927a. New Coleoptera XII. *Canadian Entomologist* 59: 136-141.
- Fall, H. C. 1927b. The North American species of *Ilybius* (Coleoptera, Dytiscidae). *Entomological News* 38: 281-285.

- Fall, H. C. 1932. Random notes and descriptions (Coleoptera). Bulletin of the Brooklyn Entomological Society 27: 145-150.
- Fall, H. C. 1934. A new name and other miscellaneous notes (Coleoptera). Pan-Pacific Entomologist 10: 171-174.
- Flint, R. F. 1957. Glacial geology and the Pleistocene epoch. John Wiley and Sons, New York. 589 pp.
- Freitag, R. 1965. A revision of the North American species of the *Cicindela maritima* group with a study of hybridization between *Cicindela duodecimguttata* and *oregona*. Quaestiones entomologicae 1: 87-170.
- Galewski, K. 1964a. The hibernation of the adults of the European species of Dytiscidae (Coleoptera) out of water. Polskie Pismo Entomologiczne 34: 25-40.
- Galewski, K. 1964b. Immature stages of the central European species of *Colymbetes* Clairville (Coleoptera, Dytiscidae). Annales Zoologici. Warszawa 22: 23-55.
- Galewski, K. 1971. A study on morphobiotic adaptations of European species of the Dytiscidae (Coleoptera). Polskie Pismo Entomologiczne 41: 488-702.
- \*Gebler, F. A. von. 1832. Notice sur les Coléoptères qui se trouvent dans le district des mines de Nertschinsk, dans la Sibérie orientale. Mémoires de la Société des Naturalistes de Moscou. 8, 1832 (Mém. nouv. 2). p. 23-78; 1841, p. 544.
- Gellerman, H. 1928. A new species of *Hydroporus* from Washington. Pan-Pacific Entomologist 5: 63-65.
- Gemminger, M. and von Harold, E. 1868. Catalogus coleopterorum hucusque synonymicus et systematicus, Volume 2. Monachii. pp. 425-752.
- Gordon, R. D. and Post, R. L. 1965. North Dakota water beetles. North Dakota Insects — Publication No. 5. Department of Entomology, North Dakota State University. 53 pp.
- Des Gozis, M. 1911. Tableaux de détermination des dytiscides, notérides, hyphyrides, hygrobiiides et haliplides de la faune Franco-rhénane. Miscellanea Entomologica 19: 1-48.
- Des Gozis, M. 1912. Tableaux de détermination des dytiscides, notérides, hyphyrides, hygrobiiides et haliplides de la faune Franco-rhénane. Miscellanea Entomologica 20: 49-80.
- Des Gozis, M. 1913. Tableaux de détermination des dytiscides, notérides, hyphyrides, hygrobiiides et haliplides de la faune Franco-rhénane. Miscellanea Entomologica 21: 81-96.
- Des Gozis, M. 1914. Tableaux de détermination des dytiscides, notérides, hyphyrides, hygrobiiides et haliplides de la faune Franco-rhénane. Miscellanea Entomologica 21: 97-112.
- Guignot, F. 1931. Sur la systematique des *Agabus*. Bulletin de la Societe Entomologique de France 36: 201-203.
- Guignot, F. 1933. Les Hydrocanthares de France. Toulouse. 1033 pp.
- Guignot, F. 1936. Contributions à la systematique des *Agabus* (Col., Dytiscidae). Bulletin de la Societe Entomologique de France 41: 186-191.
- Guignot, F. 1939. Contribution à l'étude des *Bidessus*. Bull. Soc. Etude Sci. nat. Vaucluse 10: 51-61.
- Guignot, F. 1946. Genotypes des Dytiscoidea et des Gyrinoidea. Revue Française d'Entomologie 13: 112-118.
- Gyllenhal, L. 1808. Insecta Suecica descripta, Classis I, Coleoptera sive Eleutherata, volume 1, part 1. Scaris. 660 pp.
- Gyllenhal, L. 1827. Insecta Suecica descripta, Classis I, Coleoptera sive Eleutherata, volume 1, part 4. Lipsiae. 761 pp.
- Hansen, H. P. 1949. Postglacial forests in south central Alberta, Canada. American Journal of Botany 36: 54-65.
- Hardy, W. G. (Editor). 1967. Alberta — a natural history. M. G. Hurtig, Edmonton. 343 pp.
- Harris, T. W. 1828a. Contributions to Entomology No. V. New England Farmer 7: 156.

- Harris, T. W. 1828b. Contributions to entomology. No. VI. New England Farmer 7: 164.
- Harris, T. W. 1829. Corrections and additions for the "contributions to entomology". New England Farmer 8: 1-2.
- Hatch, M. H. 1928. Studies on Dytiscidae. Bulletin of the Brooklyn Entomological Society 23: 217-229.
- Hatch, M. H. 1933a. Studies on *Hydroporus*. Bulletin of the Brooklyn Entomological Society 28: 21-27.
- Hatch, M. H. 1933b. Records of Coleoptera from Montana. Canadian Entomologist 65: 5-15.
- Hatch, M. H. 1938. Report on the Coleoptera collected by Dr. Victor B. Scheffer on the Aleutian Islands in 1937. Pan-Pacific Entomologist 14: 145-149.
- Hatch, M. H. 1939. The *cordatus*-group of *Agabus* (Coleop: Dytiscidae). Entomological News 50: 104-106.
- Hatch, M. H. 1944. Two new adaphagid water beetles from the Pacific Northwest. Bulletin of the Brooklyn Entomological Society 34: 45-47.
- Hatch, M. H. 1951. Studies on the Coleoptera of the Pacific Northwest, 4: Carabidae, Dytiscidae, Gyrinidae. Bulletin of the Brooklyn Entomological Society 46: 113-122.
- Hatch, M. H. 1953. The beetles of the Pacific Northwest. Part 1: Introduction and Adephaga. University of Washington Publications in Biology 16. 340 pp.
- Hilsenhoff, W. L. 1975. Notes on Nearctic *Acilius* (Dytiscidae), with the description of a new species. Annals of the Entomological Society of America, 68: 271-274.
- \*Hope, F. W. 1838. The coleopterist's manual, part the second, containing the predaceous land and water beetles of Linnaeus and Fabricius. London. 168 pp.
- Horn, G. H. 1871. Descriptions of new Coleoptera of the United States, with notes on known species. Transactions of the American Entomological Society 3: 325-344.
- Horn, G. H. 1883. Miscellaneous notes and short studies on North American Coleoptera. Transactions of the American Entomological Society 10: 269-312.
- Hultén, E. 1937. Outline of the history of arctic and boreal biota during the Quaternary period. Stockholm. 168 pp.
- Jackson, D. L. 1952. Observations on the capacity for flight of water beetles. Proceedings of the Royal Entomological Society of London (A) 27: 57-70.
- Jackson, D. L. 1956. Dimorphism of the metasternal wings in *Agabus raffrayi* Sharp and *A. labiatus* Brahm (Col., Dytiscidae) and its relation to capacity for flight. Proceedings of the Royal Entomological Society of London (A) 31: 1-11.
- Jackson, D. L. 1958. Egg-laying and egg-hatching in *Agabus bipustulatus* L., with notes on oviposition in other species of *Agabus* (Coleoptera: Dytiscidae). Transactions of the Royal Entomological Society of London 110: 53-80.
- Jackson, D. L. 1960. Observations on egg-laying in *Ilybius fuliginosus* Fabricius and *I. ater* Degeer (Coleoptera: Dytiscidae) with an account of the female genitalia. Transactions of the Royal Entomological Society of London 112: 37-52.
- \*Jakowlew, A. 1897. Dytiscidorum Novorum Diagnoses. L'Abeille, 29: 37-41.
- James, H. G. 1961. Some predators of *Aedes stimulans* (Walk.) and *Aedes trichurus* (Dyar) (Diptera: Culicidae) in woodland pools. Canadian Journal of Zoology 39: 533-540.
- James, H. G. 1966. Insect predators of univoltine mosquitoes in woodland pools of the Pre-Cambrian Shield in Ontario. Canadian Entomologist 98: 550-555.
- James, H. G. 1970. Immature stages of five diving beetles (Coleoptera: Dytiscidae), notes on their habits and life history, and a key to aquatic beetles of vernal woodland pools in southern Ontario. Proceedings of the Entomological Society of Ontario 100: 52-97.
- James, H. G. and Redner, R. L. 1965. An aquatic trap for sampling mosquito predators. Mosquito News 25: 35-37.

- Johnson, G. H. and Jakinovich, W. 1970. Feeding behavior of the predaceous diving beetle *Cybister fimbriolatus* Say. *Bioscience* 20: 1111.
- Kaiser, G. W., Lefkovitch, L. P. and Howden, H. F. 1972. Faunal provinces in Canada as exemplified by mammals and birds: a mathematical consideration. *Canadian Journal of Zoology* 50: 1087-1104.
- Kincaid, T. 1900. The metamorphoses of some Alaska Coleoptera. *Proceedings of the Washington Academy of Sciences* 2: 367-388.
- Kirby, W. 1837. The Insects. *In* Richardson, J., *Fauna Boreali-Americana*, Part 4. London. 249 pp.
- Kroetsch, R. 1968. Alberta. Macmillan of Canada. 231 pp.
- LaRivers, I. 1951. Nevada Dytiscidae (Coleoptera). *American Midland Naturalist* 45: 392-406.
- Larson, D. J. and Pritchard, G. 1974. Organs of possible stridulatory function in water beetles (Coleoptera; Dytiscidae). *Coleopterists' Bulletin* 28: 53-63.
- Leach, W. E. 1817. The Zoological Miscellany; being descriptions of new or interesting animals. Volume 3. London. 151 pp.
- LeConte, J. L. 1845a. Descriptions of some new and interesting insects inhabiting the United States. *Boston Journal of Natural History* 5: 203-209.
- LeConte, J. L. 1845b. Descriptions of some new species of coleopterous insects inhabiting the United States. *Proceedings of the Boston Society of Natural History* 1: 201.
- LeConte, J. L. 1850. General remarks upon Coleoptera of Lake Superior, *In* Agassiz, L., *Lake Superior: Its physical character, vegetation and animals*. Boston. pp. 209-241.
- LeConte, J. L. 1852. Descriptions of new species of Coleoptera from California. *Annals of the Lyceum of Natural History of New York* 5: 125-216.
- LeConte, J. L. 1853. Descriptions of twenty new species of Coleoptera inhabiting the United States. *Proceedings of the Academy of Natural Sciences of Philadelphia* 6: 226-235.
- LeConte, J. L. 1855. Analytical table of the species of *Hydroporus* found in the United States, with descriptions of new species. *Proceedings of the Academy of Natural Sciences of Philadelphia* 7: 290-299.
- LeConte, J. L. 1857. Report on insects collected on the survey, *In* Reports of exploration and surveys for a railroad from the Mississippi River to the Pacific Ocean. Washington. 72 pp.
- LeConte, J. L. 1858. Catalogue of Coleoptera of the regions adjacent to the boundary line between the United States and Mexico. *Journal of the Academy of Natural Sciences of Philadelphia* 4: 9-42.
- LeConte, J. L. 1859a. The Coleoptera of Kansas and eastern New Mexico. *Smithsonian Contributions to Knowledge* 11: 1-66.
- LeConte, J. L. 1859b. The complete writings of Thomas Say on the entomology of North America. 2 vols. New York.
- LeConte, J. L. 1861. New species of Coleoptera inhabiting the Pacific district of the United States. *Proceedings of the Academy of Natural Sciences of Philadelphia* 13: 338-359.
- LeConte, J. L. 1862. Synopsis of the species of *Colymbetes* inhabiting America north of Mexico. *Proceedings of the Academy of Natural Sciences of Philadelphia* 14: 521-523.
- LeConte, J. L. 1863a. List of the Coleoptera of North America. *Smithsonian Miscellaneous Collections*. no. 140. 49 pp.
- LeConte, J. L. 1863b. New species of North American Coleoptera. *Smithsonian Miscellaneous Collections*. no. 167. 86 pp.
- LeConte, J. L. 1866. Additions to the coleopterous fauna of the United States. No. 1. *Proceedings of the Academy of Natural Sciences of Philadelphia* 18: 361-394.
- LeConte, J. L. 1869. List of Coleoptera collected in Vancouver's Island by Henry and Joseph

- Matthews, with descriptions of some new species. *The Annals and Magazine of Natural History* 4: 368-385.
- LeConte, J. L. 1878a. Descriptions of new species. *In* Hubbard and Schwarz, *The Coleoptera of Michigan*. *Proceedings of the American Philosophical Society* 17: 593-626.
- LeConte, J. L. 1878b. *The Coleoptera of the alpine regions of the Rocky Mountains*. *Bulletin of the United States Geological Survey* 4: 447-480.
- Leech, H. B. 1937. A new North American *Agabus*, with notes on other species (Coleoptera: Dytiscidae). *Canadian Entomologist* 69: 146-150.
- Leech, H. B. 1938a. Descriptions of three new species of *Agabus* from Hudson Bay. (Coleoptera: Dytiscidae). *Canadian Entomologist* 70: 123-127.
- Leech, H. B. 1938b. A study of the Pacific Coast species of *Agabus* Leach, with a key to the Nearctic species. Unpublished master's thesis, Berkeley, California, Berkeley Library.
- Leech, H. B. 1939. On some Nearctic species of *Agabus*, with the description of a new species. (Coleoptera: Dytiscidae). *Canadian Entomologist* 71: 217-221.
- Leech, H. B. 1940. Description of a new species of *Laccornis*, with a key to the Nearctic species. (Coleoptera: Dytiscidae). *Canadian Entomologist* 72: 122-128.
- Leech, H. B. 1941a. Descriptions of two new species of water beetles of the genus *Hydroporus* from California (Coleoptera: Dytiscidae). *Pan-Pacific Entomologist* 17: 129-132.
- Leech, H. B. 1941b. The dates of the publication of two articles on Coleoptera by John L. LeConte, issued in 1845. *Entomological News* 52: 290-291.
- Leech, H. B. 1942a. Dimorphism in the flying wings of a species of water beetle, *Agabus bifarius* (Kirby) (Coleoptera: Dytiscidae). *Annals of the Entomological Society of America* 35: 76-80.
- Leech, H. B. 1942b. Key to the Nearctic genera of water beetles of the tribe Agabini, with some generic synonymy (Coleoptera: Dytiscidae). *Annals of the Entomological Society of America* 35: 355-362.
- Leech, H. B. 1942c. New or insufficiently known Nearctic species and subspecies of *Agabus* (Coleoptera, Dytiscidae). *Canadian Entomologist* 74: 125-136.
- Leech, H. B. 1945a. The specific characters and distribution of *Agabus vancouverensis* and *A. hypomelas* (Coleoptera, Dytiscidae). *Canadian Entomologist* 77: 77-78.
- Leech, H. B. 1945b. Three new species of Nearctic *Deronectes* (Coleoptera, Dytiscidae). *Canadian Entomologist* 77: 105-110.
- Leech, H. B. 1948a. Some Nearctic species of Hydradephagid water beetles, new and old (Coleoptera). *Canadian Entomologist* 80: 89-96.
- Leech, H. B. 1948b. Contributions toward a knowledge of the insect fauna of lower California, No. 11. Coleoptera: Haliplidae, Dytiscidae, Gyrinidae, Hydrophilidae, Limnebiidae. *Proceedings of the California Academy of Sciences* 25: 348-420.
- Leech, H. B. 1949a. New species and subspecies of Nearctic water beetles (Coleoptera: Dytiscidae and Hydrophilidae). *Wasmann Club Collector* 7: 243-256.
- Leech, H. B. 1949b. Addendum to an article "Some Nearctic species of Hydradephagid water beetles, new and old (Coleoptera)". *Canadian Entomologist* 81: 233.
- Leech, H. B. 1964. A new species of *Agabus* from the Death Valley region of California (Coleoptera: Dytiscidae). *Coleopterists' Bulletin* 18: 79-82.
- Leech, H. B. and Chandler, H. P. 1956. Aquatic Coleoptera, pp. 293-371, *In* Usinger, R. L., *Aquatic insects of California*. University of California Press, Berkeley.
- Leng, C. W. 1920. *Catalogue of the Coleoptera of America north of Mexico*. J. D. Sherman, Mount Vernon, N. Y. 470 pp.
- Leng, C. W. and Mutchler, A. J. 1918. Water beetles of Florida. *Bulletin of the American Museum of Natural History* 38: 73-116.



- Leng, C. W. and Mutchler, A. J. 1927. Supplement to catalogue of the Coleoptera of America north of Mexico. J. D. Sherman, Mount Vernon, N. Y. 78 pp.
- Leng, C. W. and Mutchler, A. J. 1933. Second and third supplements 1925 and 1932 (inclusive) to catalogue of the Coleoptera of America, north of Mexico. J. D. Sherman, Mount Vernon, N. Y. 112 pp.
- Lichti-Federovich, S. 1970. The pollen stratigraphy of a dated section of Late Pleistocene lake sediment from Central Alberta. Canadian Journal of Earth Sciences 7: 938-945.
- Lindroth, C. H. 1965. Skaftafell, Iceland, a living glacial refugium. Oikos, Supplement 6: 1-142.
- Lindroth, C. H. 1969. The ground-beetles of Canada and Alaska. Part 1. Opuscles Entomologiques, Supplement 35. xlvii pp.
- \*Linnaeus, C. 1758. Systema naturae per regna tria naturae secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. ed. 10. Vol. 1. Holmiae. 823 pp.
- Löve, D. 1959. The postglacial development of the flora of Manitoba: a discussion. Canadian Journal of Botany 37: 547-585.
- MacCrimmon, H. R. 1971. World distribution of rainbow trout (*Salmo gairdneri*). Journal of the Fisheries Research Board of Canada 28: 663-704.
- Mackay, R. J. 1969. Aquatic insect communities of a small stream on Mont St. Hilaire, Quebec. Journal of the Fisheries Research Board of Canada 26: 1157-1183.
- Malcolm, S. E. 1971. The water beetles of Maine: including the families Gyrinidae, Haliplidae, Dytiscidae, Noteridae and Hydrophilidae. Technical Bulletin 48. Life Sciences and Agriculture Experiment Station, University of Maine or Orono. 49 pp.
- Mannerheim, C. G. 1843. Beitrag zur Kaefer-fauna des Aleutischen Inseln, der Insel Sitka, und Neu-Californiens. Bulletin de la Société Impériale des Naturalistes de Moscou 16: 175-314.
- Mannerheim, C. G. 1852. Zweiter Nachtrag zur Kaefer-fauna der Nord-Amerikanischen Laender des Russischen Reiches. Bulletin de la Société Impériale des Naturalistes de Moscou 25: 283-387.
- Mannerheim, C. G. 1853. Dritter Nachtrag zur Kaefer-fauna der Nord-Amerikanischen Laender des Russischen Reiches. Bulletin de la Société Impériale des Naturalistes de Moscou 26: 95-273.
- Marshall, T. 1802. Entomologia Britannica, sistens insecta Britanniae indigena, secundum methodum Linnaeanum disposita. London. 548 pp.
- Martin, P. S. 1958. Pleistocene ecology and biogeography of North America, pp. 375-420 In Hubbs, C. L. (Editor), Zoogeography. American Association for the Advancement of Science Symposium, Publication no. 50. Washington. 509 pp.
- Matheson, R. 1914. Life-history of a dytiscid beetle (*Hydroporus septentrionalis* Gyll.). Canadian Entomologist 46: 37-40.
- Mayr, E. 1963. Animal species and evolution. Harvard University Press, Cambridge. 797 pp.
- Mayr, E. 1969. Principles of systematic zoology. McGraw-Hill, New York. 328 pp.
- McPhail, J. D. and Lindsey, C. C. 1970. Freshwater fishes of northwestern Canada and Alaska. Bulletin of the Fisheries Research Board of Canada 173. 381 pp.
- Melsheimer, F. E. 1844. Descriptions of new species of Coleoptera of the United States. Proceedings of the Academy of Natural Sciences of Philadelphia 2: 26-47.
- Melsheimer, F. E. 1853. Catalogue of the described Coleoptera of the United States. Smithsonian Institution, Washington, 174 pp.
- Moss, E. H. 1947. The fescue grassland of Alberta. Canadian Journal of Research 25: 209-227.
- Moss, E. H. 1952. Grassland of the Peace River region, western Canada. Canadian Journal of Botany 30: 98-124.
- Moss, E. H. 1953. Marsh and bog vegetation in northwestern Alberta. Canadian Journal of Botany 31: 448-470.

- Moss, E. H. 1955. The vegetation of Alberta. *Botanical Review* 21: 493-567.
- Moss, E. H. and Pegg, G. 1962. Noteworthy plant species and communities in westcentral Alberta. *Canadian Journal of Botany* 41: 1079-1105.
- Motschulsky, V. 1859. Coléoptères nouveaux de la Californie. *Bulletin de la Société Impériale des Naturalistes de Moscou* 2: 122-185.
- Motschulsky, V. 1860. Coléoptères de la Sibirie Orientale et en Particulier des Rives de l'Amour, pp. 77-257 *In* Schrencks, L. V., *Reisen und Forschungen im Amur-Lande. Band 2. Zweit. Lieferung Coleoperen.* St. Petersburg.
- Needham, J. C. and Williamson, H. V. 1907. Observations on the natural history of diving beetles. *American Naturalist* 477-494.
- Nimmo, A. P. 1971. The adult Rhyacophilidae and Limnephilidae (Trichoptera) of Alberta and eastern British Columbia and their post-glacial origin. *Quaestiones entomologicae* 7: 3-234.
- Ogilvie, R. T. 1962. Notes on plant distribution in the Rocky Mountains of Alberta. *Canadian Journal of Botany* 40: 1091-1094.
- Oliver, D. R. 1963. Entomological studies in the Lake Hazen area, Ellesmere Island, including lists of species of Arachnida, Collembola and Insecta. *Arctic* 16: 175-180.
- Paetz, M. J. and Nelson, J. S. 1970. *The fishes of Alberta.* The Queen's Printer, Edmonton. 282 pp.
- \*Panzer, G. W. F. 1794. *Faunae insectorum germanicae initia oder Deutschlands Insecten.* Heft 13-24.
- Paykull, G. 1798. *Fauna Suecica: Insecta, Vol. 1. Upsaliae.* 358 pp.
- Popham, E. J. 1952. Observations on the behavior of aquatic insects during the drying up of a small moorland pond. *Entomologist's Monthly Magazine* 88: 180-181.
- \*Poppius, B. 1910. Die Coleopteren des arktischen Gebietes, pp. 289-447 *In* *Fauna Arctica.* Bd. 5, Lfg. 1. Jena.
- Prest, V. K. 1968. Quaternary geology of Canada, pp. 676-764 *In* Douglas, R. J. W. (Editor), *Geology and economic minerals of Canada.* Geological Survey of Canada, economic geology report no. 1. Queen's Printer, Ottawa. 838 pp.
- Prest, V. K. 1969. Retreat of Wisconsin and Recent ice in North America. Map number 1257a, Geological Survey of Canada. Department of Energy, Mines and Resources. Queen's Printer, Ottawa.
- Pritchard, G. and Hall, H. A. 1971. An introduction to the biology of craneflies in a series of abandoned beaver ponds, with an account of the life cycle of *Tipula sacra* Alexander (Diptera: Tipulidae). *Canadian Journal of Zoology* 49: 467-482.
- Raup, H. M. 1934. Phytogeographic studies in the Peace and Upper Liard River regions, Canada. *Contributions of the Arnold Arboretum* 6: 1-230.
- Rawson, D. S. and Moore, J. E. 1944. The saline lakes of Saskatchewan. *Canadian Journal of Research* 22: 141-201.
- Reeves, B. O. K. 1973. The nature and age of the contact between the Laurentide and Cordilleran ice sheets in the western interior of North America. *Arctic and Alpine Research* 5: 1-16.
- Ritchie, J. C. 1969. Absolute pollen frequencies and carbon-14 age of a section of Holocene lake sediment from the Riding Mountain area of Manitoba. *Canadian Journal of Botany* 47: 1345-1349.
- Ritchie, J. C. and DeVries, B. 1964. Contributions to the Holocene paleoecology of west-central Canada. A late-glacial deposit from the Missouri Coteau. *Canadian Journal of Botany* 42: 677-692.
- Roback, S. S., Cairns, J. and Kaesler, R. L. 1969. Cluster analysis of occurrence and distribution of insect species in a portion of the Potomac River. *Hydrobiologia* 34: 484-502.

- Roberts, C. H. 1905. The distinctive characters of the eastern species of the genera *Dytiscus* and *Cybister*. *Journal of the New York Entomological Society* 13: 103-107.
- Ross, H. H. 1958. Affinities and origins of the northern and montane insects of western North America, pp. 231-252. *In* Hubbs, C. L. (Editor), *Zoogeography*. American Association for the Advancement of Science, Symposium, Publication no. 50. Washington, D. C. 509 pp.
- Ross, H. H. 1970. The ecological history of the Great Plains: evidence from grassland insects, pp. 225-240. *In* Dort, W., Jr. and J. K. Jones, Jr. (Editors), *Pleistocene and recent environments of the central Great Plains*. Department of Geology, University of Kansas, Special Publication 3. 433 pp.
- \*Rowe, J. S. 1956. Vegetation of the southern boreal forest in Saskatchewan and Manitoba. Ph.D. thesis, University of Manitoba. Unpublished (from Löve, 1959).
- Rowe, J. S. 1959. Forest regions of Canada. Forestry Branch, Department of Northern Affairs and National Resources, Bulletin 123: 1-71. Queen's Printer, Ottawa.
- Say, T. 1823a. Descriptions of Coleopterous insects collected in the late expedition to the Rocky Mountains performed by order of Mr. Calhoun, Secretary of War, under the command of Major Long. *Journal of the Academy of Natural Sciences of Philadelphia* 3: 139-216.
- Say, T. 1823b. Descriptions of insects of the families Carabici and Hydrocanthari of Latreille, inhabiting North America. *Transactions of the American Philosophical Society* 2: 1-109.
- Say, T. 1824. Coleoptera, pp. 268-378. *In* Narrative of an expedition to the source of St. Peter's River, performed by order of Mr. Calhoun, Secretary of War, under the command of Stephen H. Long, Major U.S.T.E. Volume 2. Philadelphia.
- Say, T. 1825. Descriptions of new species of Coleopterous Insects inhabiting the United States. *Journal of the Academy of Natural Sciences of Philadelphia* 5: 160-202.
- Say, T. 1834. Descriptions of new North American insects and observations on some already described. *Transactions of the American Philosophical Society* 4: 409-470.
- \*Schaller, J. G. 1783. Neue insekten beschrieben. *Schriften der naturforschenden Gesellschaft zu Halle* 1: 217-328.
- \*Schaum, H. R. and Kiesenwetter, E. A. H. 1868. *Naturgeschichte der Insecten Deutschlands* . . . , Abth. I, Coleoptera, Vol. 1, pt. 2 lief 1, pp. 1-144.
- Schildknecht, H. 1970. The defensive chemistry of land and water beetles. *Angewandte Chemie, International Edition in English* 9: 1-9.
- Schwarz, E. A. 1900. Coleoptera from the Harriman Alaska Expedition. *Proceedings of the Washington Academy of Sciences* 11: 523-537.
- Scudder, G. G. E. 1969. The fauna of saline lakes on the Fraser Plateau in British Columbia. *Verhandlungen internationale Vereinigung für Theoretische und angewandte Limnologie* 17: 430-439.
- \*Seidlitz, G. 1887. Bestimm.-Tab. Dytiscidae und Gyrinidae. *Verhandlungen des Naturforschenden vereines in Brünn* 25: 57-90.
- Seidlitz, G. 1891. *Fauna Baltica. Die Kaefer (Coleoptera) der Deutschen Ostseeprovinzen Russlands*. Königsberg. 818 pp.
- Sharp, D. 1882. On aquatic carnivorous Coleoptera or Dytiscidae. *Scientific Transactions of the Royal Dublin Society* 2: 1-1003.
- Sharplin, J. 1966. An annotated list of the Formicidae (Hymenoptera) of central and southern Alberta. *Quaestiones entomologicae* 2: 243-253.
- Sherman, J. D. 1913. Some habits of the Dytiscidae. *Journal of the New York Entomological Society* 21: 43-54.
- Simpson, G. G., Roe, A. and Lewontin, R. C. 1960. *Quantitative zoology*. Harcourt, Brace and Company. New York. 440 pp.
- Sisula, H. 1971. Growth rates of reared larvae of *Deronectes griseostriatus* (DeGeer) (Coleoptera,

- Dytiscidae). *Annales Zoologici Fennici* 8: 449-451.
- Smith, R. L. 1973. Aspects of the biology of three species of the genus *Rhantus* (Coleoptera: Dytiscidae) with special reference to the acoustical behavior of two. *Canadian Entomologist* 105: 909-919.
- Sokal, R. R. and Sneath, P. H. A. 1963. Principles of numerical taxonomy. Freeman, San Francisco. 359 pp.
- Stephens, J. F. 1828. Illustrations of British Entomology. Mandibulata, Volume 2. London. 200 pp.
- Strickland, E. H. 1938. An annotated list of the Diptera (flies) of Alberta. *Canadian Journal of Research* 16: 175-219.
- Strickland, E. H. 1951. *In* Bowman, K. An annotated list of the Lepidoptera of Alberta. *Canadian Journal of Zoology* 29: 121-165.
- Terasmae, J. 1973. Notes on Late Wisconsin and Early Holocene history of vegetation in Canada. *Arctic and Alpine Research* 5: 201-222.
- Thomson, C. G. 1860. Skandnaviens Coleoptera. Volume 2. Lund. 304 pp.
- \*Thomson, C. G. 1874. *Opuscula Entomologica* 6: 535-612.
- \*Thomson, C. G. 1886. Untitled article in *Bulletin de la Societe Entomologique de France* 6: ix-xi.
- \*Thunberg, C. P. 1794. *Dissertatio entomologica novae insectorum species sistens*, part 6. Upsaliae. pp. 107-130.
- Torre-Bueno, J. R. 1962. A glossary of entomology. Brooklyn Entomological Society. Brooklyn. 236 pp + suppl. A., 36 pp.
- Wallis, J. B. 1924. Two new species of *Coelambus*. *Canadian Entomologist* 56: 105-108.
- Wallis, J. B. 1926. Some new Coleoptera. *Canadian Entomologist* 58: 89-95.
- Wallis, J. B. 1933a. Three new species of *Hydroporus* belonging to the *villis* group (Coleoptera). *Canadian Entomologist* 65: 261-262.
- Wallis, J. B. 1933b. Some new Dytiscidae (Coleoptera). *Canadian Entomologist* 65: 268-278.
- Wallis, J. B. 1939a. *Hydaticus modestus* Sharp versus *Hydaticus stagnalis* Fab. in North America (Coleoptera, Dytiscidae). *Canadian Entomologist* 71: 126-127.
- Wallis, J. B. 1939b. The genus *Graphoderus* Aubé in North America (north of Mexico) (Coleoptera). *Canadian Entomologist* 71: 128-130.
- Wallis, J. B. 1939c. The genus *Ilybius* Er. in North America (Coleoptera, Dytiscidae). *Canadian Entomologist* 71: 192-199.
- Wallis, J. B. 1950. A new species of *Dytiscus* Linn. (Coleoptera, Dytiscidae). *Canadian Entomologist* 82: 50-52.
- Wallis, J. B. 1973. An annotated list of the Hydroadephaga (Coleoptera: Insecta) of Manitoba and Minnesota. *Quaestiones entomologicae* 9: 99-114.
- Watts, C. H. S. 1970. The larvae of some Dytiscidae (Coleoptera) from Delta, Manitoba. *Canadian Entomologist* 102: 716-728.
- Wesenberg-Lund, C. 1912. Biologische Studien über Dytisciden. *Internationale Revue des Gesammten Hydrobiologie und Hydrographie. Biologische Supplemente* 4: 1-129.
- \*Westwood, J. O. 1838. Synopsis of the genera of British insects. *In* An introduction to the modern classification of insects. London. 158 pp.
- Whitehead, D. R. 1972. Classification, phylogeny and zoogeography of *Schizogenius* Putzeys (Coleoptera: Carabidae: Scaritini). *Quaestiones entomologicae* 8: 131-348.
- Wickham, H. F. 1895a. The Coleoptera of Canada. VIII. The Haliplidae and Dytiscidae of Ontario and Quebec. *Canadian Entomologist* 27: 69-76.
- Wickham, H. F. 1895b. The Coleoptera of Canada. IX. The Dytiscidae (Colymbetini) of Ontario and Quebec. *Canadian Entomologist* 27: 117-122.

- Wickham, H. F. 1895c. The Coleoptera of Canada. X. The Dytiscidae (Dytiscini and Cybistrini) of Ontario and Quebec. *Canadian Entomologist* 27: 149-153.
- Williams, F. X. 1936. Biological studies in Hawaiian water-loving Insects. Part 1, Coleoptera. Part 2, Odonata. *Proceedings of the Hawaiian Entomological Society* 9: 235-349.
- Wilson, C. B. 1923. Water beetles in relation to pondfish culture, with life histories of those found in fishponds at Fairport, Iowa. *Bulletin of the United States Bureau of Fisheries, Washington* 39: 231-345.
- Wishart, D. 1968. A Fortran II program for numerical classification. Reference no. DC 332, Computer Services' Library, University of St. Andrews, Scotland. (Original reference not seen. From, Program package for 8 methods of cluster analysis (Clustan). Introduction and user's guide (CDC 6400 version). UCCS – 72 – CLUSTAN – 1. Computer Services, University of Calgary, 1972. 63 pp).
- Wright, H. E., Jr. 1970. Vegetational history of the Great Plains, pp. 157-202. *In* Dort, W., Jr., and J. K. Jones, Jr. (Editors), Pleistocene and recent environments of the central Great Plains. Department of Geology, University of Kansas, Special Publication 3. 433 pp.
- \*Xambeu, V. 1891. Moeurs et metamorphoses d'Insectes. *Annales de la Société Linnéenne de Lyon*, 39.
- Yeatman, C. W. 1967. Biogeography of jack pine. *Canadian Journal of Botany* 45: 2201-2211.
- Young, F. N. 1951. A new water beetle from Florida, with a key to the species of *Desmopachria* of the United States and Canada (Coleoptera; Dytiscidae). *Bulletin of the Brooklyn Entomological Society* 46: 107-112.
- Young, F. N. 1953a. A new species of *Bidessus* from southern Michigan (Coleoptera: Dytiscidae). *Bulletin of the Brooklyn Entomological Society* 48: 111-112.
- Young, F. N. 1953b. A new *Hydroporus* from Michigan, with notes on other members of the *Hydroporus vilis* group (Coleoptera: Dytiscidae). *Bulletin of the Brooklyn Entomological Society* 48: 116-122.
- Young, F. N. 1953c. Two new species of *Matus*, with a key to the known species and subspecies of the genus (Coleoptera: Dytiscidae). *Annals of the Entomological Society of America* 46: 49-55.
- Young, F. N. 1953d. The types of Hydradephaga in the W. S. Blatchley Collection, with generic reassignments and synonymies (Coleoptera: Noteridae, Dytiscidae, Gyrinidae, Haliplidae). *Canadian Entomologist* 85: 113-119.
- Young, F. N. 1954. The water beetles of Florida. University of Florida Press, Gainesville. ix + 238 pp.
- Young, F. N. 1956. A preliminary key to the species of *Hydrovatus* of the eastern United States (Coleoptera: Dytiscidae). *Coleopterists' Bulletin* 10: 53-54.
- Young, F. N. 1960a. Notes on the water beetles of Southamton Island in the Canadian Arctic (Coleoptera: Dytiscidae and Haliplidae). *Canadian Entomologist* 92: 275-278.
- Young, F. N. 1960b. The colors of desert water beetles – environmental effect or protective coloration? *Annals of the Entomological Society of America* 53: 422-425.
- Young, F. N. 1960c. The water beetles of a temporary pond in southern Indiana. *Proceedings of the Indiana Academy of Science* 69: 154-164.
- Young, F. N. 1963a. The Nearctic species of *Copelatus* Erichson (Coleoptera: Dytiscidae). *Quarterly Journal of the Florida Academy of Sciences* 26: 56-77.
- Young, F. N. 1963b. Two new North American species of *Hydrovatus*, with notes on other species (Coleoptera: Dytiscidae). *Psyche* 70: 184-192.
- Young, F. N. 1963c. A new species of *Laccophilus* from the Bahamas (Coleoptera: Dytiscidae). *American Museum Novitates* (2152): 1-5.
- Young, F. N. 1967. A key to the genera of American Bidessine water beetles, with descriptions

- of three new genera (Coleoptera: Dytiscidae, Hydroporinae). *Coleopterists' Bulletin* 21: 75-84.
- Young, F. N. 1969. A checklist of the American Bidessini (Coleoptera: Dytiscidae, Hydroporinae). *Smithsonian Contributions to Zoology* 33: 1-5.
- Young, F. N. and Severin, H. C. 1956. Evidence of intergradation between putative species of *Colymbetes* in South Dakota (Coleoptera: Dytiscidae). *Journal of the Kansas Entomological Society* 29: 79-83.
- Zaitsev, F. A. 1953. Fauna of the U.S.S.R. Coleoptera, Volume 4. Amphizoidae, Hygrobiidae, Haliplidae, Dytiscidae, Gyrinidae. English Translation (1972), Israel Program for Scientific Translations. Jerusalem. 401 pp.
- Zaitzev, P. 1905. Notizen über Wasserkäfer (Coleoptera aquatica). *Russkoe Entomologicheskoe Obozrenie* 5: 211-215.
- Zaitzev, P. 1907. Berichtigungen und Zusätze zu den Haliplidae, Dytiscidae und Gyrinidae in den neuesten Katalogen der Coleopteren. *Russkoe Entomologicheskoe Obozrenie* 7: 114-124.
- Zimmerman, J. R. 1970. A taxonomic revision of the aquatic beetle genus *Laccophilus* (Dytiscidae) of North America. *Memoirs of the American Entomological Society* 26: 1-275.
- Zimmerman, J. R. and Smith, R. L. A revision of *Rhantus* of North America. In press.
- Zimmermann, A. 1919. Die Schwimmkäfer des Deutschen Entomologischen Museums in Berlin-Dahlem. *Archiv für Naturgeschichte* 83: 68-249.
- Zimmermann, A. 1920. *Coleopterorum catalogus*, pars 71, Dytiscidae, Haliplidae, Hygrobiidae, Amphizoidae. Volume 4. Berlin. 326 pp.
- \*Zimmermann, A. 1921. Zoologische Ergebnisse zweier in den Jahren 1902 und 1904 durch die sinaihalbinsel unternommener botanischer Studienreisen, Dytiscidae und Gyrinidae. *Entomologische Blätter für Biologie und Systematik der Käfer* 17: 84-91.
- Zimmermann, A. 1934. Monographie der paläarktischen Dytisciden V. Colymbetinae. (1. Teil: Copelatini, Agabini: Gattung *Gaurodytes* Thoms.). *Koleopterologische Rundschau* 20: 138-214.
- Zimmermann, A. 1935. Monographie der paläarktischen Dytisciden. VI. Colymbetinae. (2. Teil. Agabini; Colymbetini: Gattung *Ilybius* Er.). *Koleopterologische Rundschau* 21: 61-92.

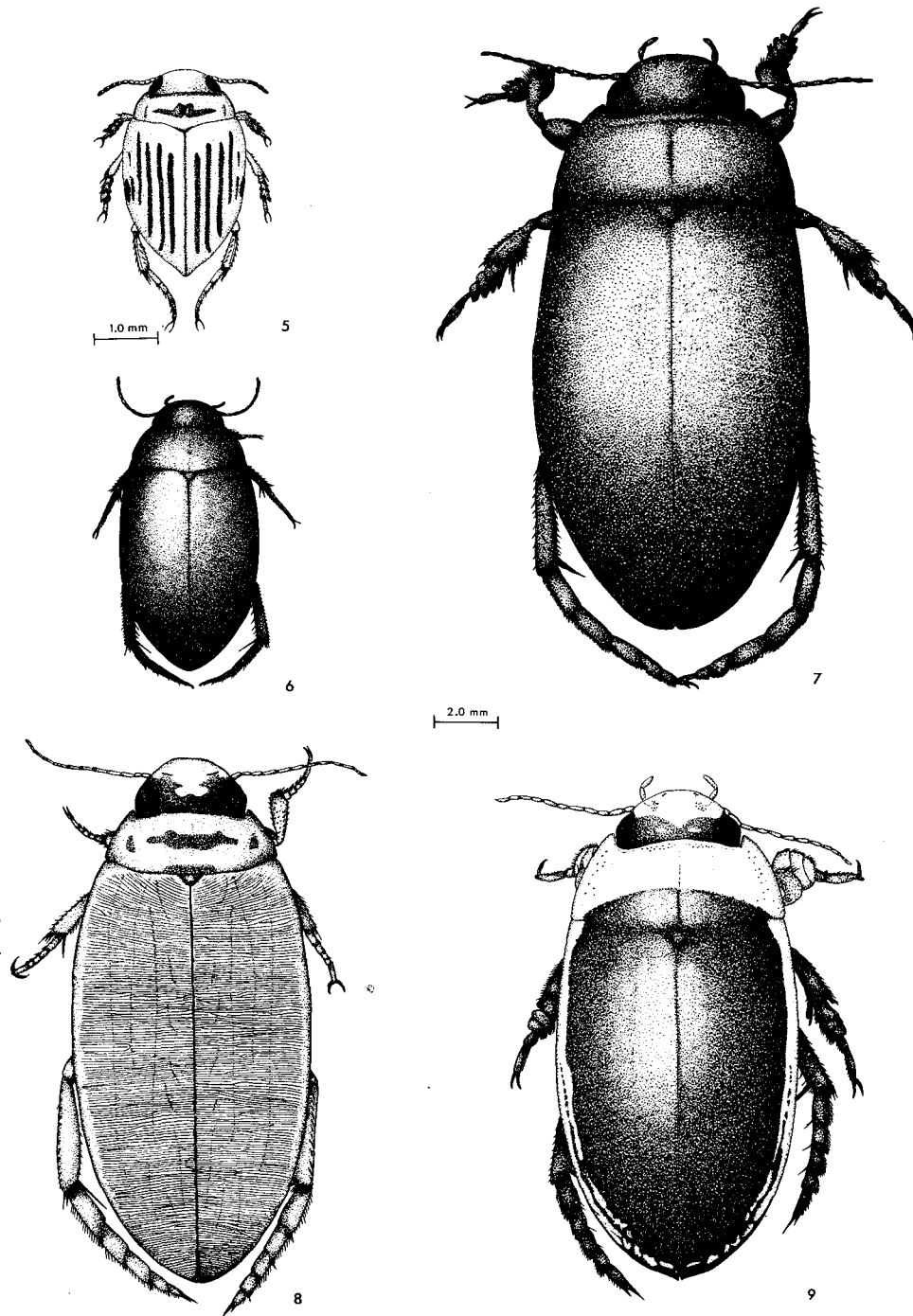


Fig. 5-9. Habitus illustration, dorsal aspect. 5. *Hydroporus rivalis*. 6. *Agabus anthracinus*. 7. *Neoscutopterus hornii*. 8. *Colymbetes sculptilis*. 9. *Hydaticus modestus*.

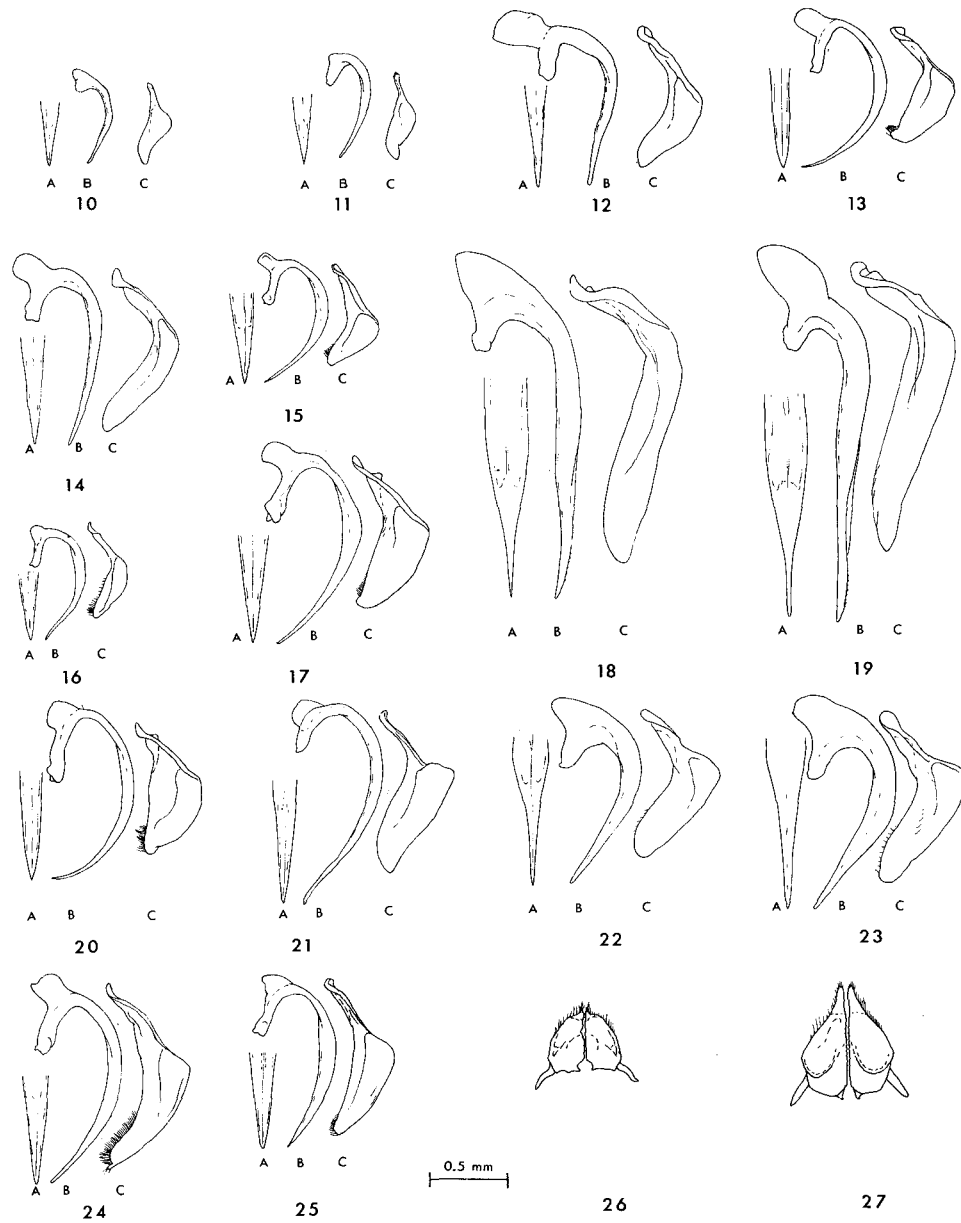


Fig. 10-25. *Hygrotus*, male genitalia: A. aedeagus, apex, ventral aspect; B. aedeagus, lateral aspect; C. paramere. 10. *H. sayi*. 11. *H. turbidus*. 12. *H. compar*. 13. *H. canadensis*. 14. *H. patruelis*. 15. *H. sellatus*. 16. *H. suturalis*. 17. *H. tumidiventris*. 18. *H. dentiger*. 19. *H. unguicularis*. 20. *H. semivittatus*. 21. *H. punctilineatus*. 22. *H. impressopunctatus*. 23. *H. picatus*. 24. *H. masculinus*. 25. *H. salinarius*. Fig. 26-27. *Hygrotus*, female ovipositor, dorsal aspect. 26. *H. impressopunctatus*. 27. *H. picatus*.



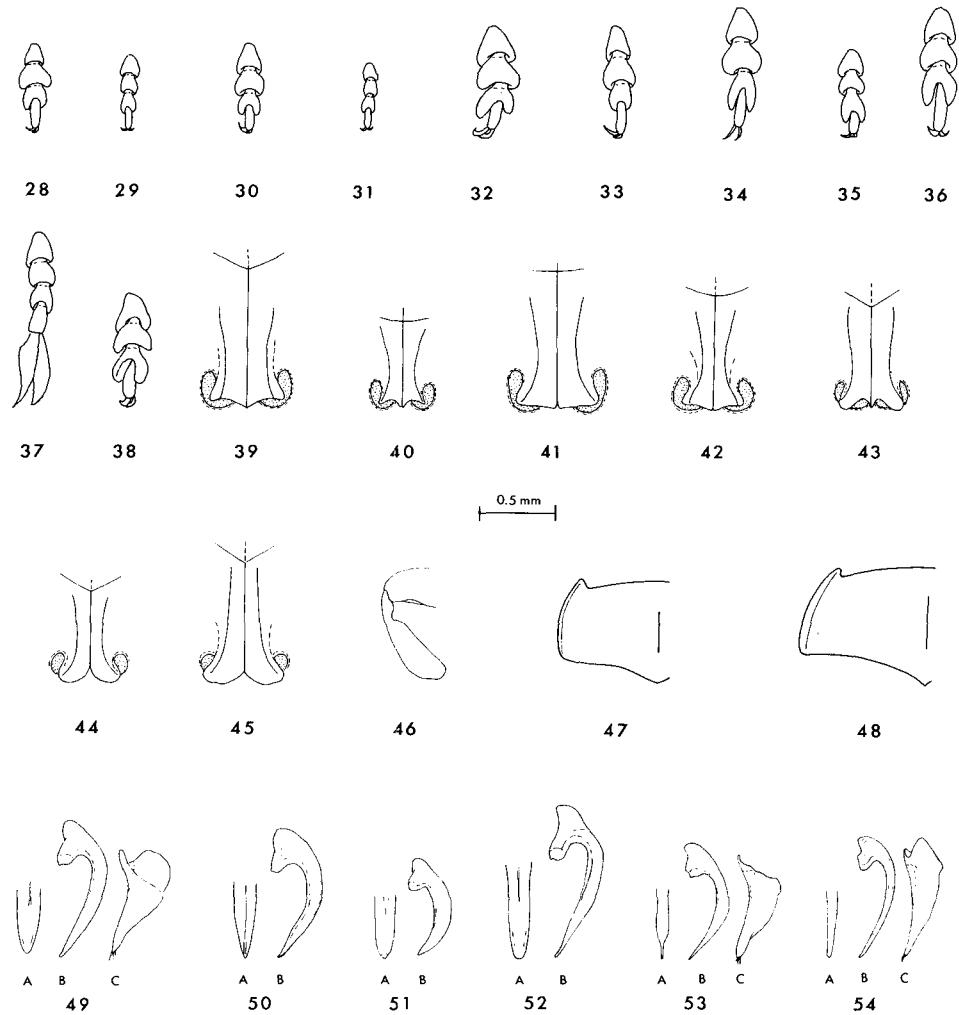


Fig. 28-38. *Hygroptus*, male protarsus, dorsal aspect. 28. *H. compar*. 29. *H. canadensis*. 30. *H. patruelis*. 31. *H. sellatus*. 32. *H. unguicularis*. 33. *H. tumidiventris*. 34. *H. semivittatus*. 35. *H. punctilineatus*. 36. *H. picatus*. 37. *H. masculinus*. 38. *H. salinaris*. Fig. 39-45. *Hydroporus*, metacoxal processes. 39. *H. superioris*. 40. *H. paugus*. 41. *H. notabilis*. 42. *H. mannerheimi*. 43. *H. quadrimaculatus*. 44. *H. griseostriatus*. 45. *H. spenceri*. Fig. 46. *Hydroporus paugus*, male protibia, anterior aspect. Fig. 47-48. *Hydroporus*, pronotum, left half, dorsal aspect. 47. *H. rubyi*. 48. *H. stagnalis*. Fig. 49-54. *Hydroporus*, male genitalia: A. aedeagus, apex, ventral aspect; B. aedeagus, lateral aspect; C. paramere. 49. *H. undulatus*. 50. *H. vittatus*. 51. *H. dimidiatus*. 52. *H. superioris*. 53. *H. paugus*. 54. *H. rubyi*.

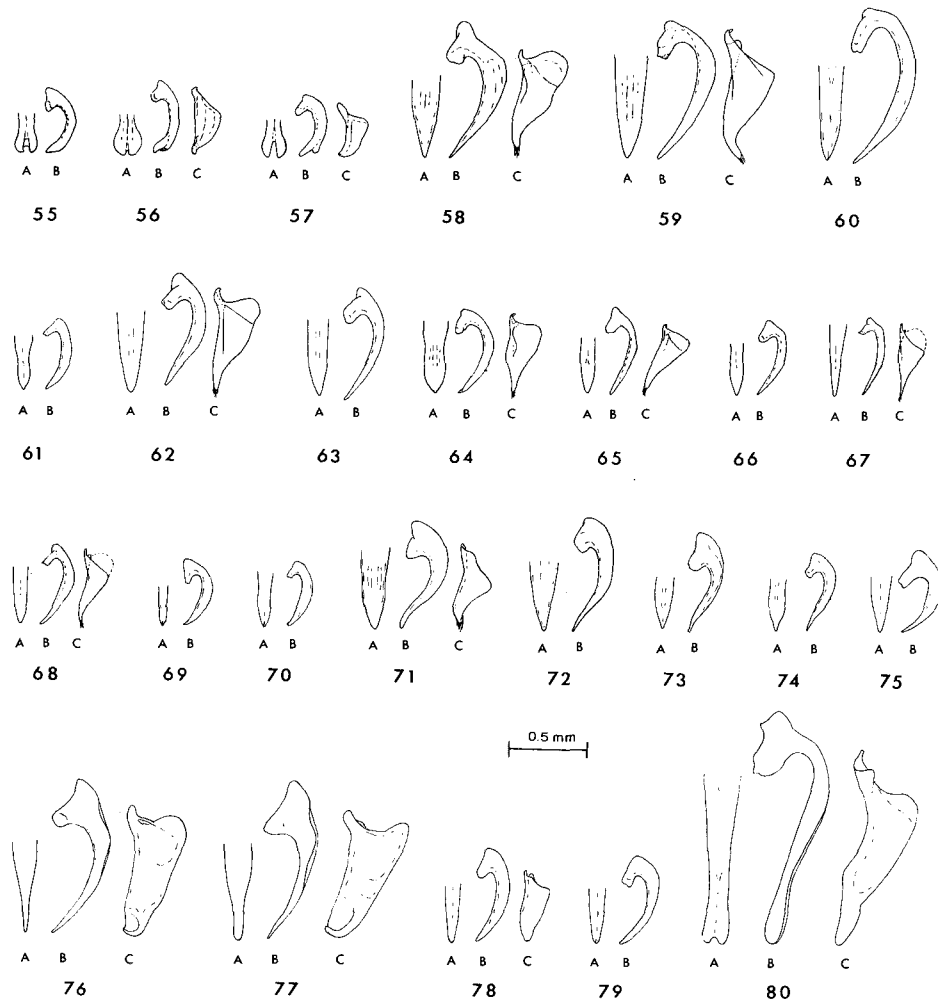


Fig. 55-80. *Hydroporus*, male genitalia: A. aedeagus, apex, ventral aspect; B. aedeagus, lateral aspect; C. paramere. 55. *H. edwardsi*. 56. *H. compertus*. 57. *H. planiusculus*. 58. *H. columbianus*. 59. *H. notabilis*. 60. *H. dentellus*. 61. *H. hockingi*. 62. *H. mannerheimi*. 63. *H. tademus*. 64. *H. signatus*. 65. *H. appalachius*. 66. *H. occidentalis*. 67. *H. fuscipennis*. 68. *H. criniticoxis*. 69. *H. striola*. 70. *H. badiellus*. 71. *H. carri*. 72. *H. transpunctatus*. 73. *H. despectus*. 74. *H. sp. nr. despectus*. 75. *H. quadrimaculatus*. 76. *H. elegans*. 77. *H. depressus*. 78. *H. striatellus*. 79. *H. griseostriatus*. 80. *H. spenceri*.

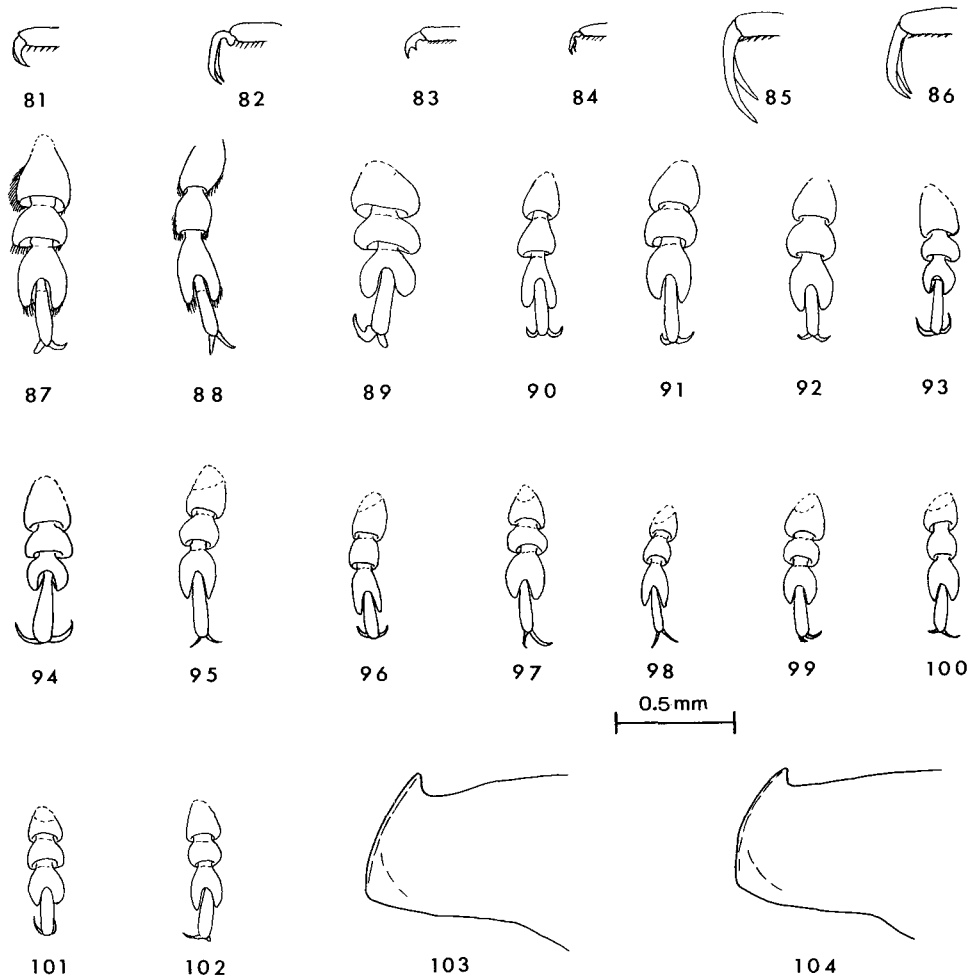


Fig. 81-86. *Hydroporus*, male, right protarsal claws, anterior aspect. 81. *H. columbianus*. 82. *H. notabilis*. 83. *H. dentellus*. 84. *H. signatus*. 85. *H. elegans*. 86. *H. depressus*. Fig. 87-102. *Hydroporus*, protarsus, dorsal aspect. 87. *H. columbianus*, ♂. 88. *H. columbianus*, ♀. 89. *H. notabilis*, ♂. 90. *H. notabilis*, ♀. 91. *H. mannerheimi*, ♂. 92. *H. tademus*, ♂. 93. *H. carri*, ♂. 94. *H. transpunctatus*, ♂. 95. *H. rectus*, ♂. 96. *H. rectus*, ♀. 97. *H. tenebrosus*, ♂. 98. *H. tenebrosus*, ♀. 99. *H. pervicinus*, ♂. 100. *H. pervicinus*, ♀. 101. *H. despectus*, ♂. 102. *H. sp. nr. despectus*, ♂. Fig. 103-104. *Hydroporus*, pronotum, left side, dorsal aspect. 103. *H. appalachius*. 104. *H. occidentalis*.

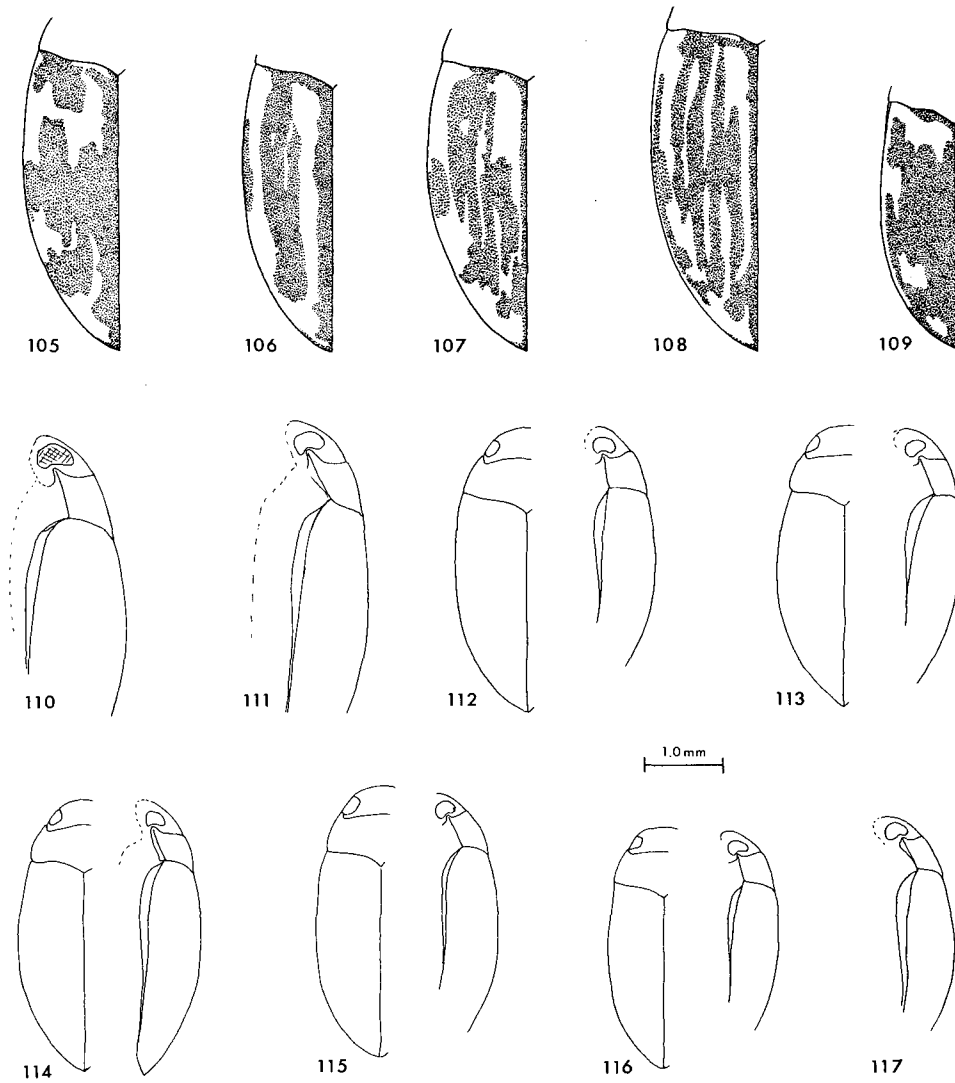


Fig. 105-109. *Hydroporus*, left elytron, dorsal aspect. 105. *H. undulatus*. 106. *H. vittatus*. 107. *H. dimidiatus*. 108. *H. superioris*. 109. *H. appalachius*. Fig. 110. *Hygrotes* sp., anterior portion of body, lateral aspect. Fig. 111-117. *Hydroporus*, habitus of left side of body: A. dorsal aspect; B. lateral aspect. 111. *H. mannerheimi*. 112. *H. hockingi*. 113. *H. rufinasus*. 114. *H. glabriusculus*. 115. *H. tristis*. 116. *H. badiellus*. 117. *H. striola*.

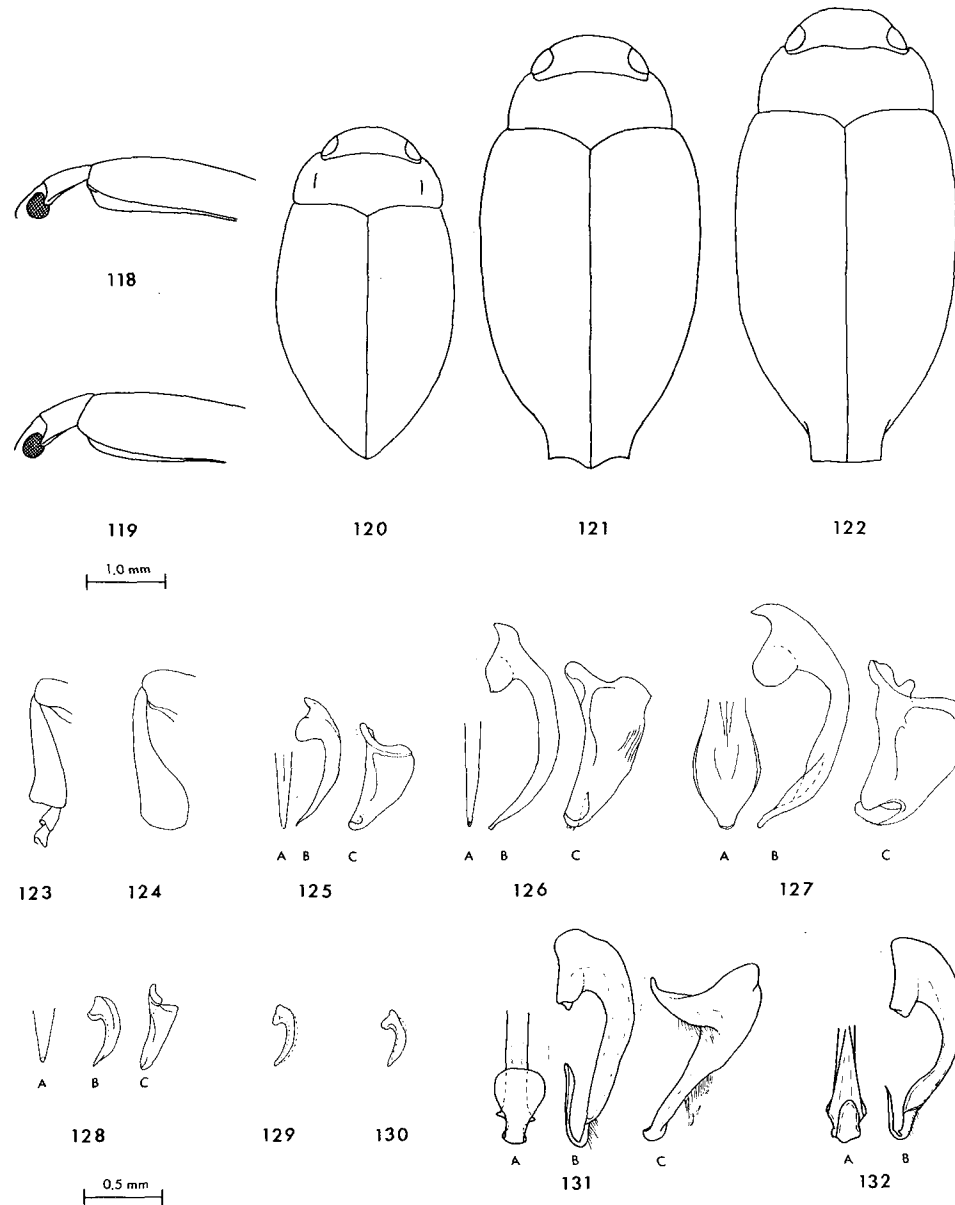


Fig. 118-119. *Hydroporus*, base of elytron, lateral aspect. 118. *H. snoqualmie*. 119. *H. scitulus*. Fig. 120-122. *Hydroporus*, female habitus, dorsal aspect. 120. *H. snoqualmie*. 121. *H. laevis*. 122. *H. alaskanus*. Fig. 123-124. *Hydroporus*, male protibia, anterior aspect. 123. *H. laevis*. 124. *H. alaskanus*. Fig. 125-130. *Hydroporus*, male genitalia: A. aedeagus, apex, ventral aspect; B. aedeagus, lateral aspect; C. paramere. 125. *H. snoqualmie*. 126. *H. laevis*. 127. *H. alaskanus*. 128. *H. scitulus*. 129. *H. rivalis*. 130. *H. congruus*. Fig. 131-132. *Laccornis*, male genitalia: A. aedeagus, apex, ventral aspect; B. aedeagus, lateral aspect; C. paramere. 131. *L. conoideus*. 132. *L. pacificus*.

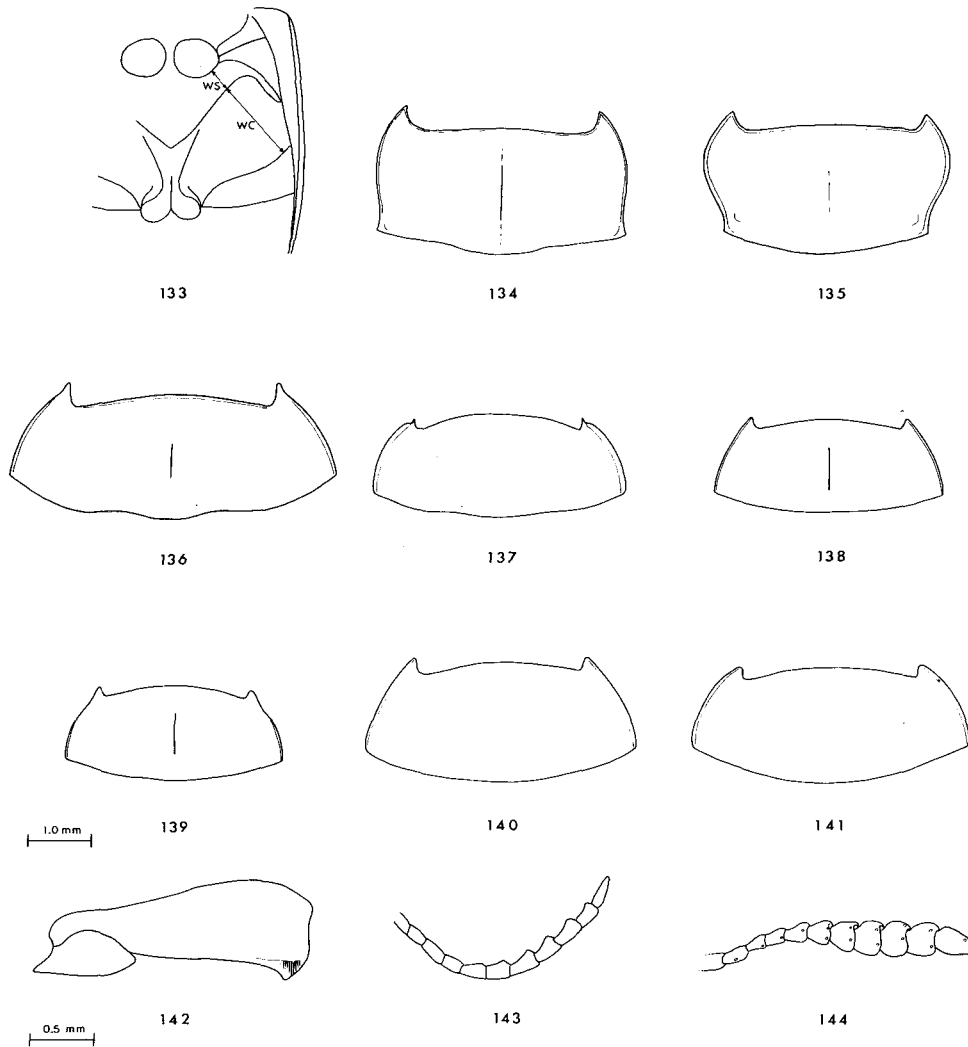


Fig. 133. *Agabus antennatus*, metathorax, ventral aspect, showing positions of measurements WS (width of metasternum) and WC (width metacoxa). Fig. 134-141. *Agabus*, pronotum, dorsal aspect. 134. *A. bjorkmanae*. 135. *A. cordatus*. 136. *A. erichsoni*. 137. *A. triton*. 138. *A. arcticus*, ♂. 139. *A. arcticus*, ♀. 140. *A. infuscatus*, ♂, Edson, Alta. 141. *A. infuscatus*, ♂, Newfoundland. Fig. 142. *Agabus anthracinus*, ♂, metafemur, ventral aspect. Fig. 143-144. *Agabus*, right antenna. 143. *A. elongatus*, ♂. 144. *A. antennatus*, ♂.

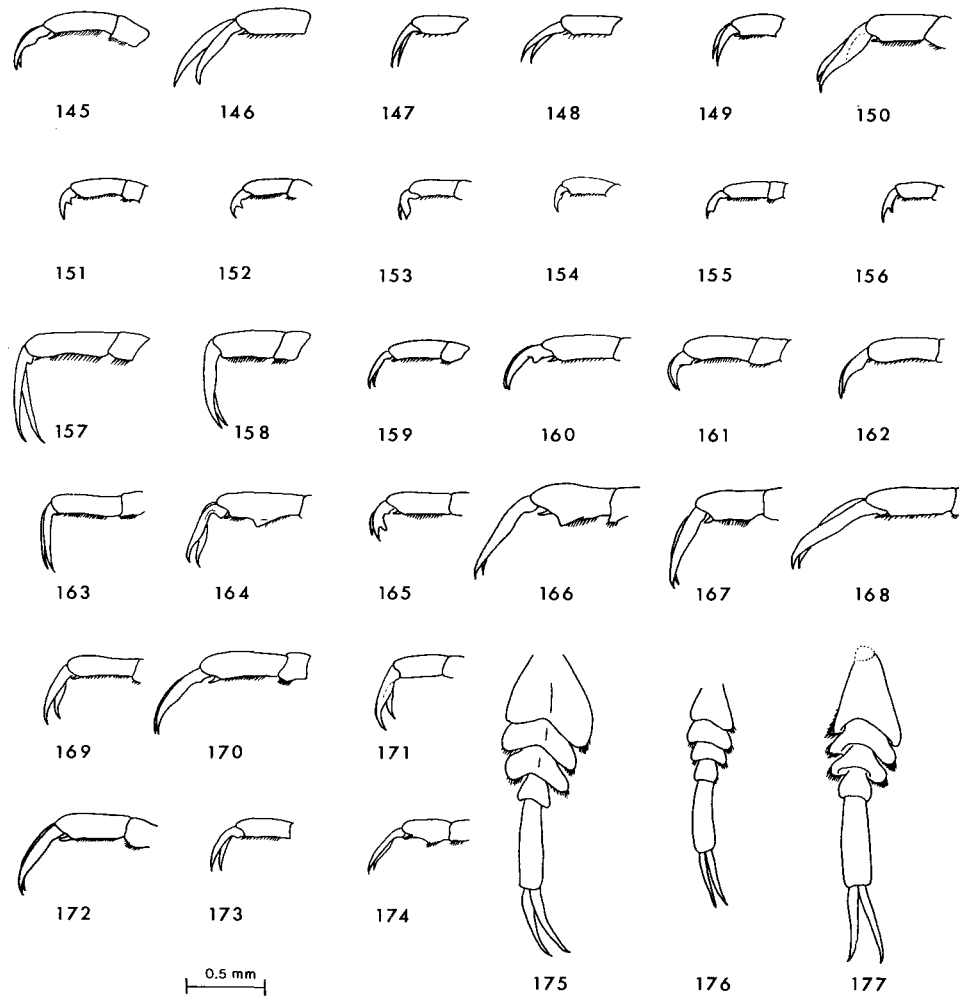


Fig. 145-174. *Agabus*, male, right protarsal claws, anterior aspect. 145. *A. seriatus*. 146. *A. pseudoconfertus*. 147. *A. kenaiensis*. 148. *A. verisimilis*. 149. *A. hypomelas*. 150. *A. erichsoni*. 151. *A. semipunctatus*. 152. *A. falli*. 153. *A. triton*. 154. *A. margareti*. 155. *A. punctulatus*. 156. *A. pisobius*. 157. *A. austinii*. 158. *A. ambiguus*. 159. *A. strigulosus*. 160. *A. tristis*. 161. *A. leptapsis*. 162. *A. arcticus*. 163. *A. anthracinus*. 164. *A. elongatus*. 165. *A. lutosus*. 166. *A. ajax*. 167. *A. infuscatus*. 168. *A. ontarionis*. 169. *A. nectris*. 170. *A. audeni*. 171. *A. canadensis*. 172. *A. confinis*. 173. *A. bifarius*. 174. *A. antennatus*. Fig. 175-177. *Agabus*, male protarsus, dorsal aspect. 175. *A. ajax*. 176. *A. infuscatus*. 177. *A. ontarionis*.

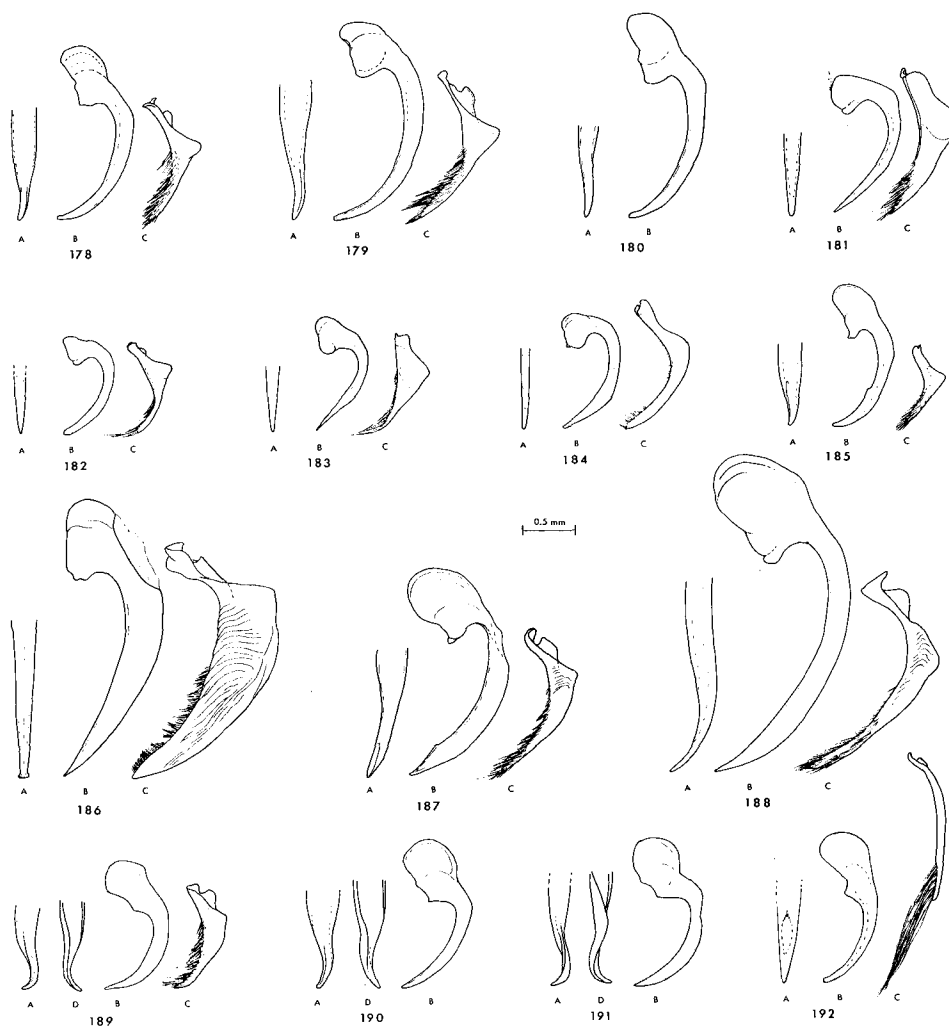


Fig. 178-192. *Agabus*, male genitalia: A. aedeagus, apex, ventral aspect; B. aedeagus, lateral aspect; C. paramere. 178. *A. seriatus*. 179. *A. bjorkmanae*. 180. *A. cordatus*. 181. *A. pseudoconfertus*. 182. *A. kenaiensis*. 183. *A. verisimilis*. 184. *A. hypomelas*. 185. *A. semipunctatus*. 186. *A. erichsoni*. 187. *A. falli*. 188. *A. triton*. 189. *A. punctulatus*. 190. *A. colymbus*. 191. *A. pisobius*. 192. *A. margareti*.



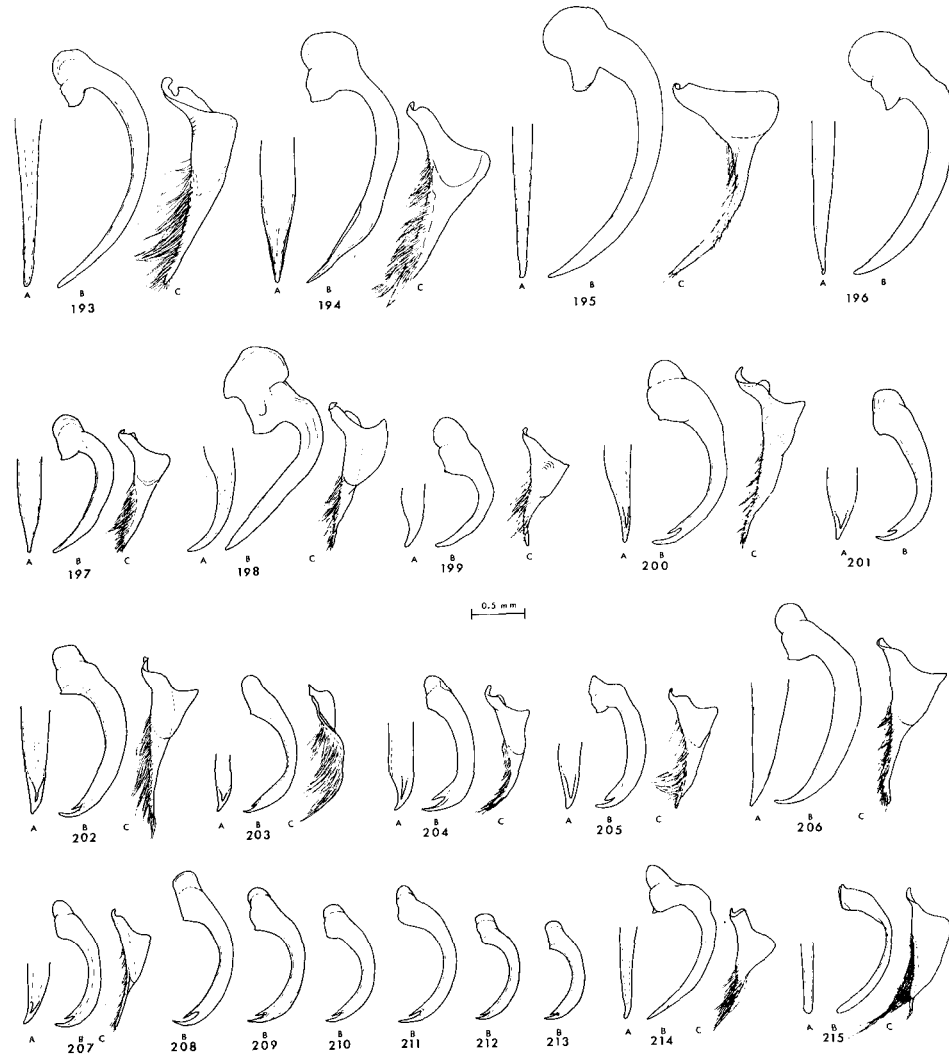


Fig. 193-215. *Agabus*, male genitalia: A. aedeagus, apex, ventral aspect; B. aedeagus, lateral aspect; C. paramere. 193. *A. austini*. 194. *A. ambiguus*. 195. *A. tristis*. 196. *A. leptapsis*. 197. *A. strigulosus*. 198. *A. arcticus*. 199. *A. anthracinus*. 200. *A. ajax*. 201. *A. infuscatus*. 202. *A. ontarionis*. 203. *A. elongatus*. 204. *A. lutosus*. 205. *A. nectris*. 206. *A. audeni*. 207. *A. canadensis*. 208. *A. confinis*. 209. *A. congener*. 210. *A. approximatus* (Beazer, Alta.). 211. *A.* species nr. *approximatus* (Boom L, Banff National Park). 212. *A. inscriptus* (Boom Lake, Banff National Park). 213. *A. inscriptus* (Beavermines Lake, Alta.). 214. *A. bifarius*. 215. *A. antennatus*.

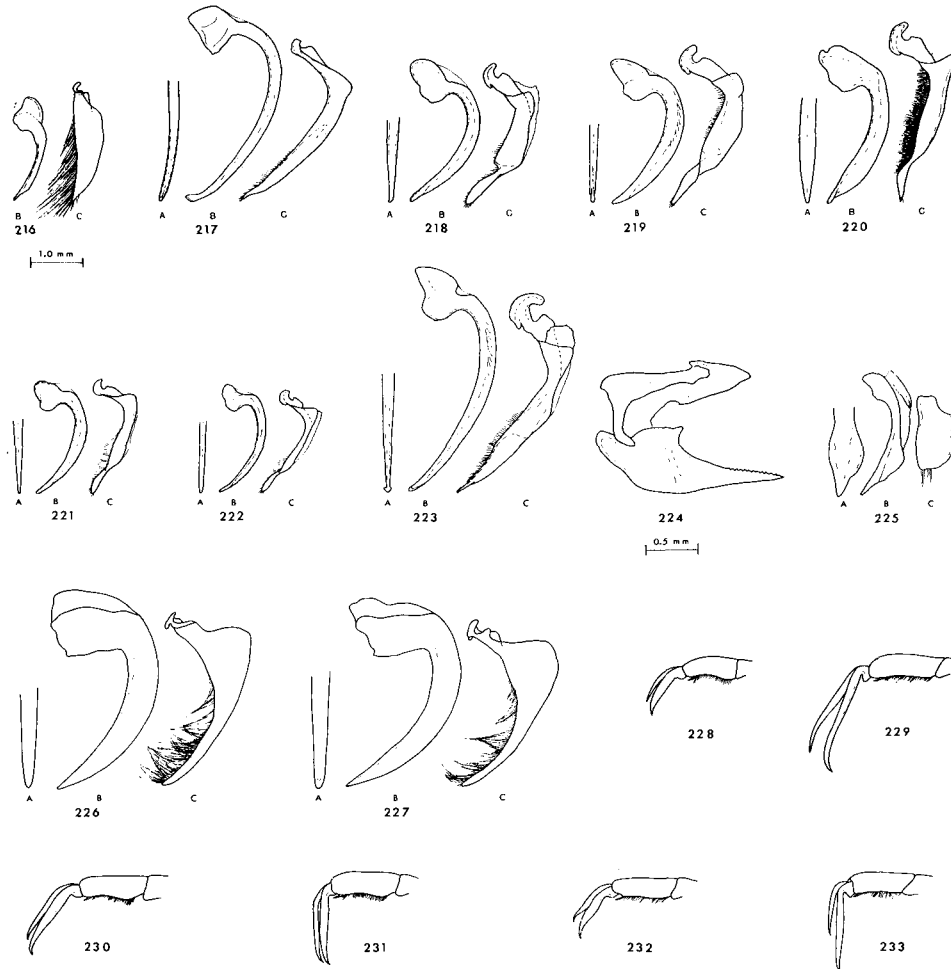


Fig. 216. *Carrhydrus crassipes*, male genitalia: B. aedeagus, lateral aspect; C. paramere. Fig. 217-223. *Ilybius*, male genitalia: A. aedeagus, apex, ventral aspect; B. aedeagus, lateral aspect; C. paramere. 217. *I. discedens*. 218. *I. fraterculus*. 219. *I. subaeneus*. 220. *I. pleuriticus*. 221. *I. angustior*. 222. *I. churchillensis*. 223. *I. quadrimaculatus*. Fig. 224. *Ilybius angustior*, ovipositor, lateral aspect. Fig. 225. *Coptotomus longulus*, male genitalia: A. aedeagus, apex, ventral aspect; B. aedeagus, lateral aspect; C. paramere. Fig. 226-227. *Rhantus*, male genitalia: A. aedeagus, apex, ventral aspect; B. aedeagus, lateral aspect; C. paramere. 226. *R. suturellus*. 227. *R. wallisi*. Fig. 228-233. *Rhantus*, male right protarsal claws, anterior aspect. 228. *R. sinuatus*. 229. *R. consimilis*. 230. *R. wallisi*. 231. *R. suturellus*. 232. *R. binotatus*. 233. *R. frontalis*.

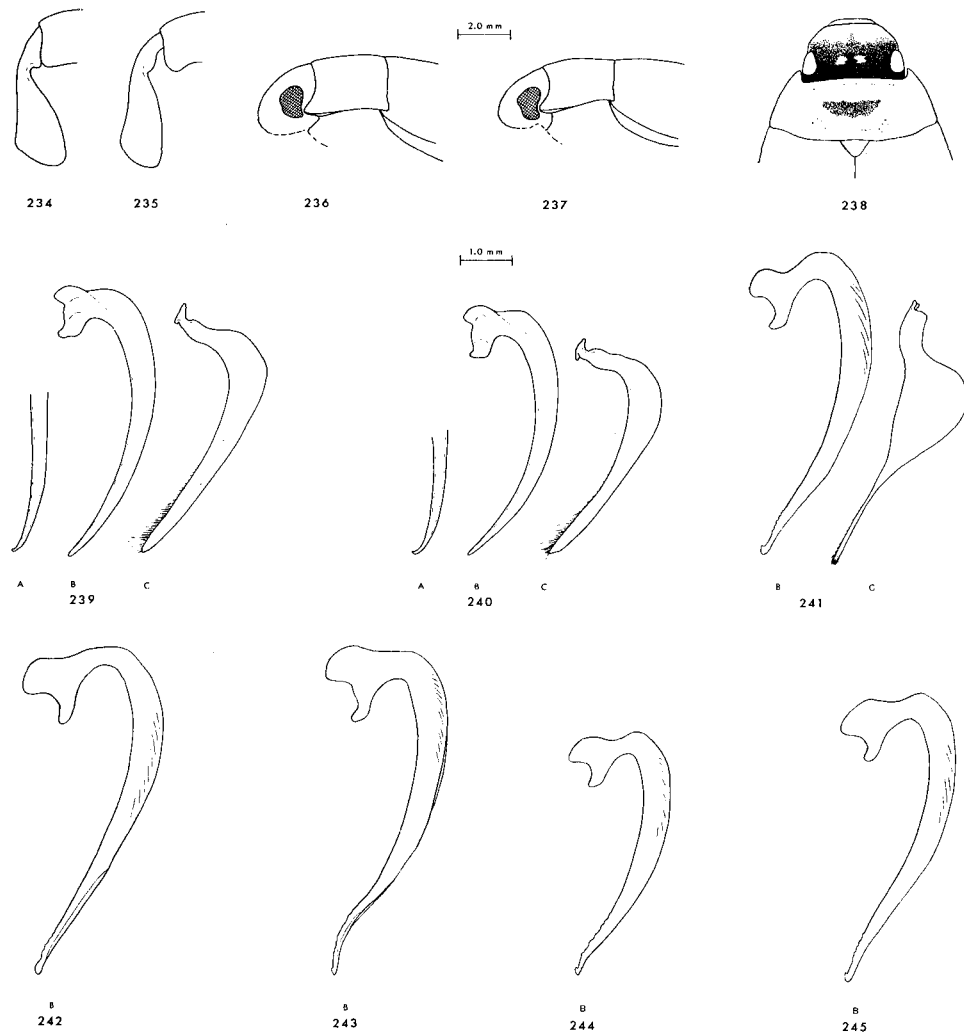


Fig. 234-235. *Neoscutopterus*, male protibia, anterior aspect. 234. *N. hornii*. 235. *N. angustus*. Fig. 236-237. *Neoscutopterus*, pronotum, lateral aspect. 236. *N. hornii*. 237. *N. angustus*. Fig. 238. *Colymbetes exaratus*, head and pronotum, dorsal aspect. Fig. 239-245. Male genitalia: A. aedeagus, apex, ventral aspect; B. aedeagus, lateral aspect; C. paramere. 239. *Neoscutopterus hornii*. 240. *Neoscutopterus angustus*. 241. *Colymbetes longulus*. 242. *Colymbetes seminiger*. 243. *Colymbetes exaratus*. 244. *Colymbetes sculptilis* (Barons, Alta.). 245. *Colymbetes sculptilis* (Gift Lake, Alberta).

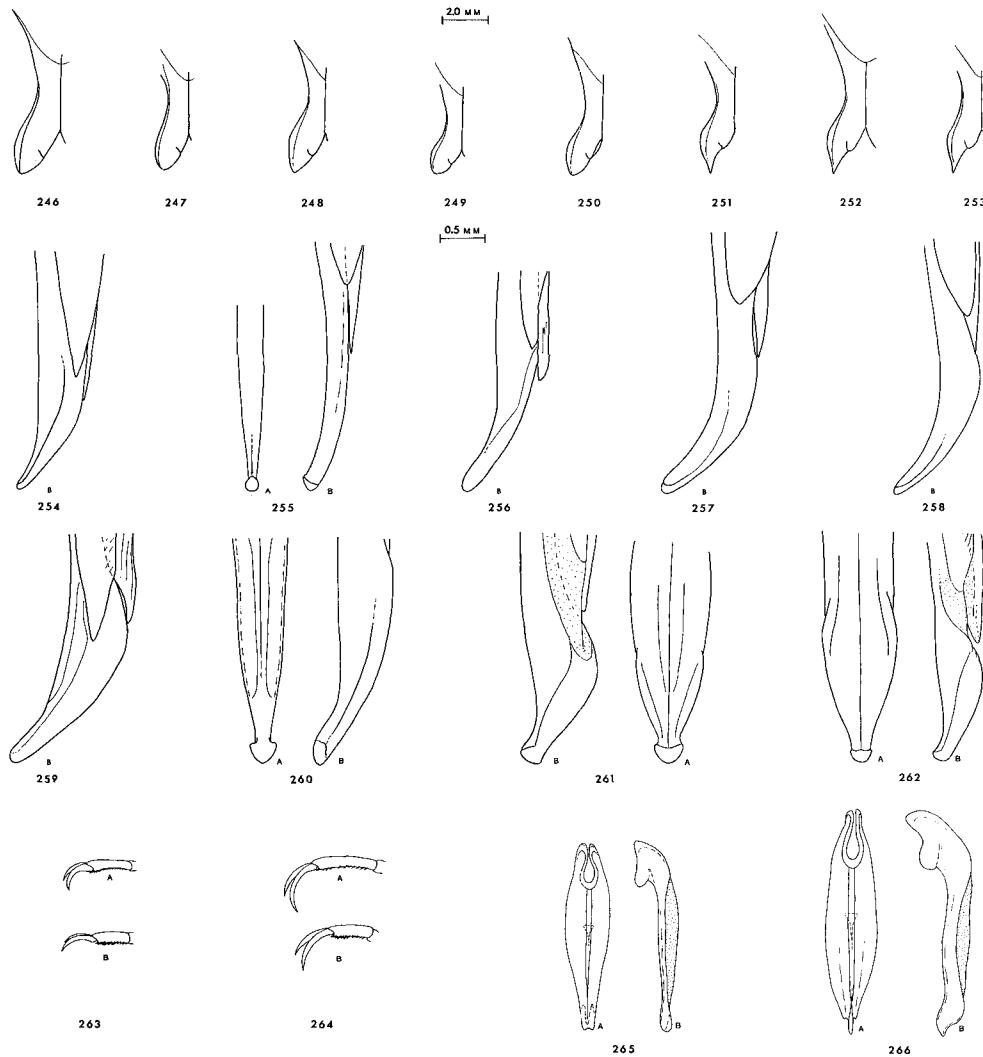


Fig. 246-253. *Dytiscus*, right metacoxal process. 246. *D. harrisii*. 247. *D. hybridus*. 248. *D. marginicollis*. 249. *D. fasciventris*. 250. *D. cordieri*. 251. *D. circumcinctus*. 252. *D. dauricus*. 253. *D. alaskanus*. Fig. 254-262. *Dytiscus*, male genitalia: A. aedeagus, apex, ventral aspect; B. aedeagus, apex, lateral aspect. 254. *D. harrisii*. 255. *D. hybridus*. 256. *D. marginicollis*. 257. *D. fasciventris*. 258. *D. hatchi*. 259. *D. cordieri*. 260. *D. circumcinctus*. 261. *D. dauricus*. 262. *D. alaskanus*. Fig. 263-264. *Acilius*, male tarsal claws: A. protarsal claws; B. mesotarsal claws. 263. *A. semisulcatus*. 264. *A. athabascae*. Fig. 265-266. *Acilius*, male genitalia: A. aedeagus, ventral aspect; B. aedeagus, lateral aspect. 265. *A. semisulcatus*. 266. *A. athabascae*.

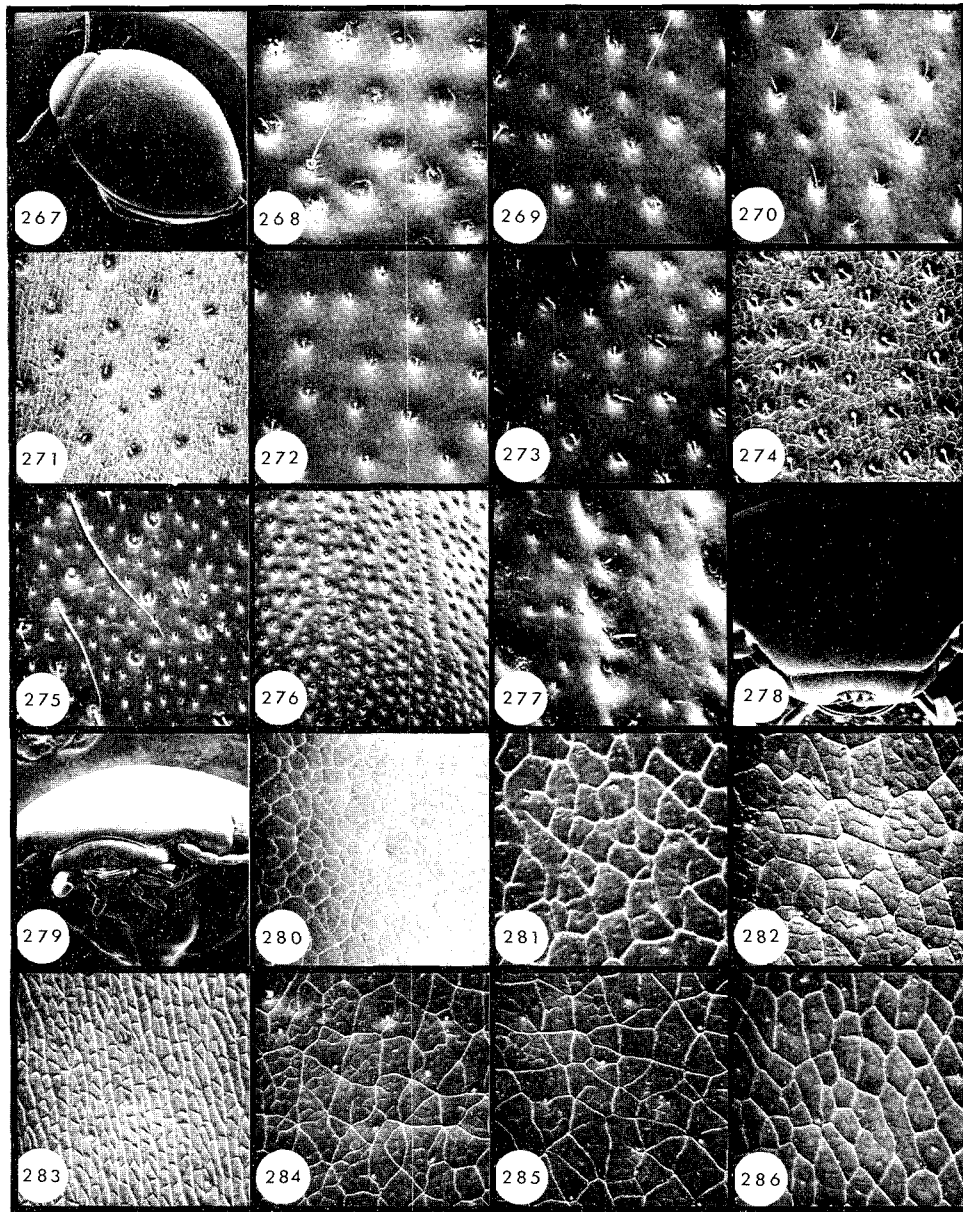


Fig. 267. *Desmopachria convexa*, dorsal aspect, X 18. Fig. 268-277. *Hygrotus*, elytral sculpture. 268. *H. sayi*, ♂, X 147. 269. *H. turbidus*, ♂, X 147. 270. *H. compar*, ♂, X 147. 271. *H. compar*, ♀, X 147. 272. *H. canadensis*, ♂, X 147. 273. *H. patruelis*, ♂, X 147. 274. *H. patruelis*, ♀, X 147. 275. *H. punctilineatus*, ♂, X 147. 276. *H. impressopunctatus*, ♂, X 29. 277. *H. impressopunctatus*, ♂, X 147. Fig. 278-279. *Agabus*, head, anterior aspect, X 15. 278. *A. seriatus*. 279. *A. semipunctatus*. Fig. 280-286. *Agabus*, elytral sculpture, X 147. 280. *A. seriatus*, ♂. 281. *A. bjorkmanae*, ♂. 282. *A. pseudoconfertus*, ♂. 283. *A. pseudoconfertus*, ♀. 284. *A. kenaiensis*, ♂. 285. *A. verisimilis*, ♂. 286. *A. erichsoni*, ♀.

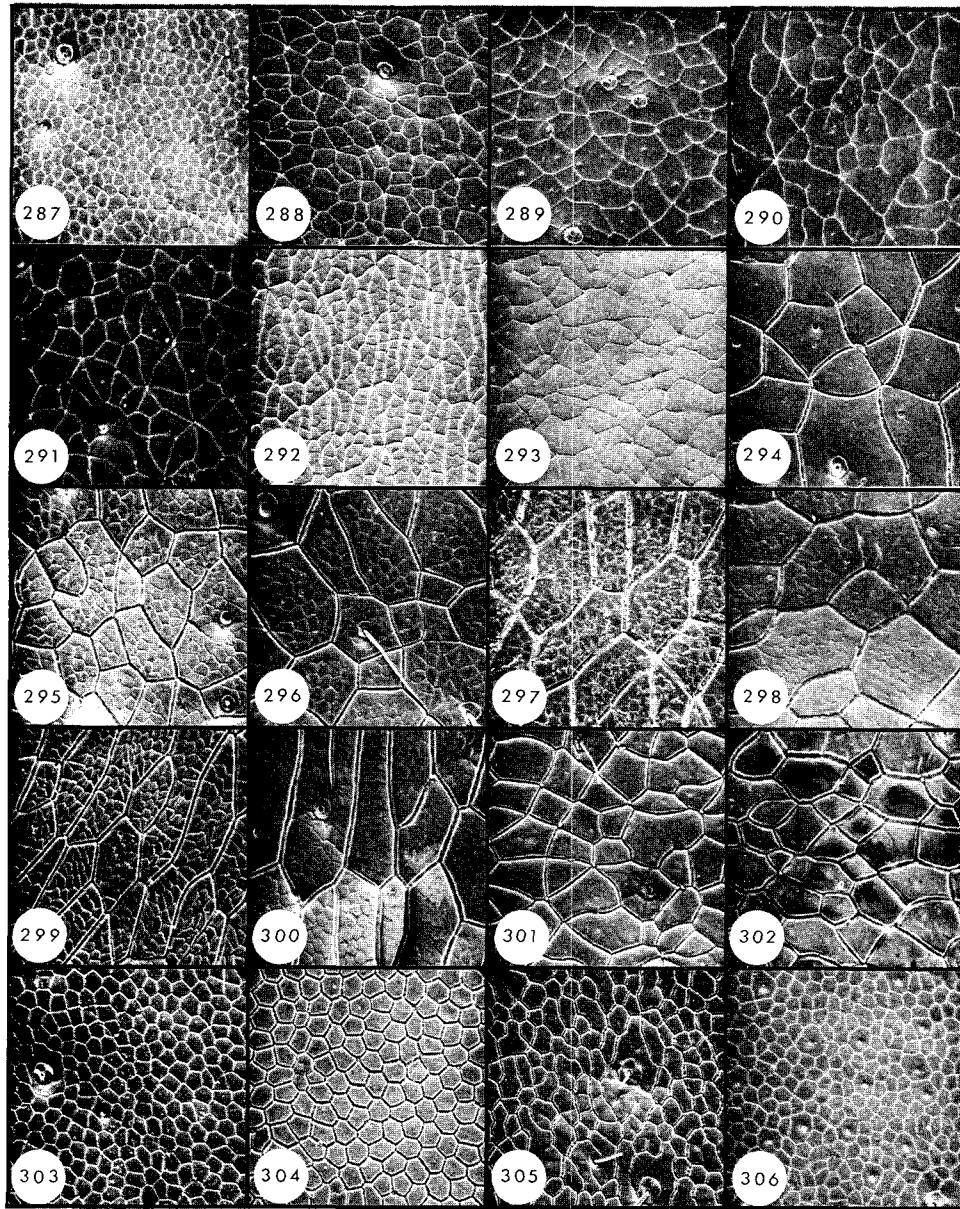


Fig. 287-306. *Agabus*, elytral sculpture, X 147. 287. *A. semipunctatus*, ♂. 288. *A. falli*, ♂. 289. *A. triton*, ♂. 290. *A. margareti*, ♂. 291. *A. punctulatus*, ♂. 292. *A. punctulatus*, ♀. 293. *A. pisobius*, ♂. 294. *A. austinii*, ♂. 295. *A. austinii*, ♀. 296. *A. ambiguus*, ♂. 297. *A. strigulosus*, ♂. 298. *A. tristis*, ♂. 299. *A. tristis*, ♀. 300. *A. leptapsis*, ♂. 301. *A. arcticus*, ♂. 302. *A. anthracinus*, ♂. 303. *A. elongatus*, ♂. 304. *A. ajax*, ♂. 305. *A. ontarionis*, ♂. 306. *A. lutosus*, ♂.

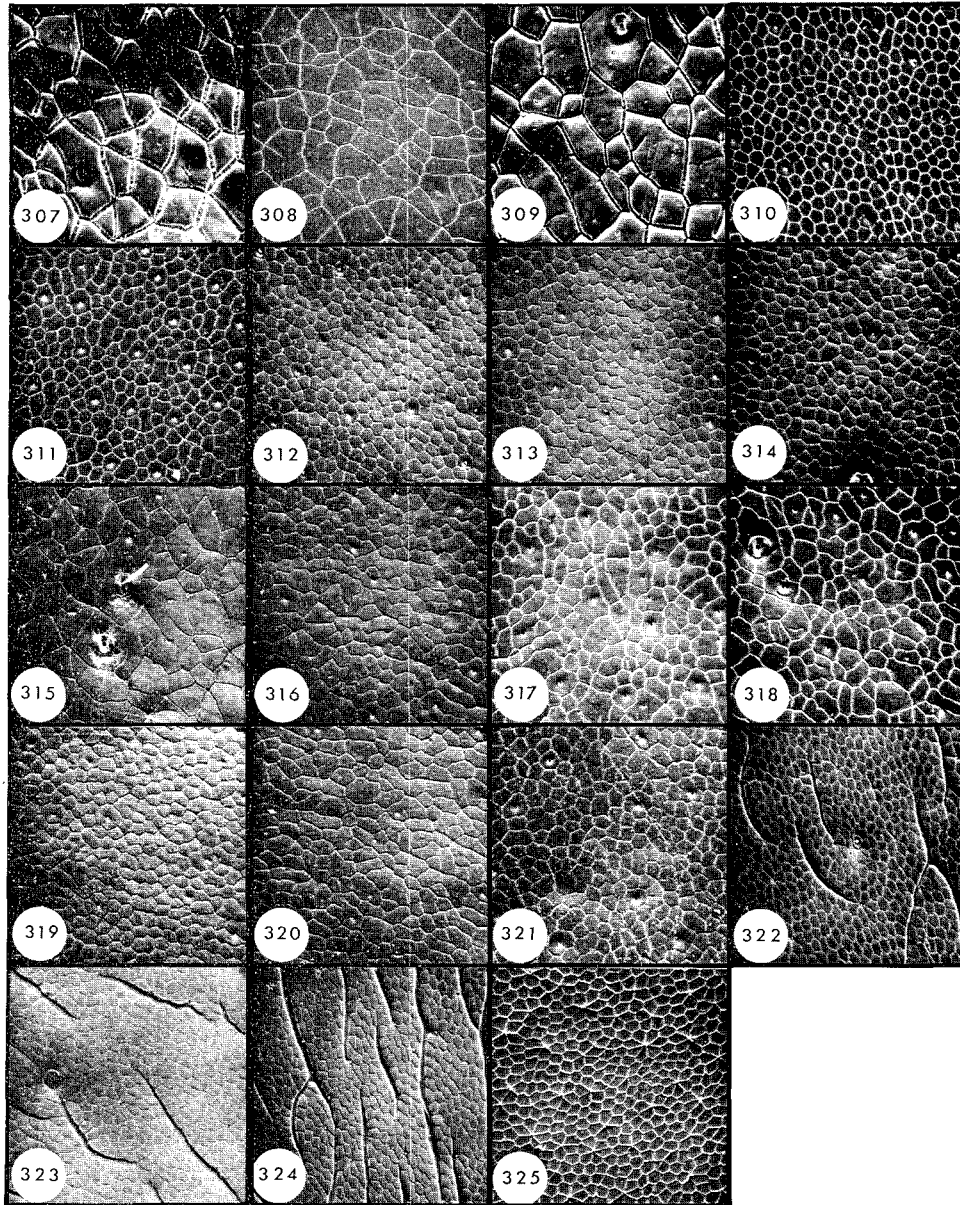


Fig. 307-325. *Agabus*, elytral sculpture, X 147. 307. *A. lutosus*, ♀. 308. *A. nectris*, ♂. 309. *A. nectris*, ♀. 310. *A. audeni*, ♂. 311. *A. canadensis*, ♂. 312. *A. phaeopterus*, ♂. 313. *A. bicolor*, ♂. 314. *A. confinis*, ♂. 315. *A. congener*, ♂. 316. *A. discolor*, ♂. 317. *A. approximatus* (Cardston, Alta.), ♂. 318. *A. species nr. approximatus* (Highwood Pass, Alta.), ♂. 319. *A. inscriptus* (Fickle Lake, Alta.), ♂. 320. *A. inscriptus* (Boom Lake, Banff National Park), ♂. 321. *A. inscriptus* (Beavermines Lake, Alta.), ♂. 322. *A. bifarius*, ♂. 323. *A. bifarius*, ♀. 324. *A. bifarius*, ♀. 325. *A. antennatus*, ♂.

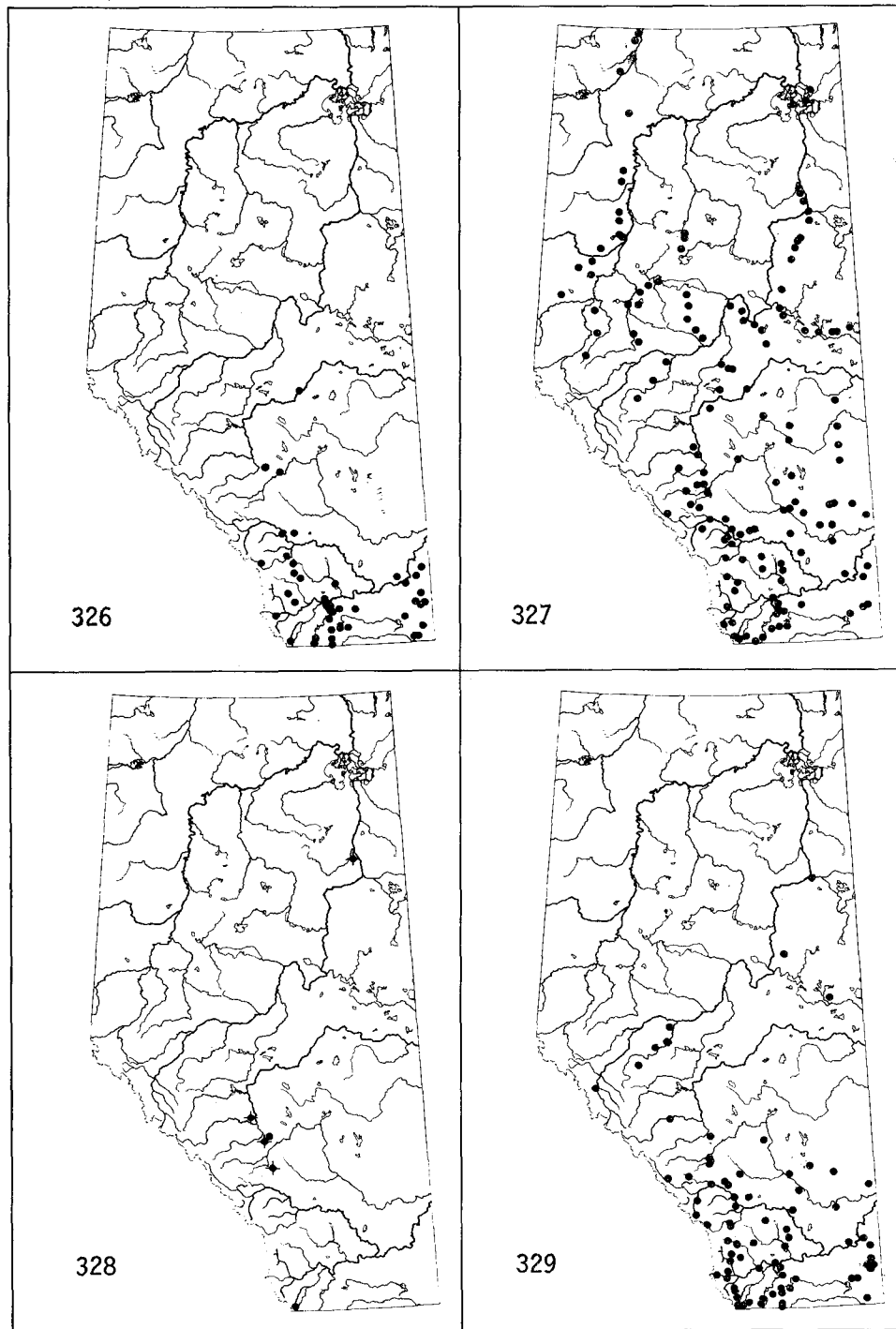


Fig. 326-329. Maps of Alberta collection localities for: 326. *Laccophilus maculosus*; 327. *L. biguttatus*; 328. *Desmopachria convexa* (•), *Liodessus cantralli* (+); 329. *L. affinis*.



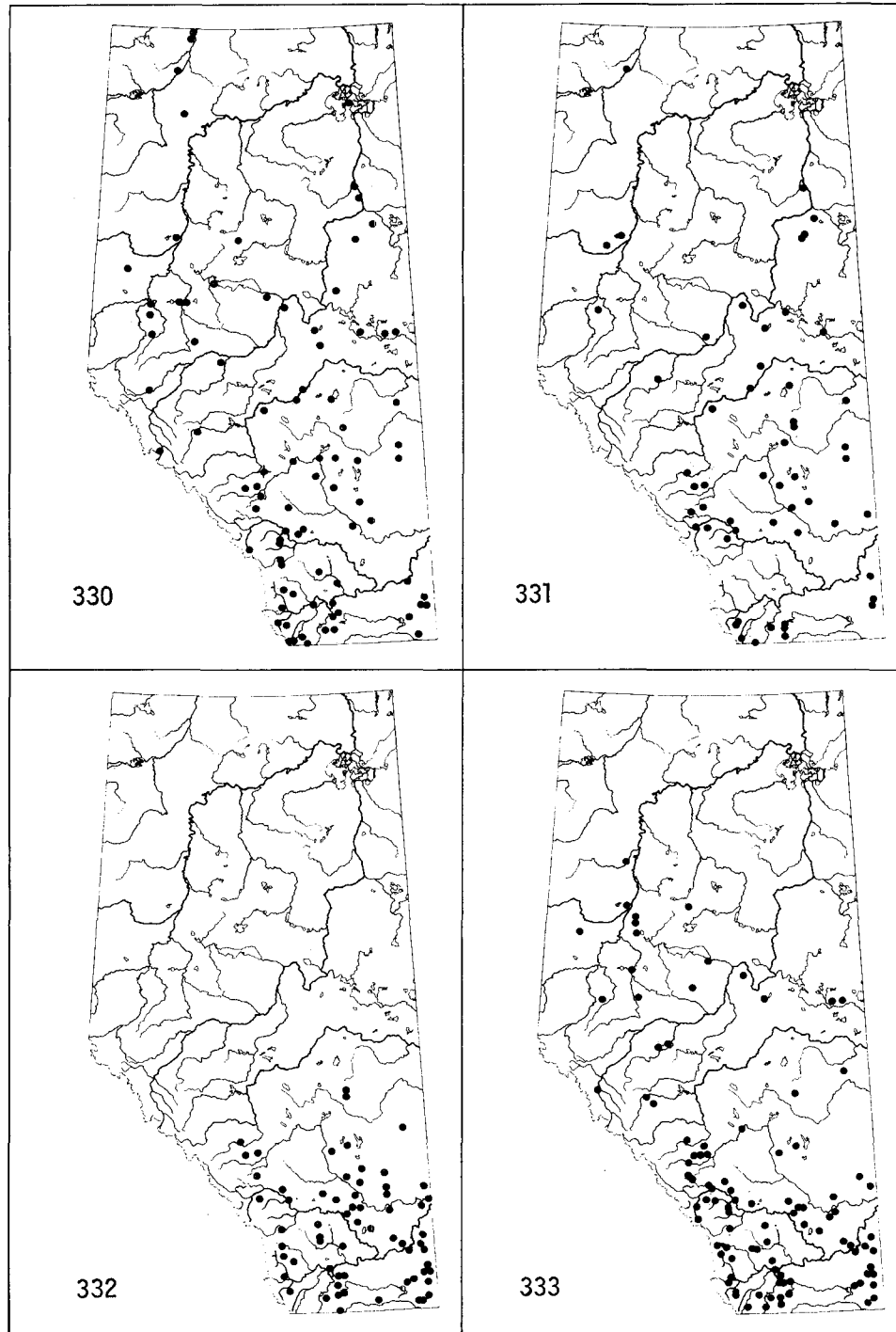


Fig. 330-333. Maps of Alberta collection localities for: 330. *Hygroplitis sayi* (•), *H. farctus* (+); 331. *H. turbidus*; 332. *H. compar*; 333. *H. canadensis*.

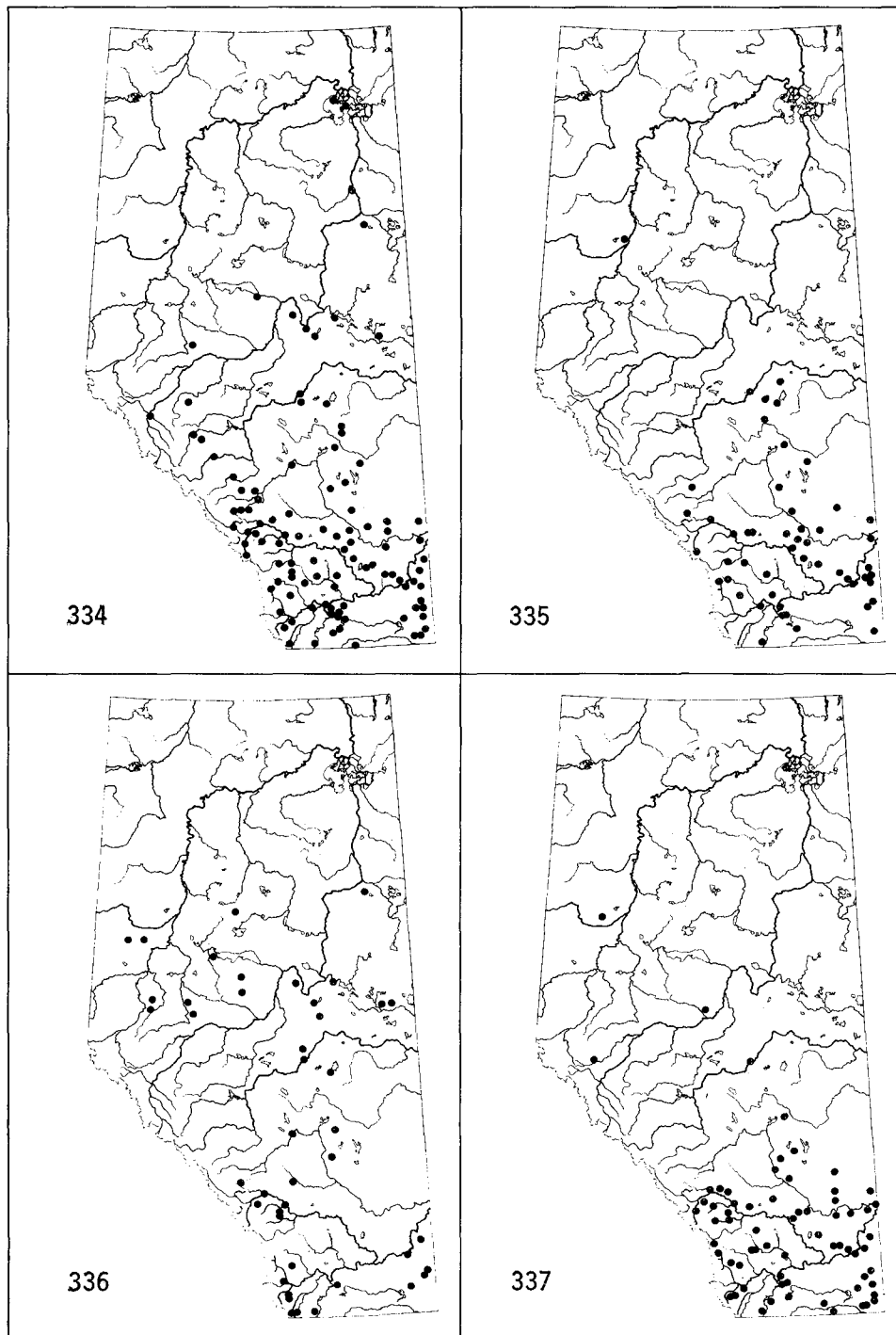


Fig. 334-337. Maps of Alberta collection localities for: 334. *Hygrotus patruelis*; 335. *H. sellatus*; 336. *H. suturalis*; 337. *H. dentiger*.

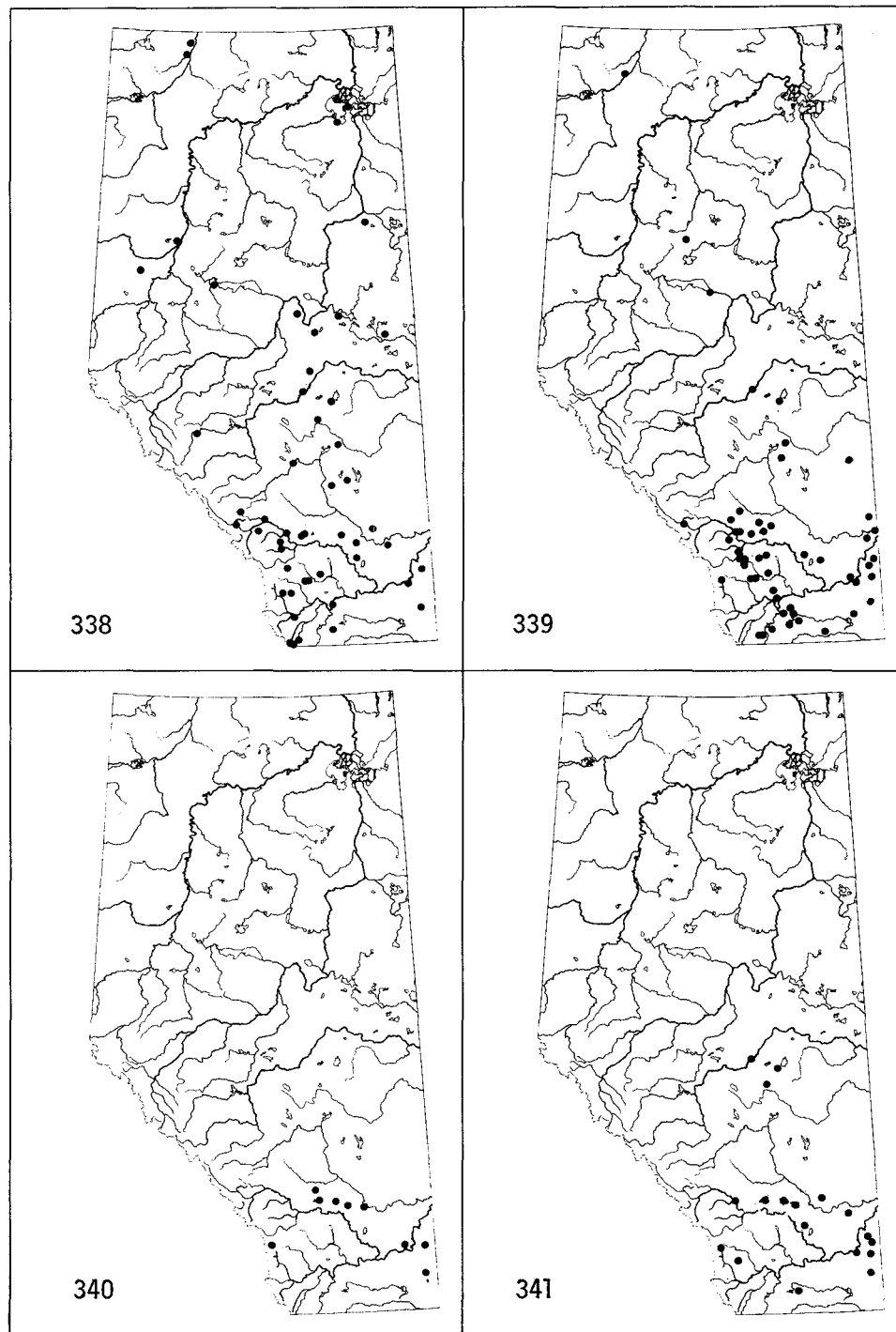


Fig. 338-341. Maps of Alberta collection localities for: 338. *Hygrotus unguicularis*; 339. *H. tumidiventris*; 340. *H. semivittatus*; 341. *H. punctilineatus*.

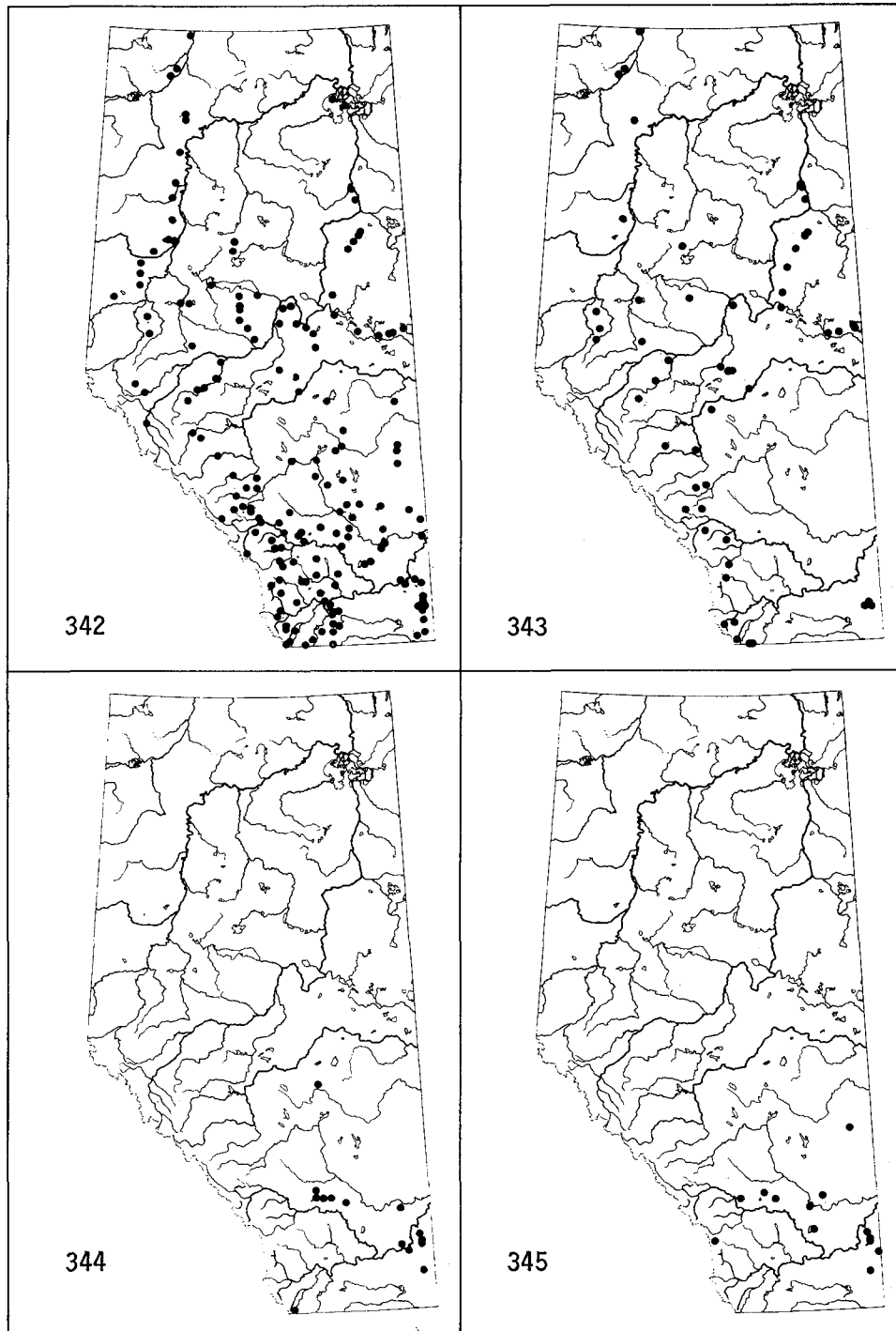


Fig. 342-345. Maps of Alberta collection localities for: 342. *Hygrotus impressopunctatus*; 343. *H. picatus*; 344. *H. masculinus*; 345. *H. salinarius*.

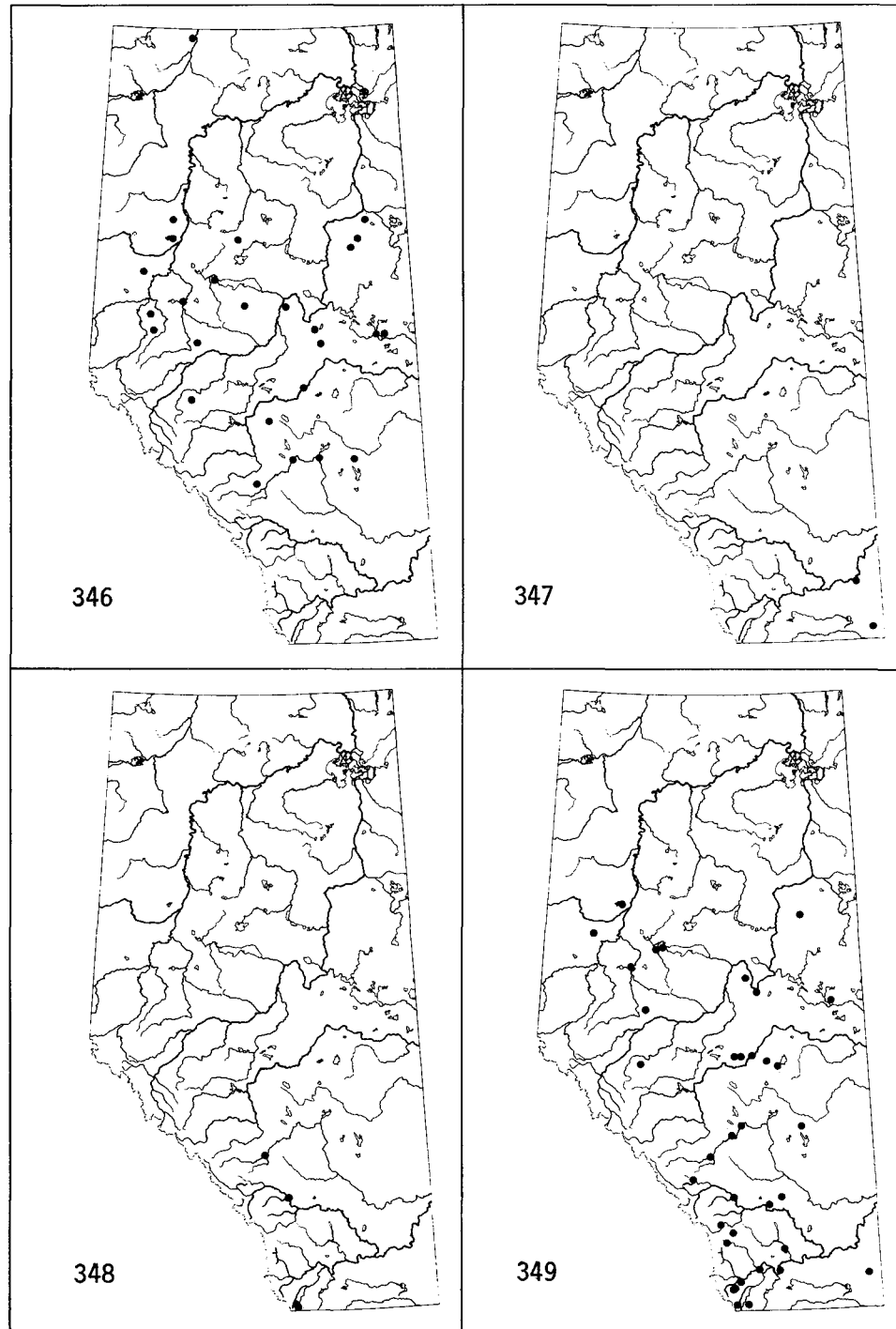


Fig. 346-349. Maps of Alberta collection localities for: 346. *Hydroporus undulatus*; 347. *H. vittatus*; 348. *H. dimidiatus*; 349. *H. superioris*.

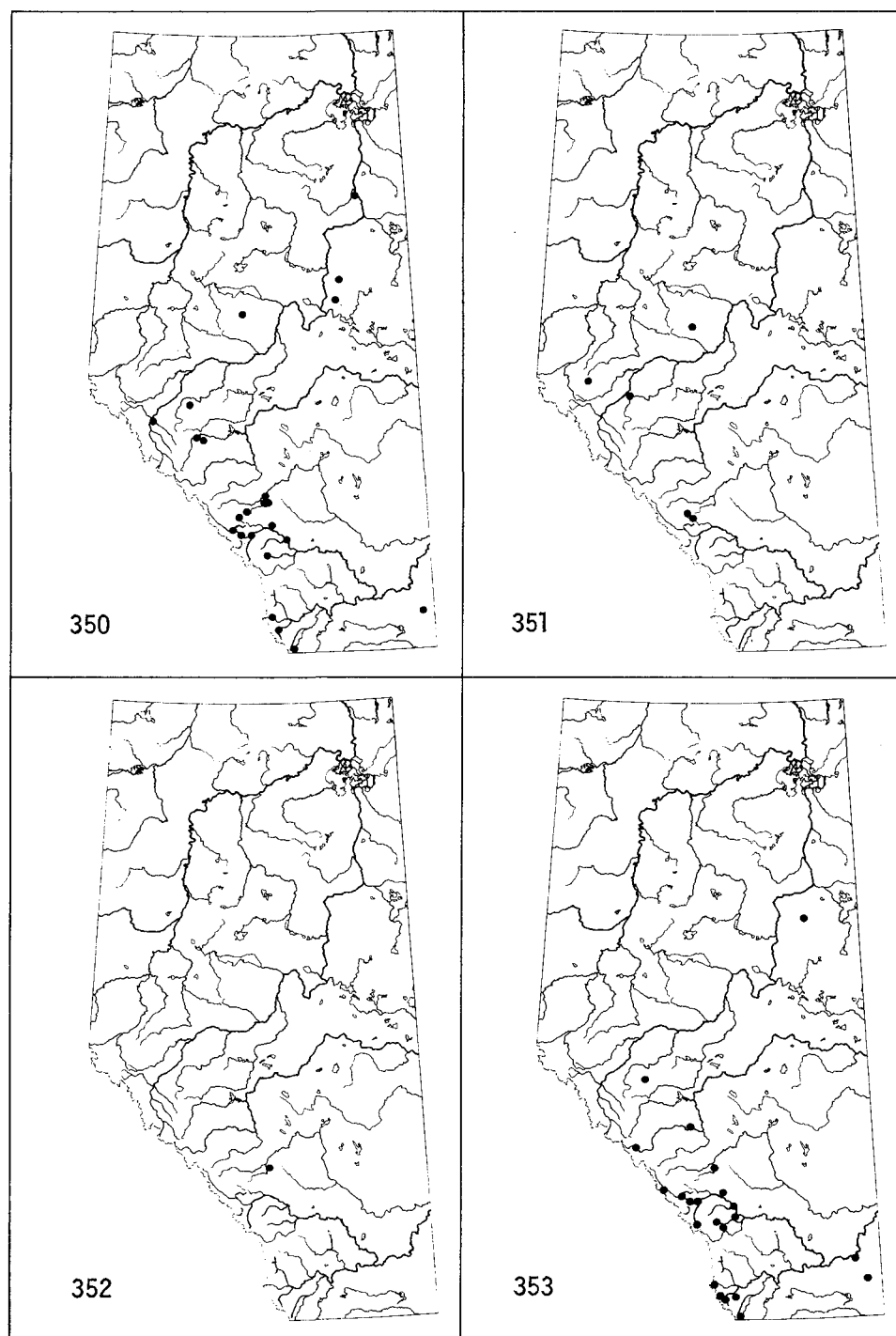


Fig. 350-353. Maps of Alberta collection localities for: 350. *Hydroporus paugus*; 351. *H. rubyi*; 352. *H. stagnalis*; 353. *H. edwardsi*.

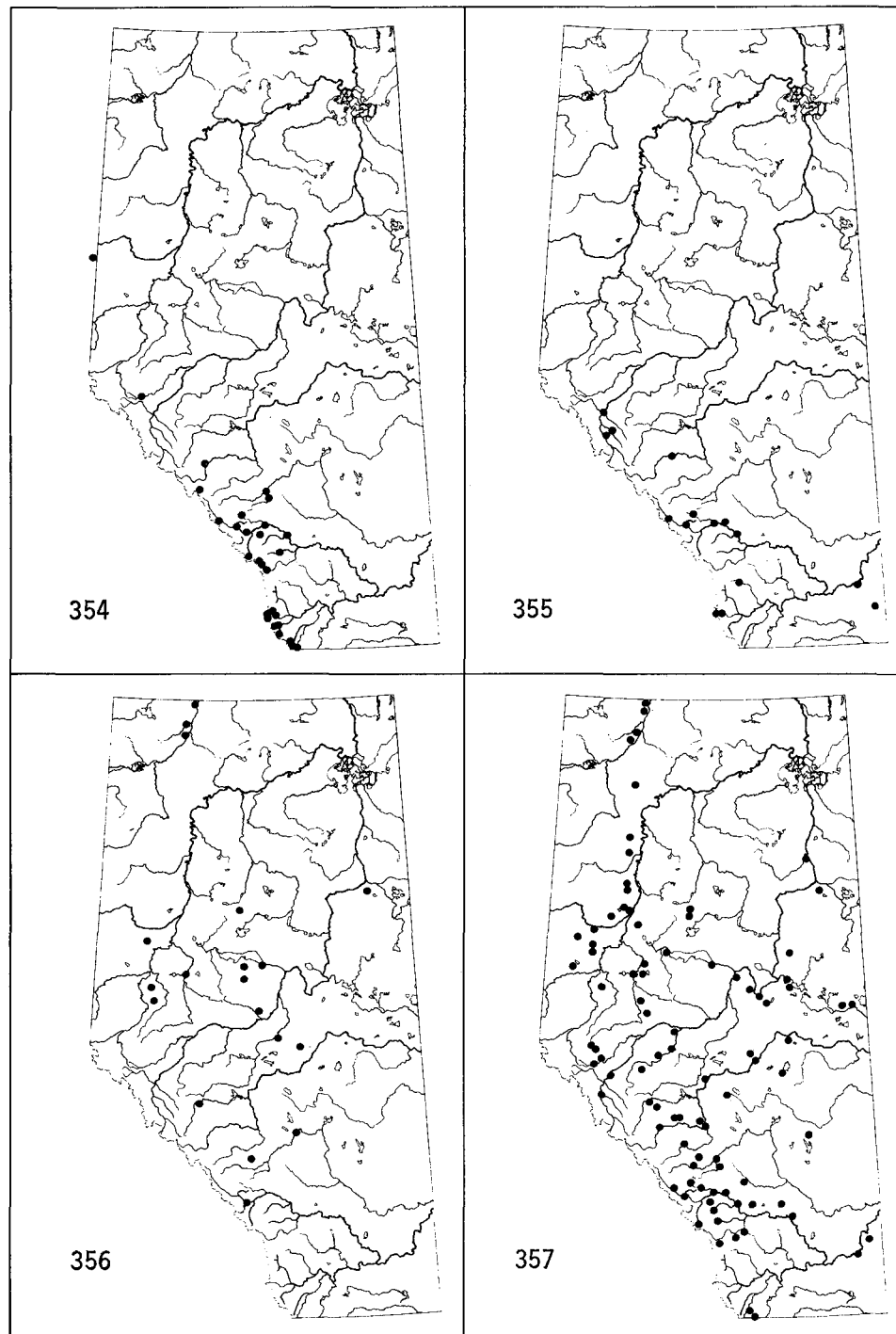


Fig. 354-357. Maps of Alberta collection localities for: 354. *Hydporus compertus*; 355. *H. planusculus*; 356. *H. columbianus*; 357. *H. notabilis*.

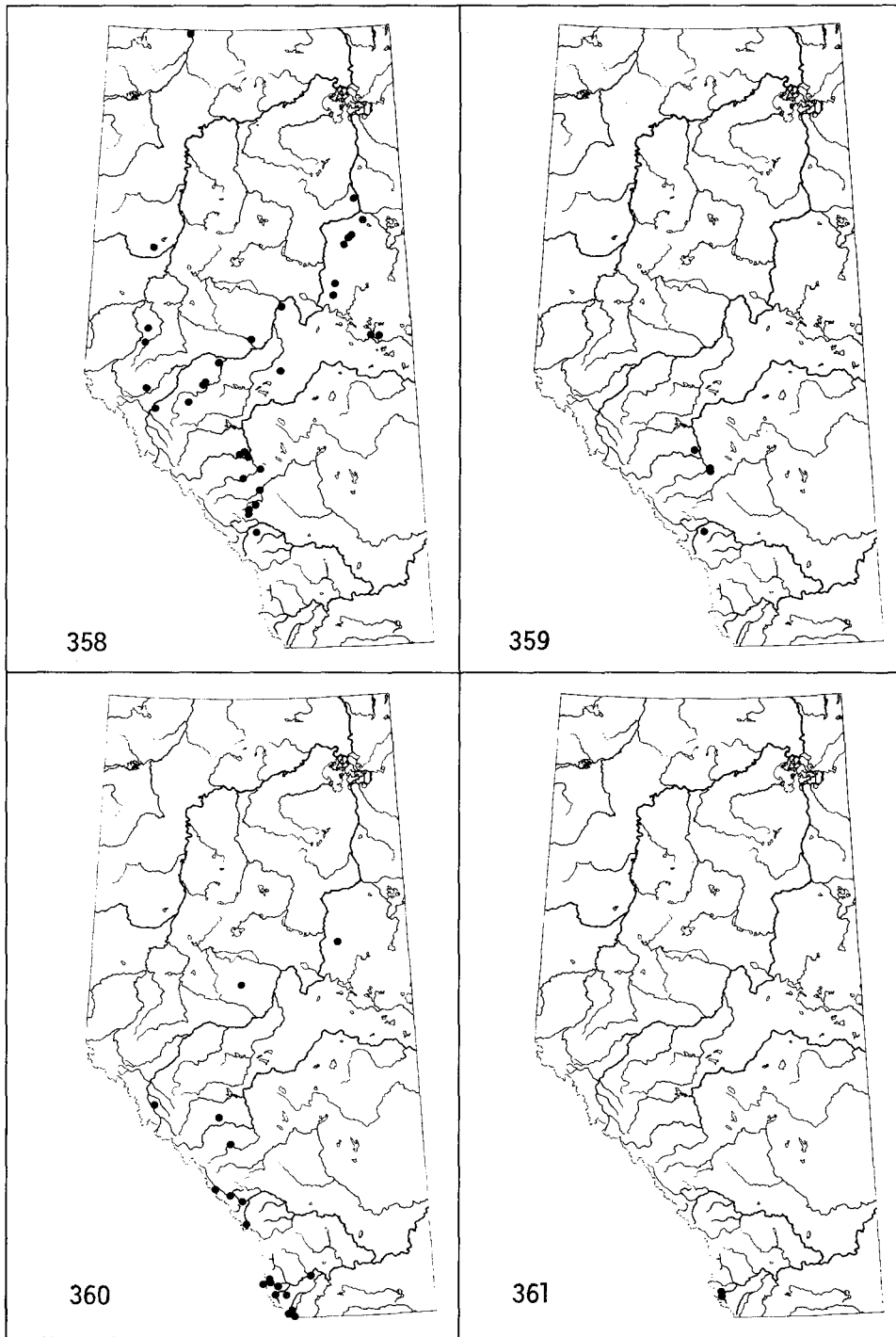


Fig. 358-361. Maps of Alberta collection localities for: 358. *Hydroporus dentellus*; 359. *H. hockingi*; 360. *H. mannerheimi*; 361. *H. tademus*.



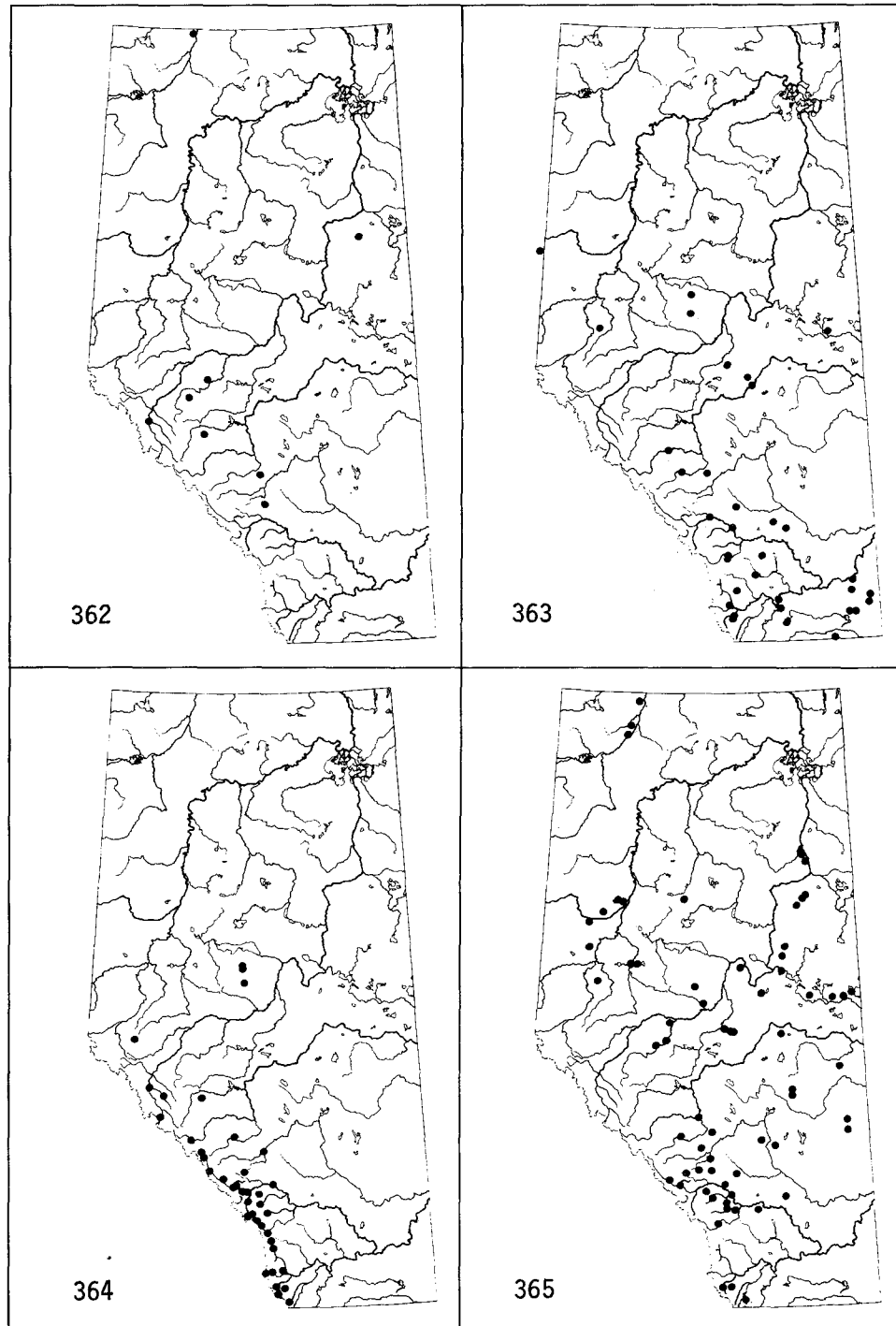


Fig. 362-365. Maps of Alberta collection localities for: 362. *Hydroporus signatus*; 363. *H. appalachius*; 364. *H. occidentalis*; 365. *H. fuscipennis*.

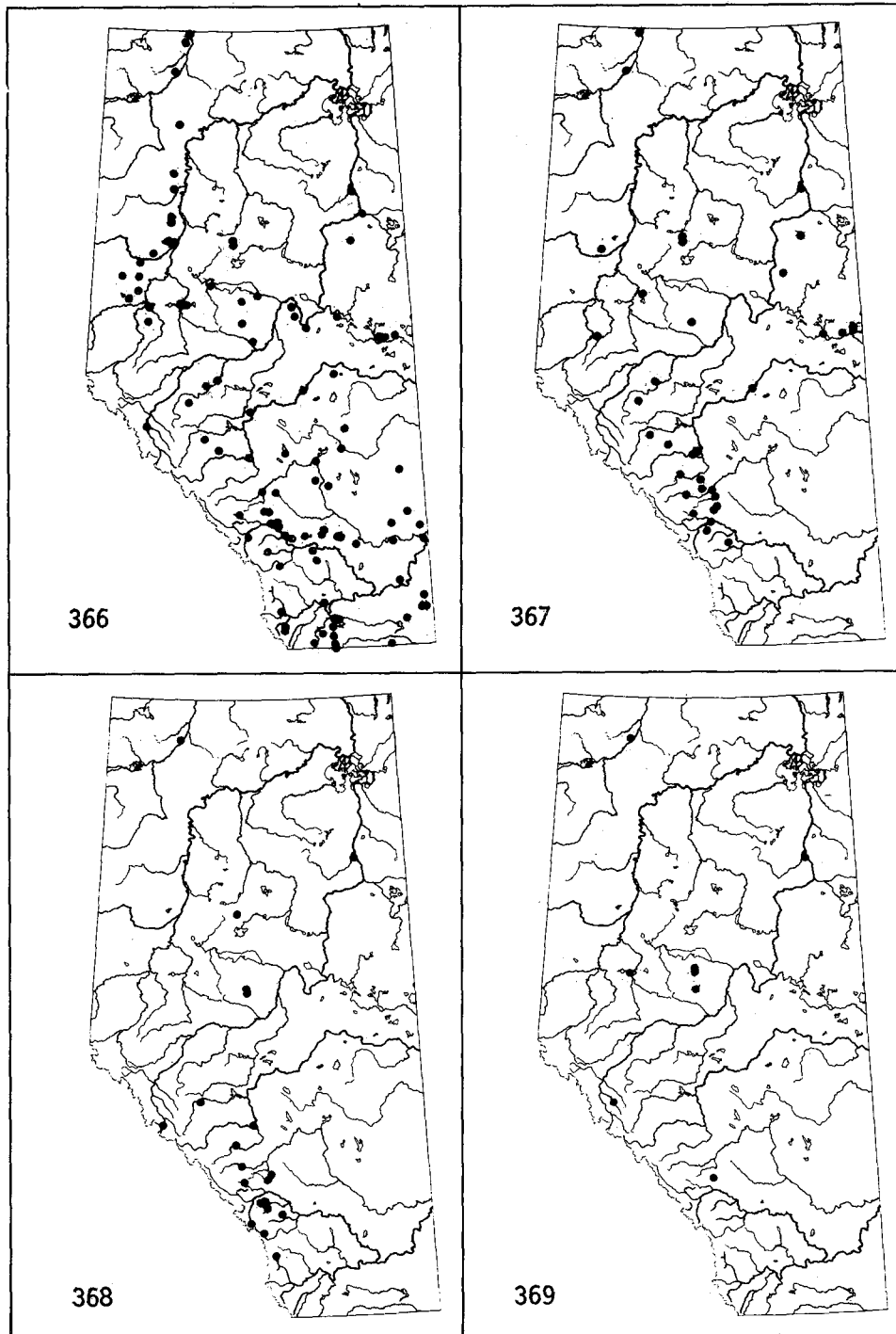


Fig. 366-369. Maps of Alberta collection localities for: 366. *Hydroporus criniticoxis*; 367. *H. rufinasus*; 368. *H. glabriusculus*; 369. *H. morio*.

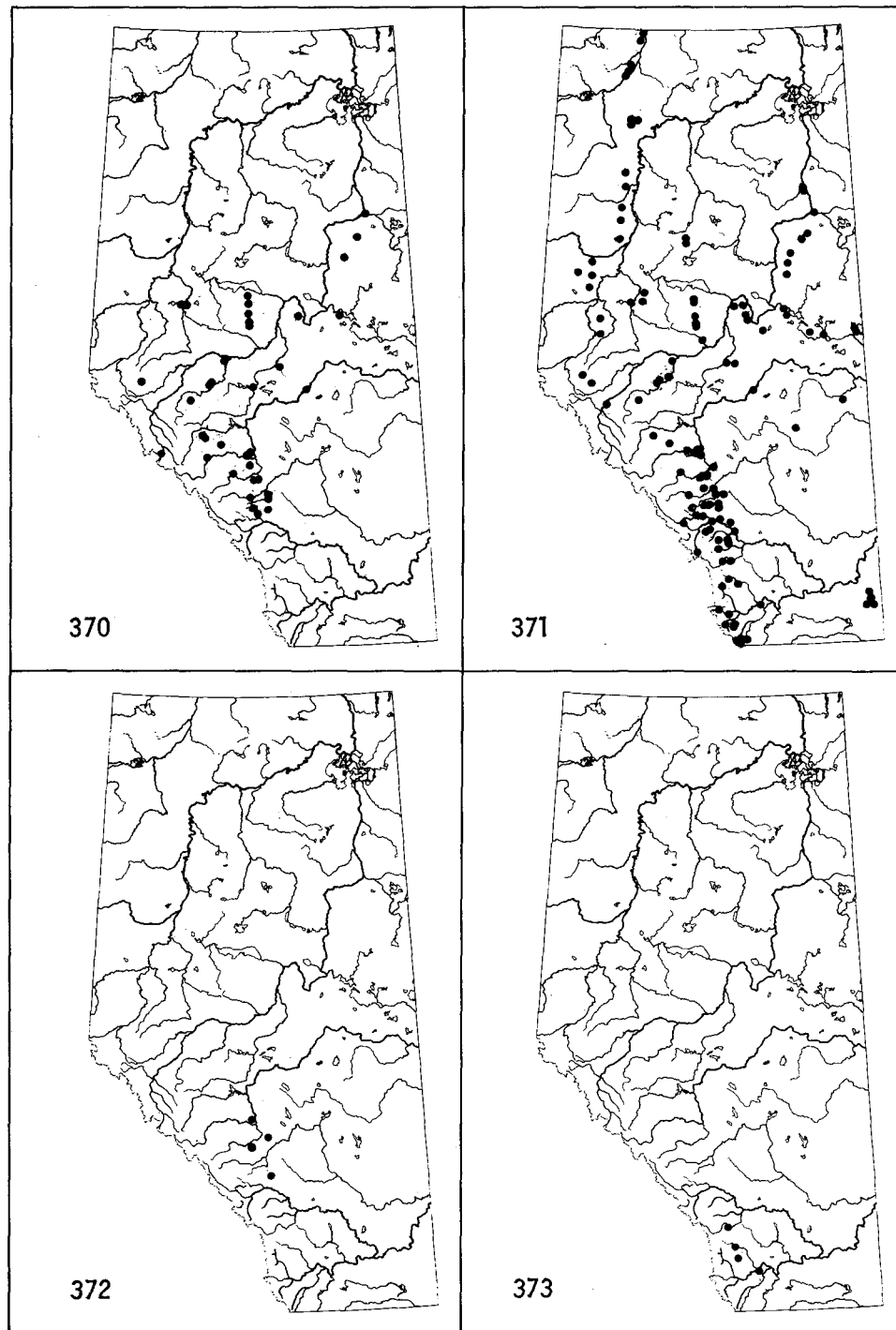


Fig. 370-373. Maps of Alberta collection localities for: 370. *Hydroporus tristis*; 371. *H. striola*; 372. *H. badiellus*; 373. *H. carri*.

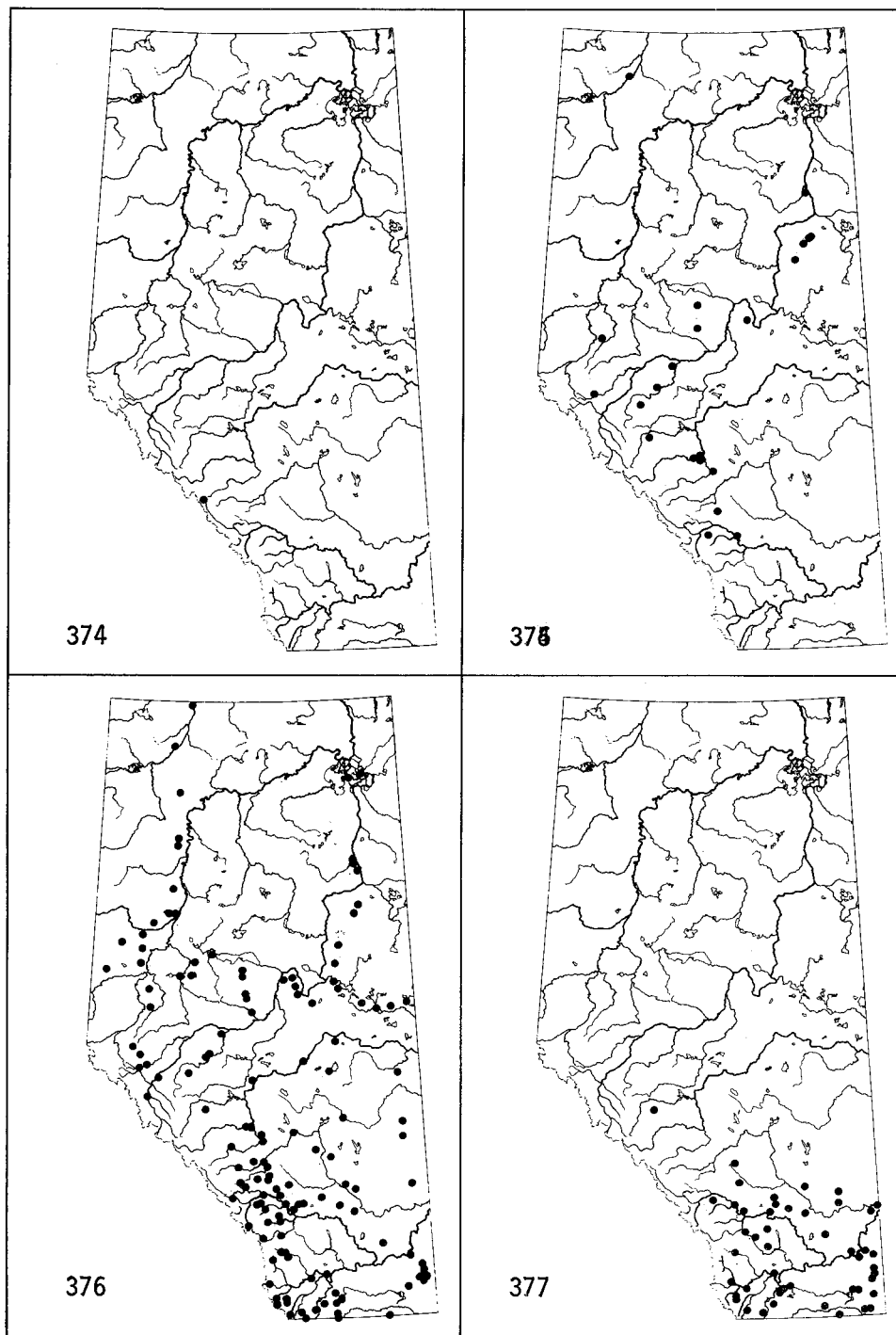


Fig. 374-377. Maps of Alberta collection localities for: 374. *Hydroporus transpunctatus*; 375. *H. rectus*; 376. *H. tenebrosus*; 377. *H. pervicinus*.

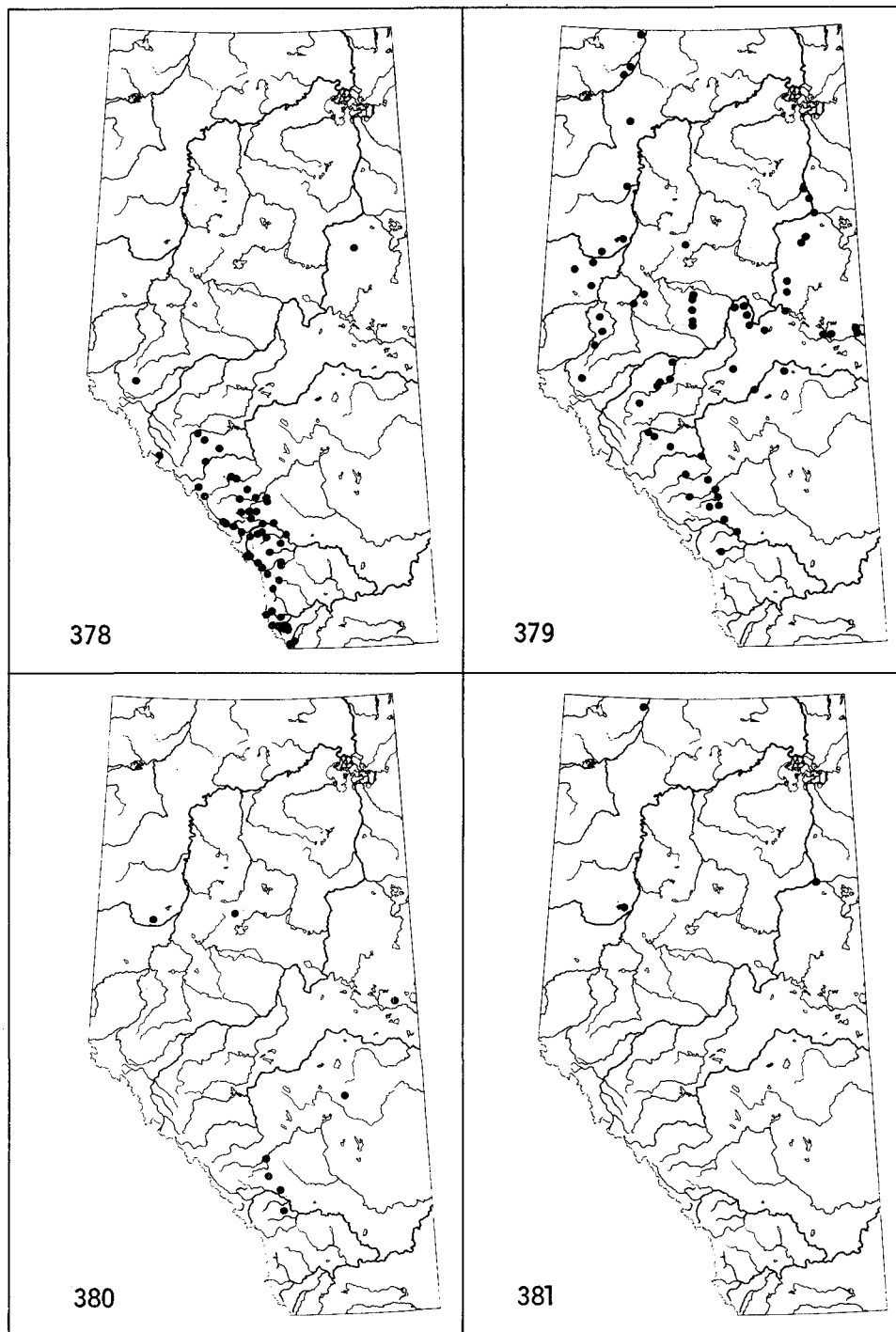


Fig. 378-381. Maps of Alberta collection localities for: 378. *Hydroporus despectus*; 379. *H. sp. nr. despectus*; 380. *H. tartaricus*; 381. *H. depressus*.

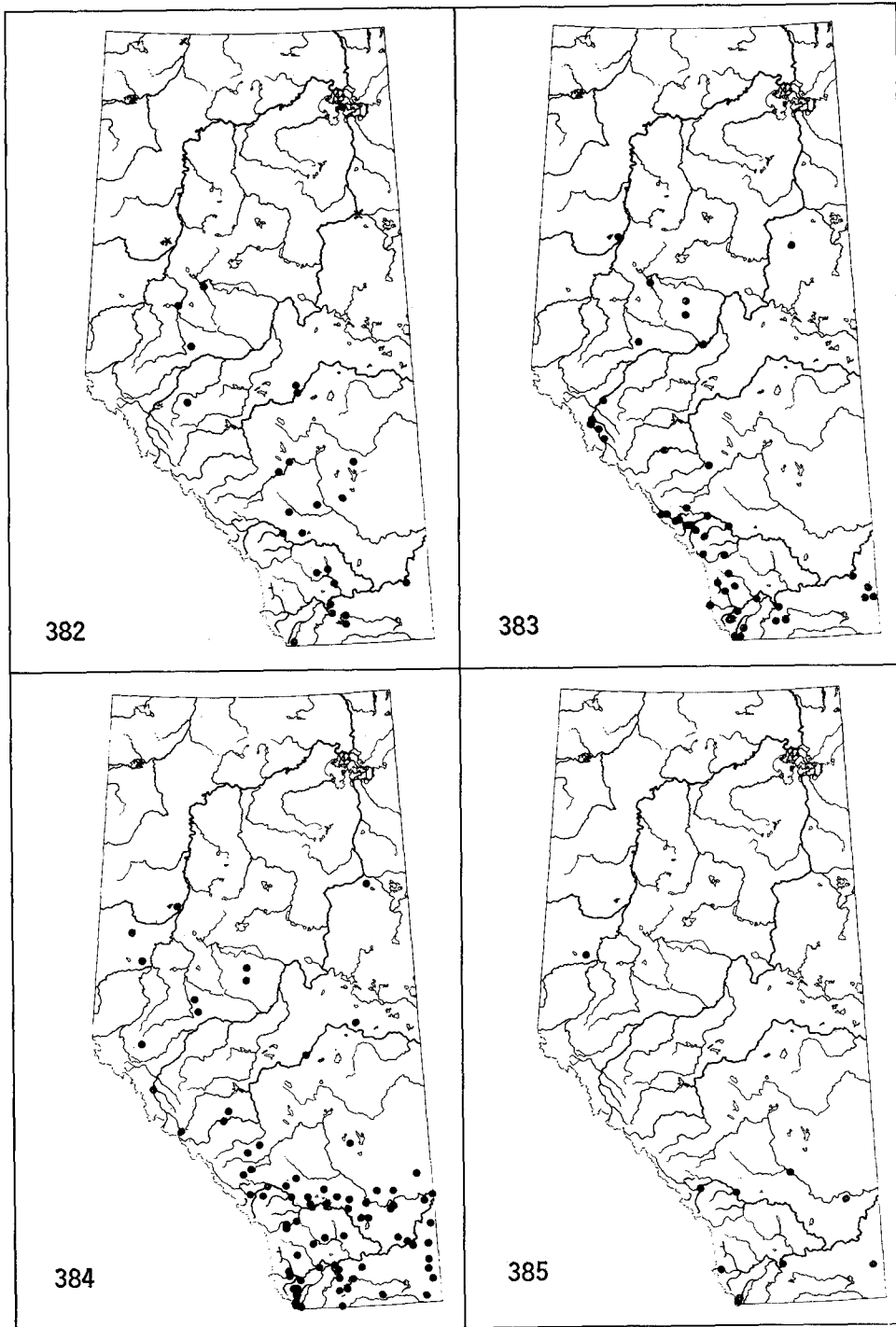


Fig. 382-385. Maps of Alberta collection localities for: 382. *Hydroporus elegans*; 383. *H. striatellus*; 384. *H. griseostriatus*; 385. *H. spenceri*.

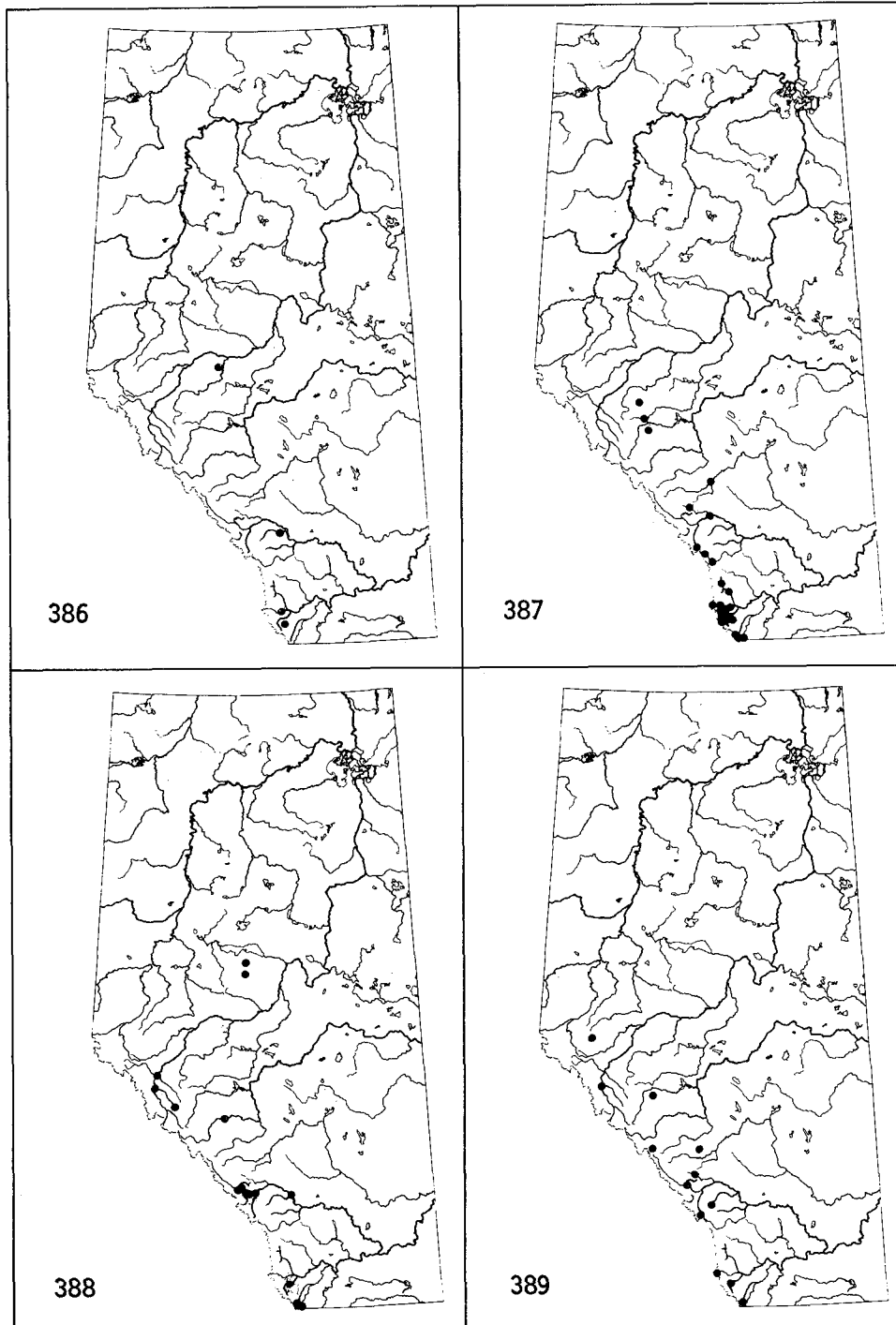


Fig. 386-389. Maps of Alberta collection localities for: 386. *Hydroporus quadrimaculatus*; 387. *H. snoqualmie*; 388. *H. laevis*; 389. *H. alaskanus*.

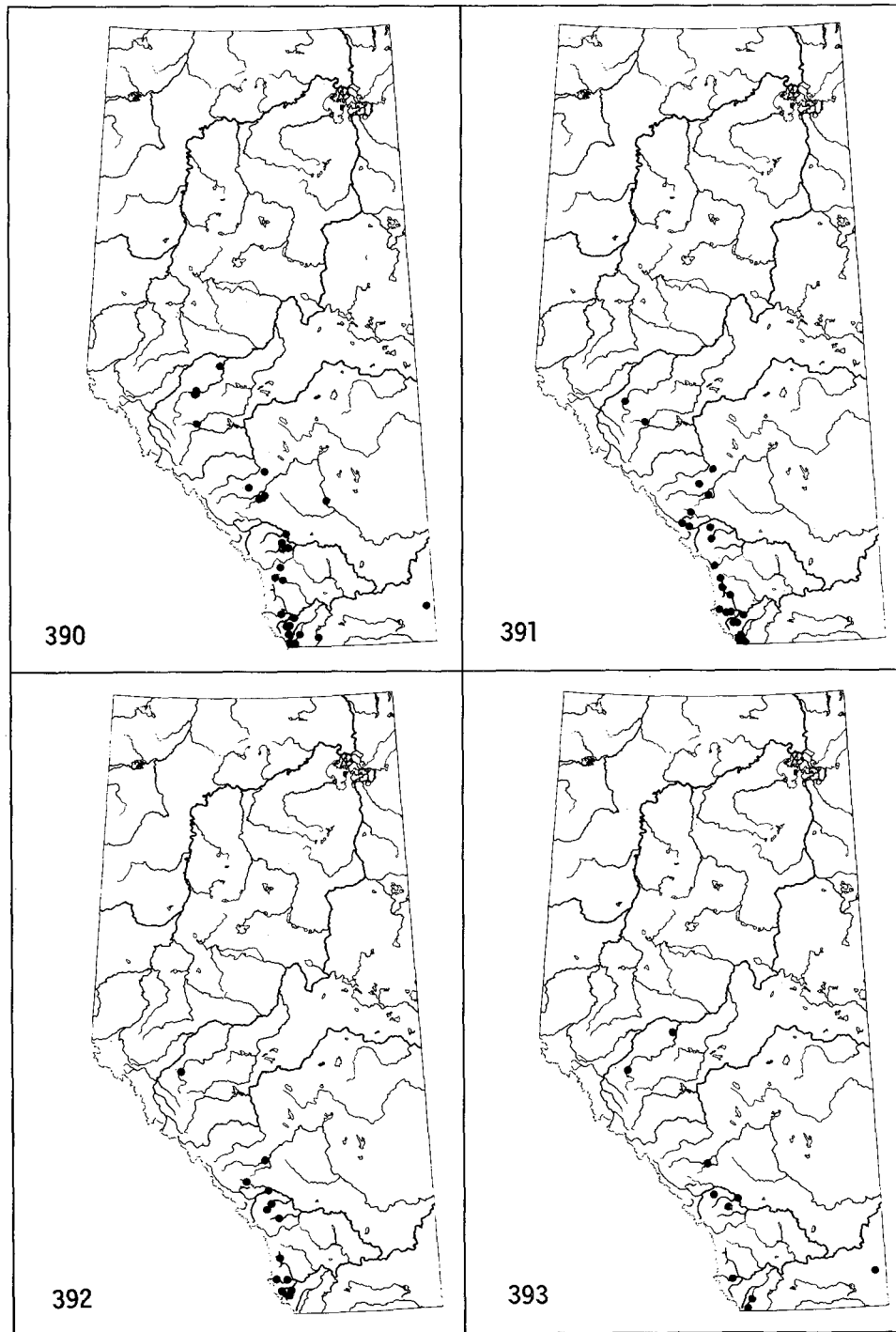


Fig. 390-393. Maps of Alberta collection localities for: 390. *Hydroporus scitulus*; 391. *H. rivalis*; 392. *H. congruus*; 393. *H. crassulus*.



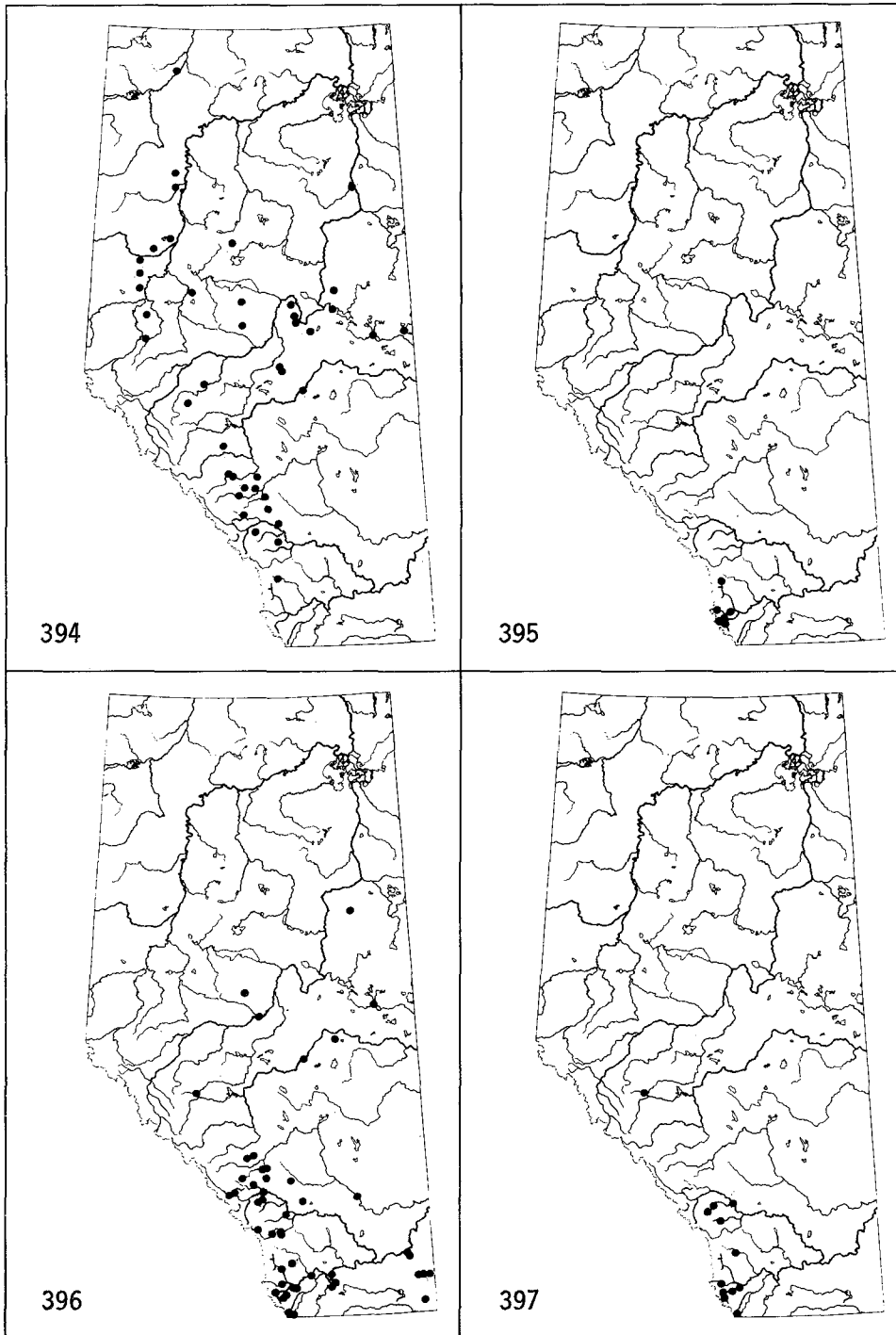


Fig. 394-397. Maps of Alberta collection localities for: 394. *Laccornis conoideus*; 395. *L. pacificus*; 396. *Agabus seriatus*; 397. *A. bjorkmanae*.

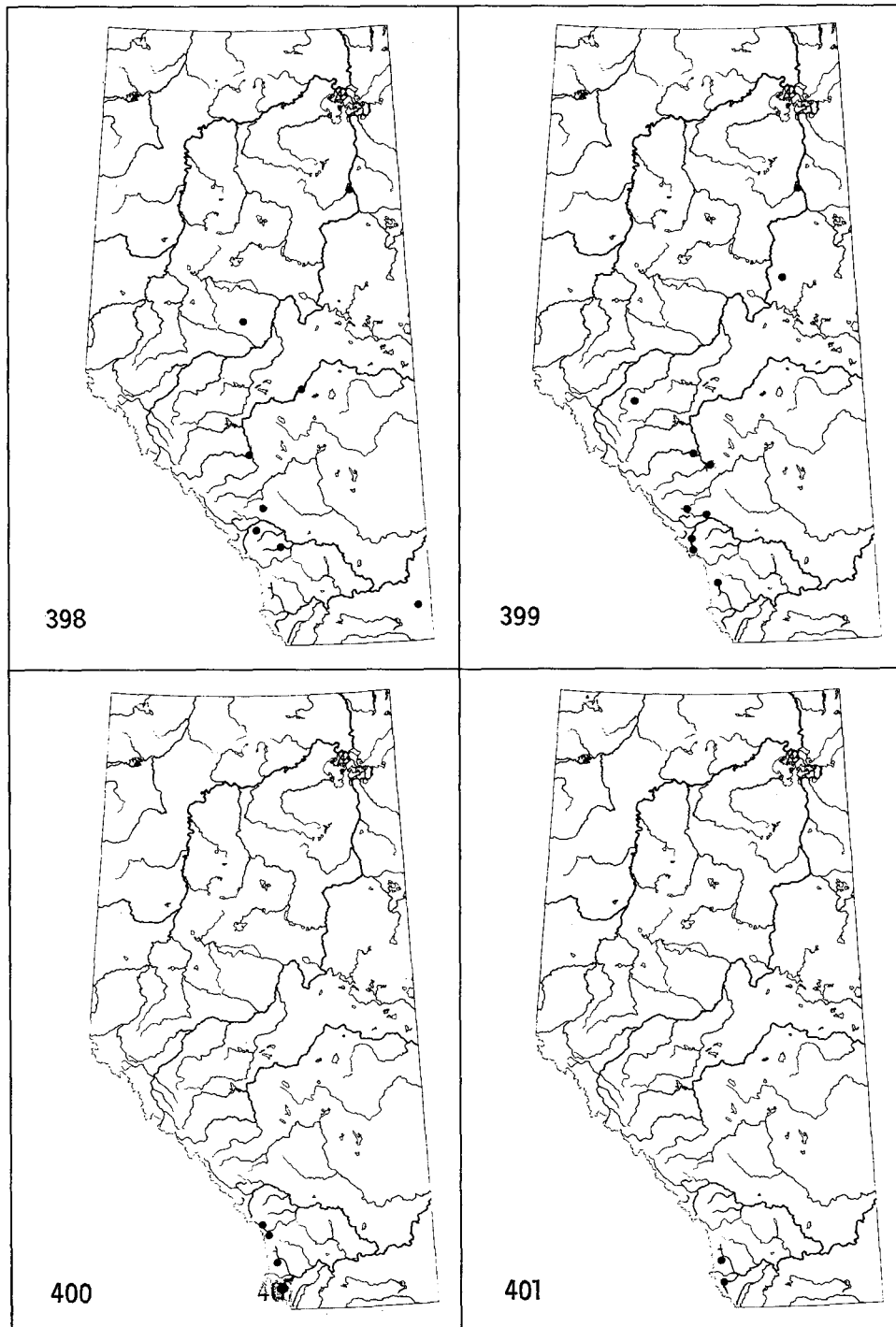


Fig. 398-401. Maps of Alberta collection localities for: 398. *Agabus pseudoconfertus*; 399. *A. kenaiensis*; 400. *A. verisimilis*; 401. *A. hypomelas*.

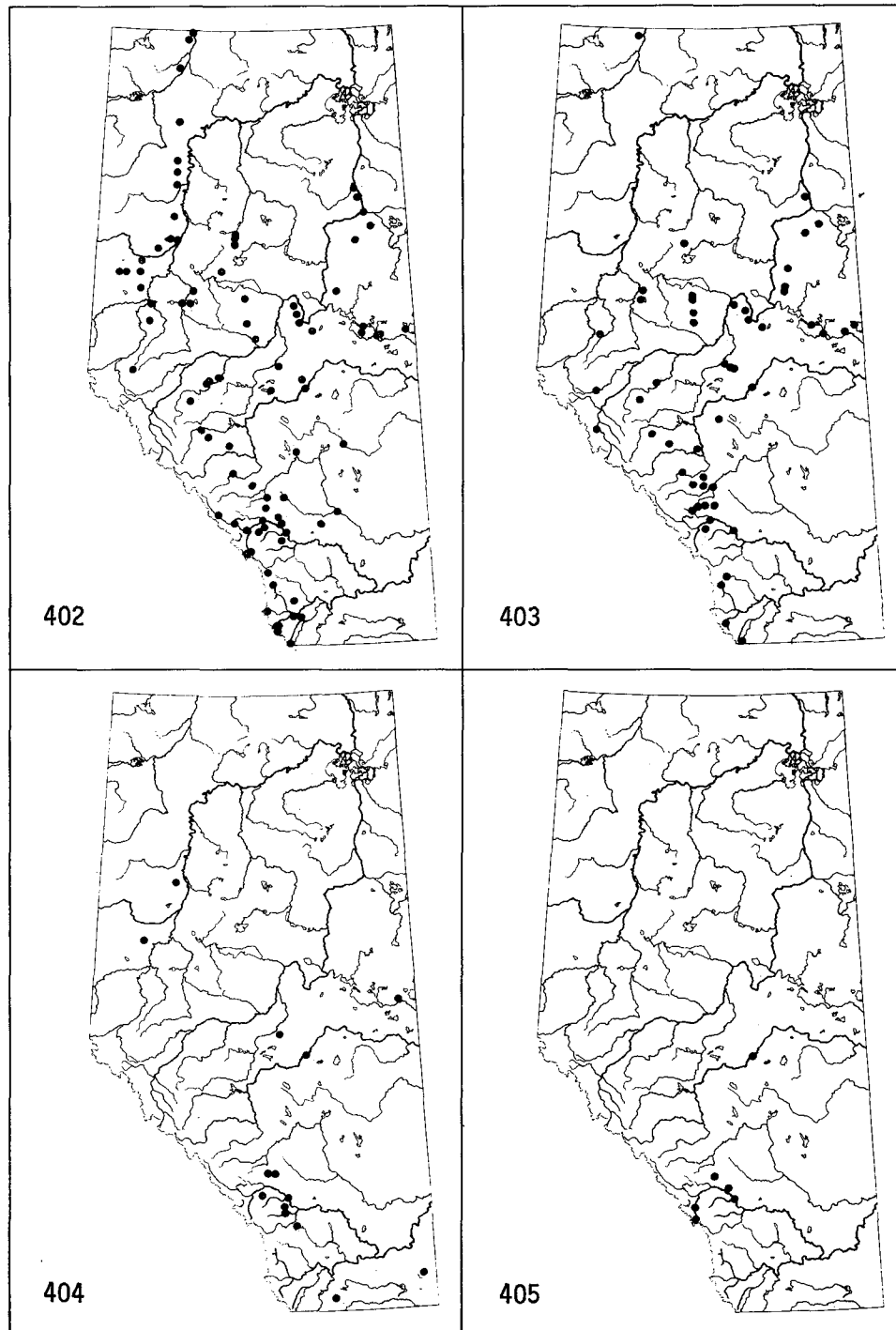


Fig. 402-405. Maps of Alberta collection localities for: 402. *Agabus erichsoni*; 403. *A. semipunctatus*; 404. *A. falli*; 405. *A. triton*.

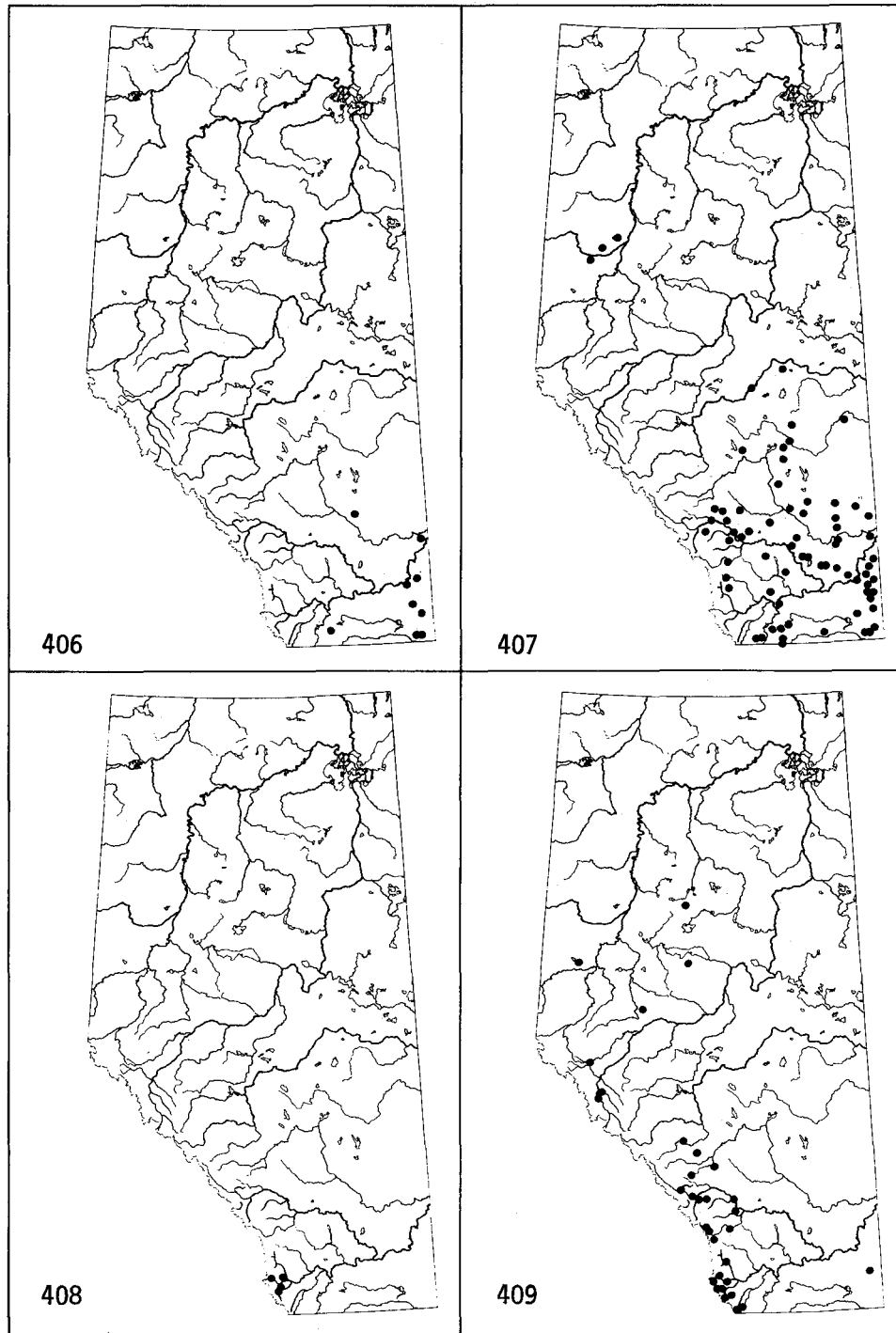


Fig. 406-409. Maps of Alberta collection localities for: 406. *Agabus margareti*; 407. *A. punctulatus*; 408. *A. pisobius*; 409. *A. austinii*.

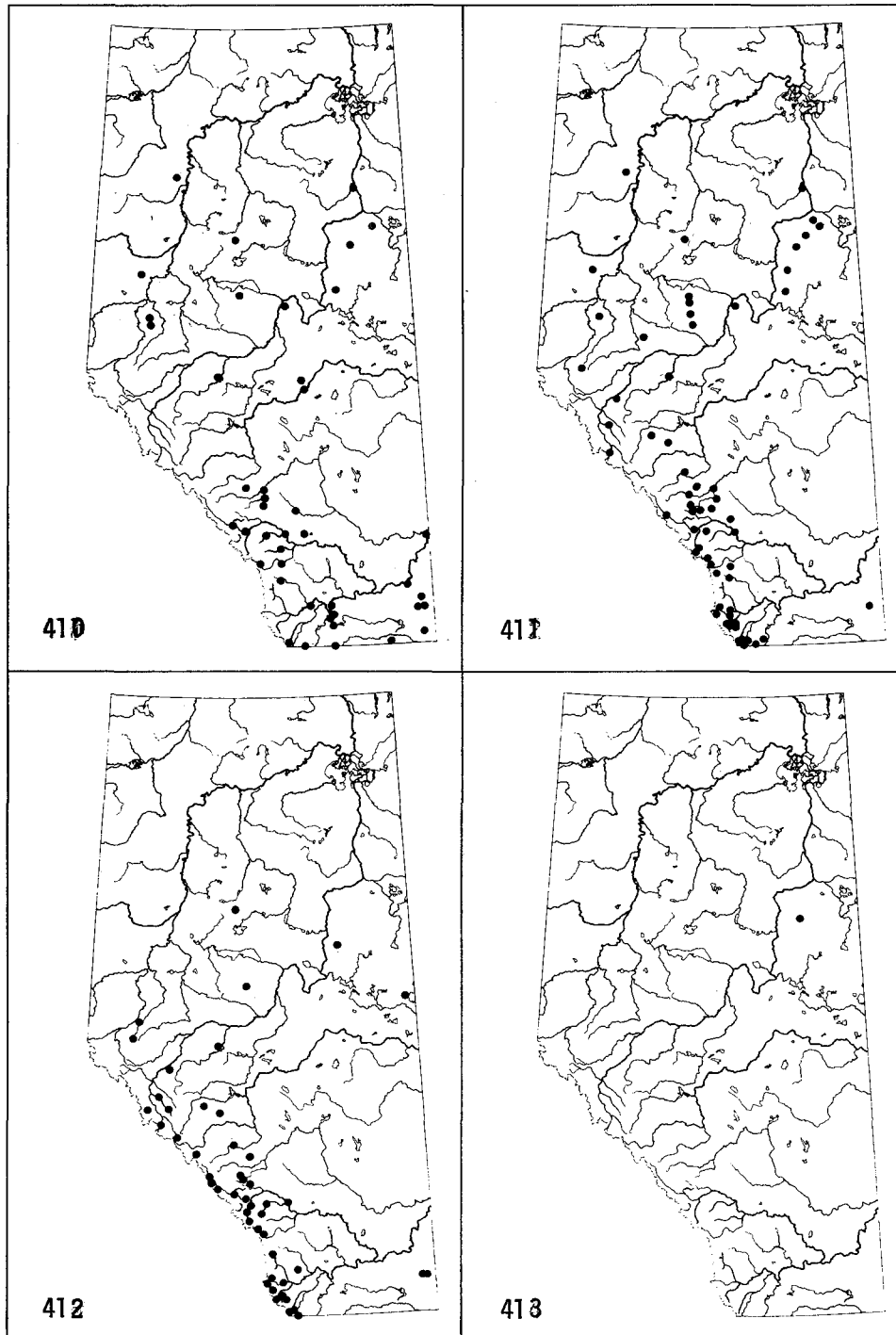


Fig. 410-413. Maps of Alberta collection localities for: 410. *Agabus ambiguus*; 411. *A. strigulosus*; 412. *A. tristis*; 413. *A. leptapsis*.

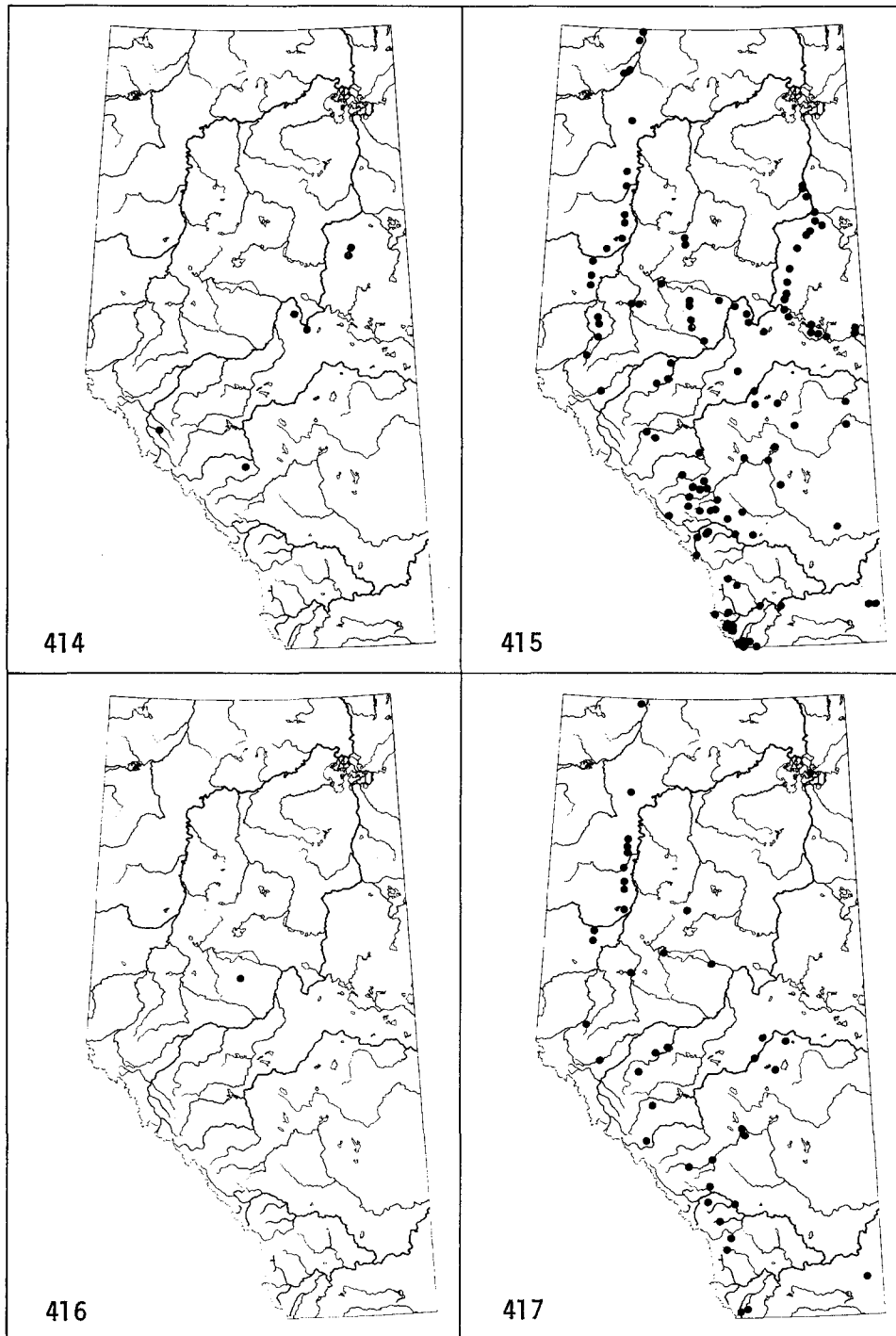


Fig. 414-417. Maps of Alberta collection localities for: 414. *Agabus arcticus*; 415. *A. anthracinus*; 416. *A. elongatus*; 417. *A. ajax*.

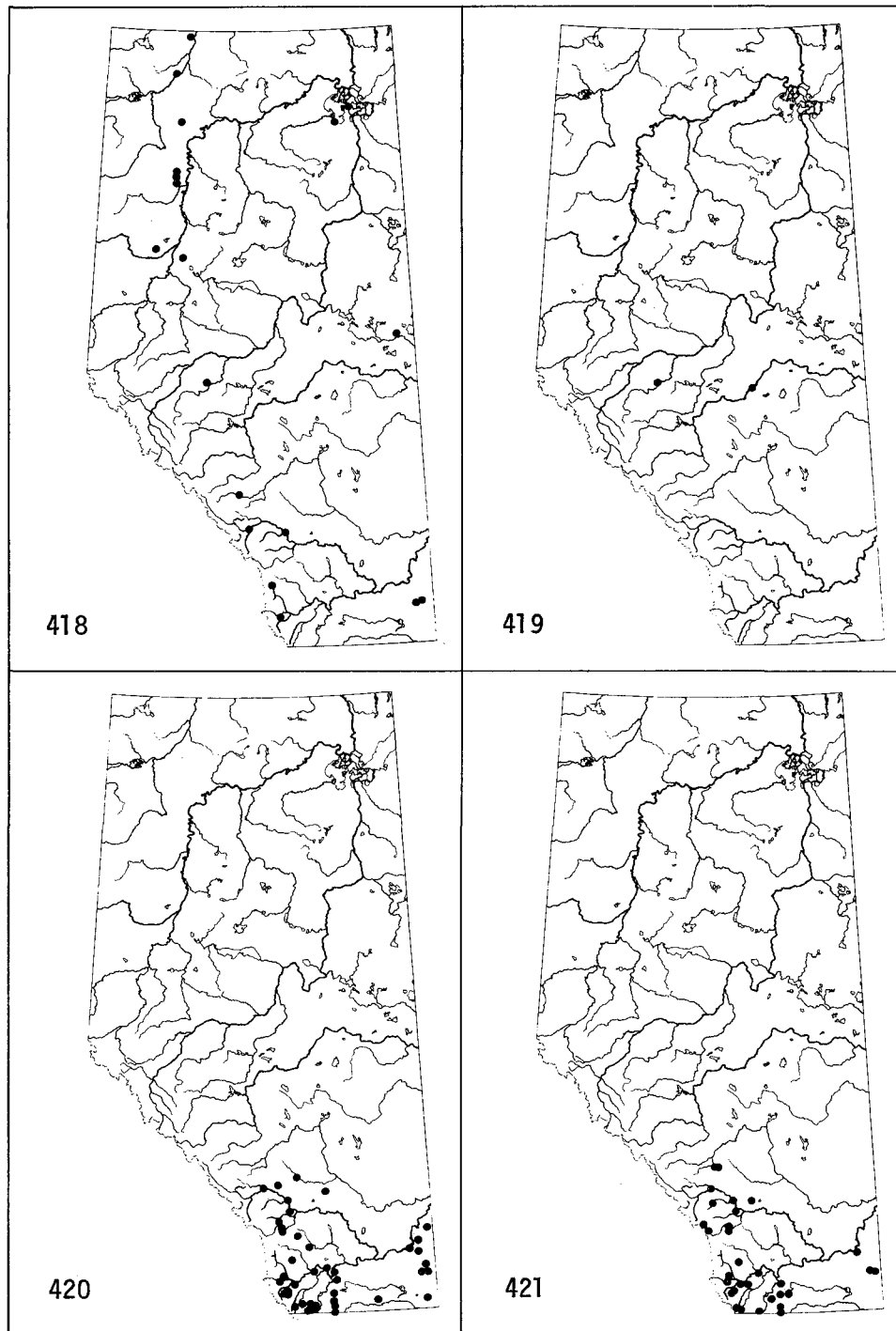


Fig. 418-421. Maps of Alberta collection localities for: 418. *Agabus ontarionis*; 419. *A. infuscatus*; 420. *A. lutosus*; 421. *A. nectris*.

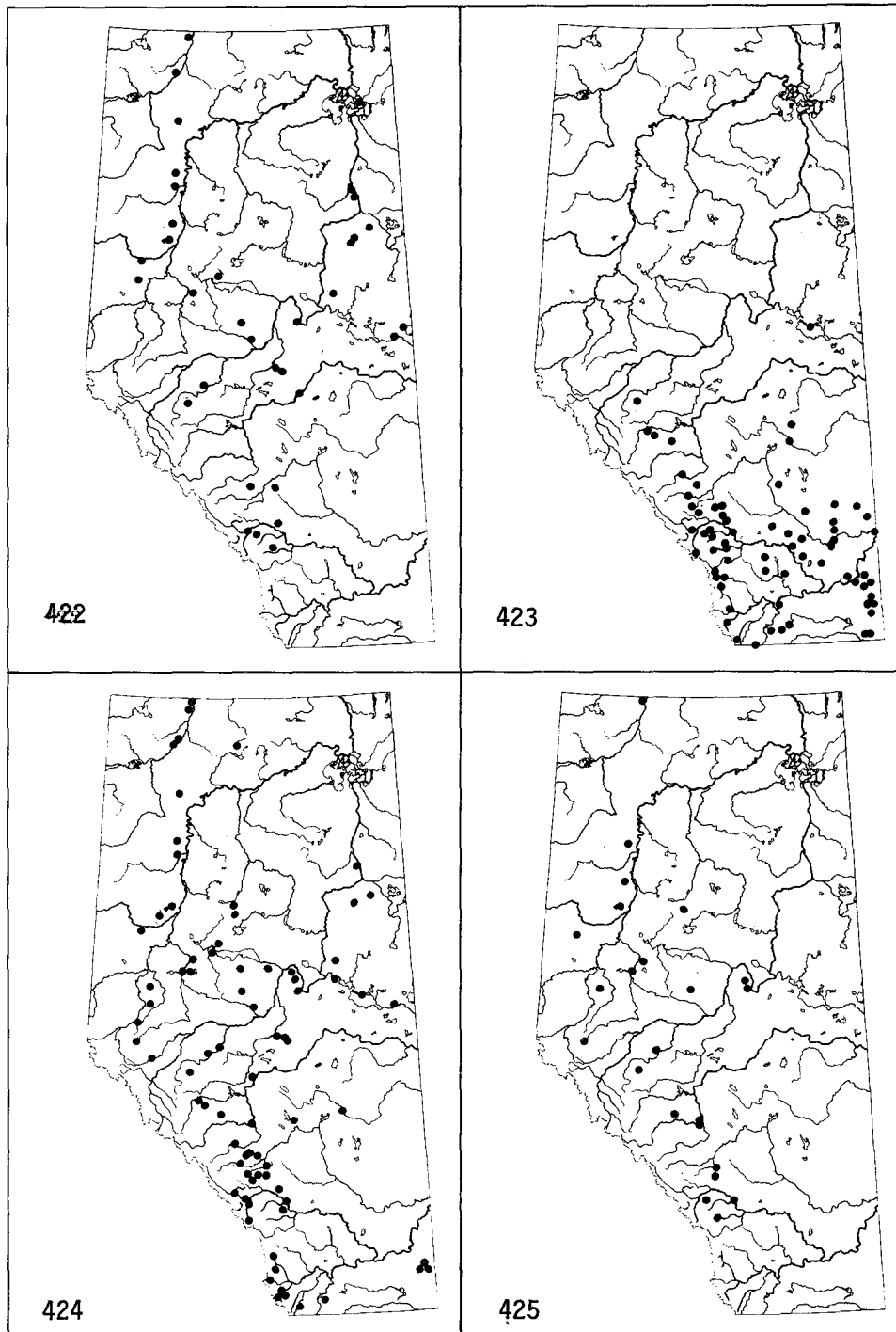


Fig. 422-425. Maps of Alberta collection localities for: 422. *Agabus audeni*; 423. *A. canadensis*; 424. *A. phaeopterus*; 425. *A. bicolor*.



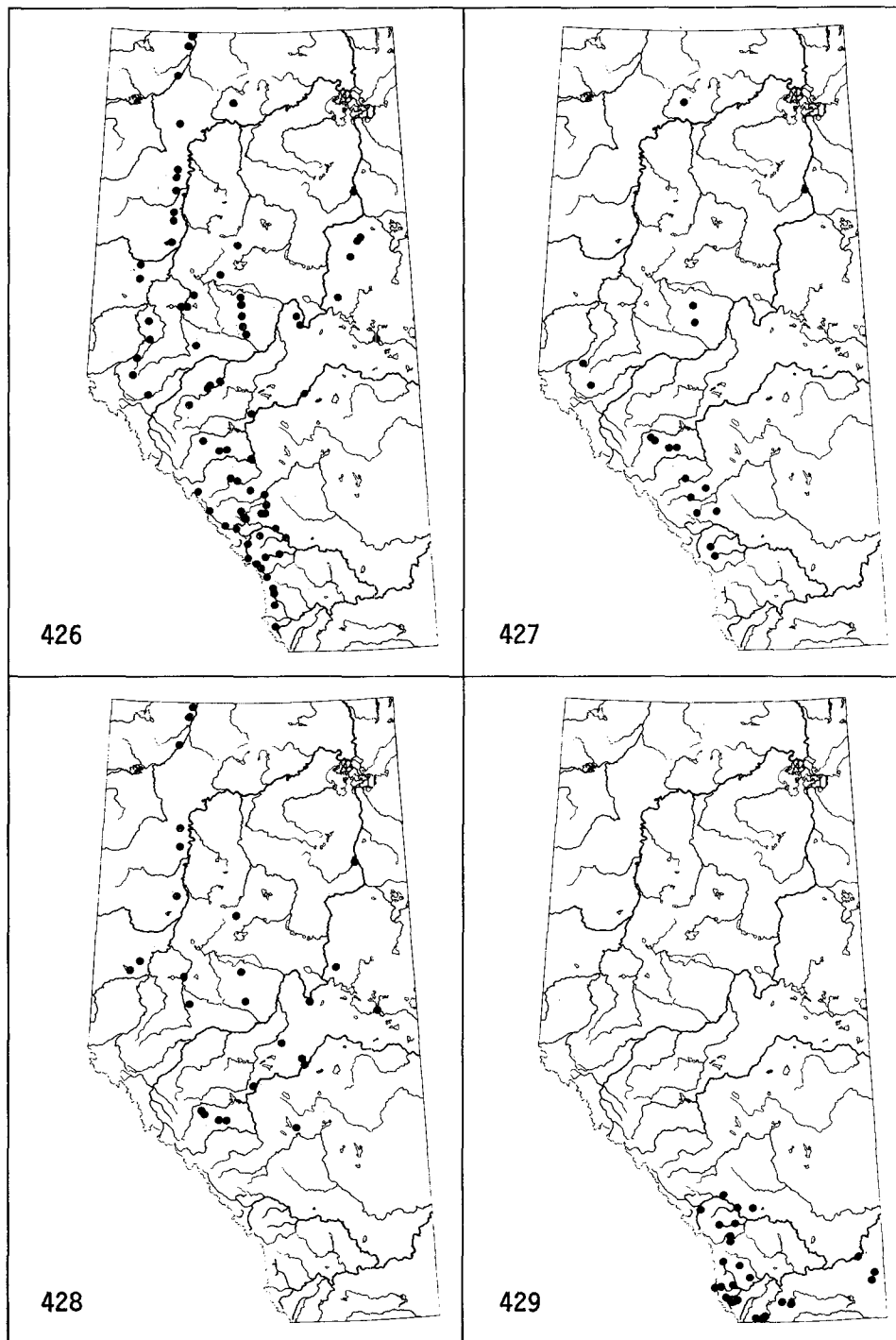


Fig. 426-429. Maps of Alberta collection localities for: 426. *Agabus confinis*; 427. *A. congener*; 428. *A. discolor*; 429. *A. approximatus*.

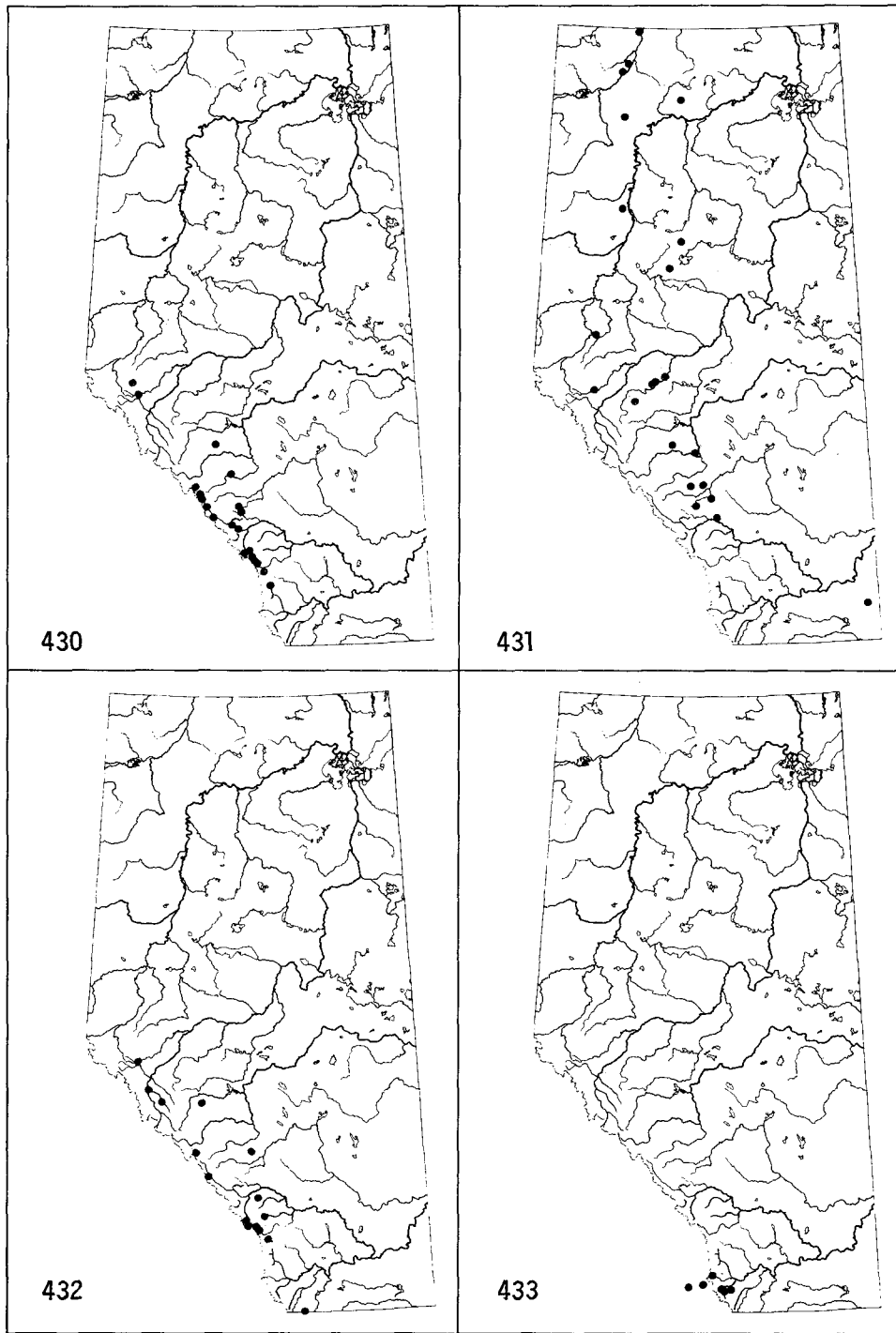


Fig. 430-433. Maps of Alberta collection localities for: 430. *Agabus* sp. nr. *approximatus*; 431. *A. inscriptus inscriptus*; 432. *A. inscriptus* form B; 433. *A. inscriptus smithi*.

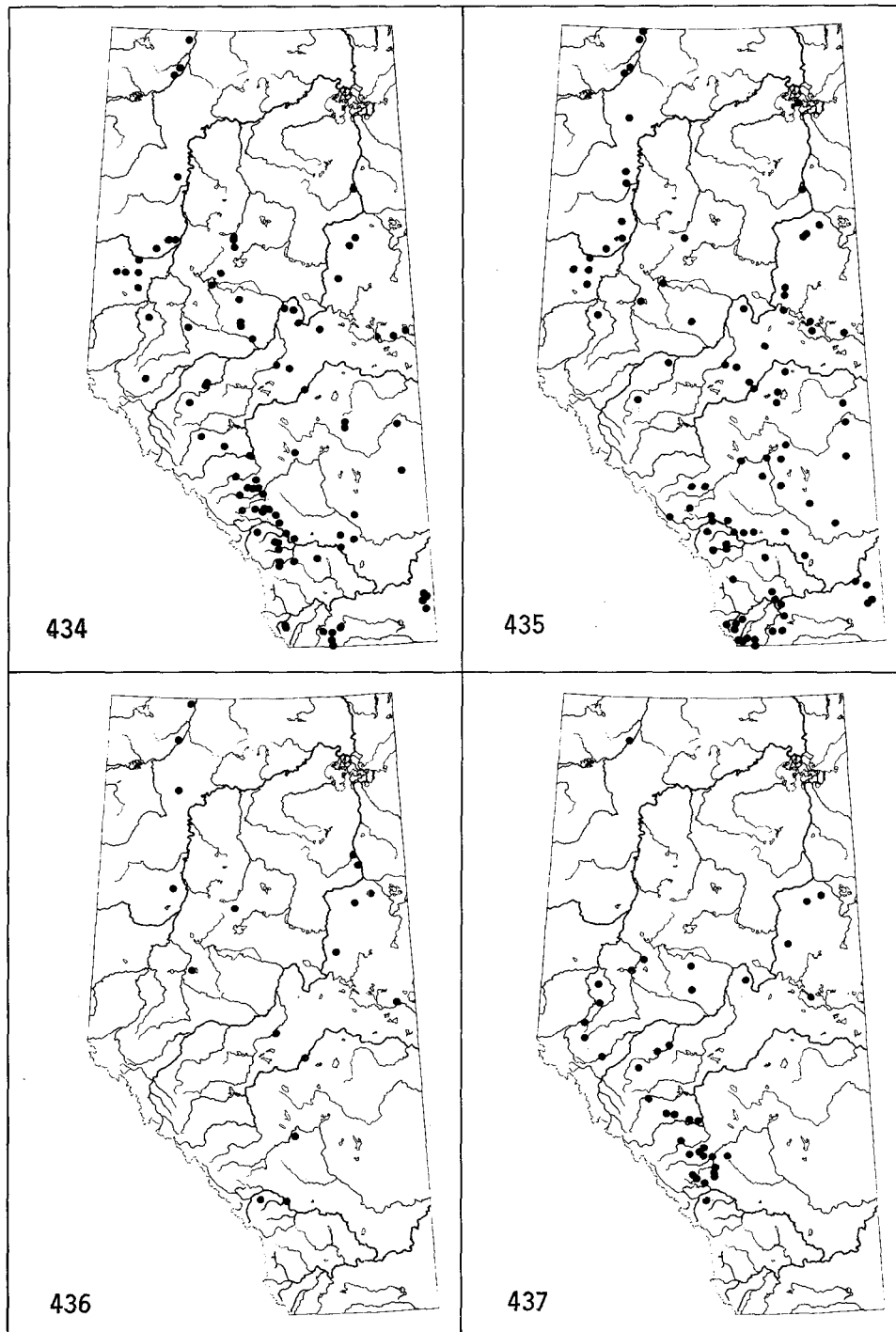


Fig. 434-437. Maps of Alberta collection localities for: 434. *Agabus bifarius*; 435. *A. antennatus*; 436. *Carhydrus crassipes*; 437. *Ilybius discedens*.

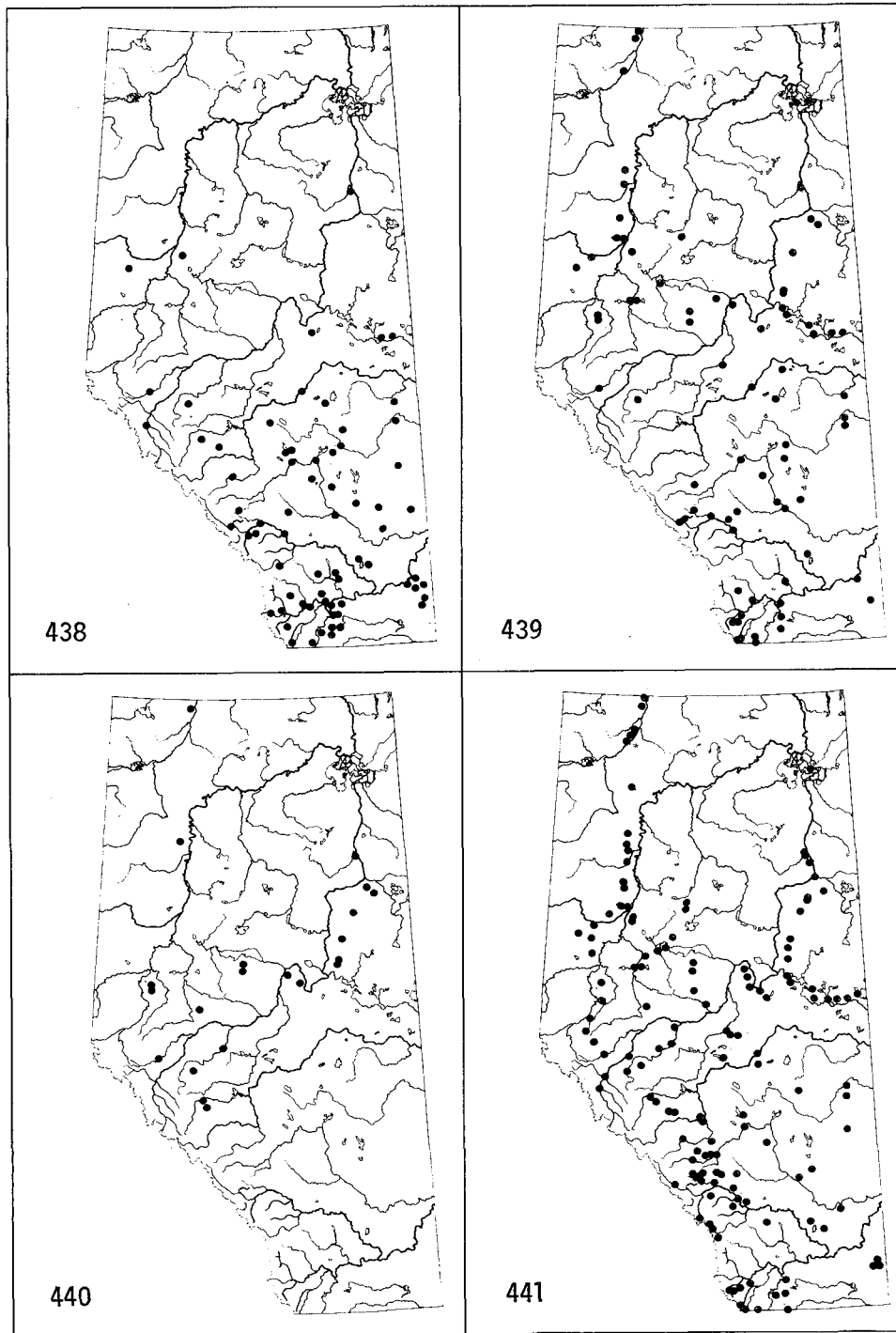


Fig. 438-441. Maps of Alberta collection localities for: 438. *Ilybius fraterculus*; 439. *I. subaeneus*; 440. *I. pleuriticus*; 441. *I. angustior*.

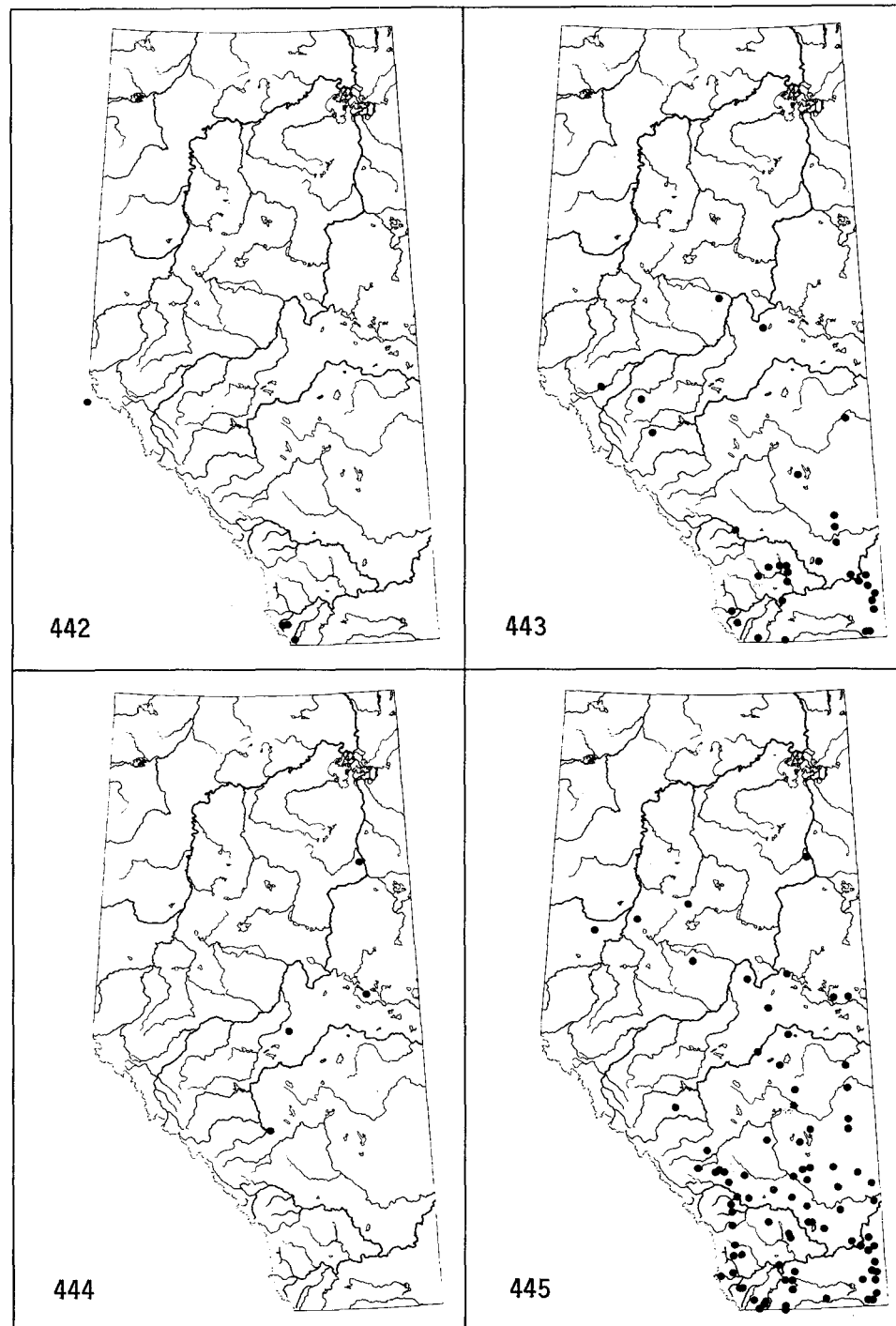


Fig. 442-445. Maps of Alberta collection localities for: 442. *Ilybius quadrimaculatus*; 443. *Coptotomus longulus*; 444. *Rhantus sinuatus*; 445. *R. consimilis*.

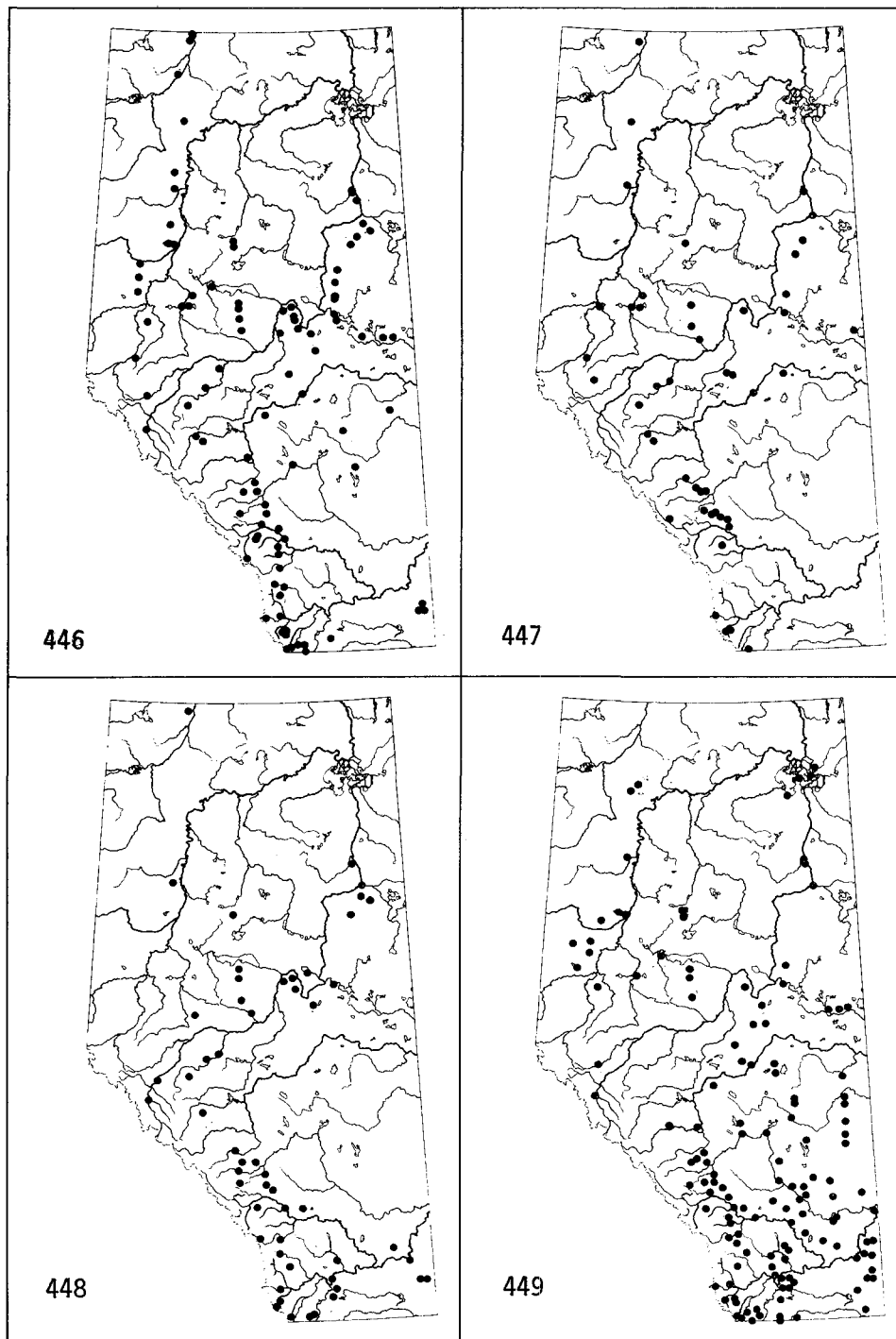


Fig. 446-449. Maps of Alberta collection localities for: 446. *Rhantus wallisi*; 447. *R. suturellus*; 448. *R. binotatus*; 449. *R. frontalis*.

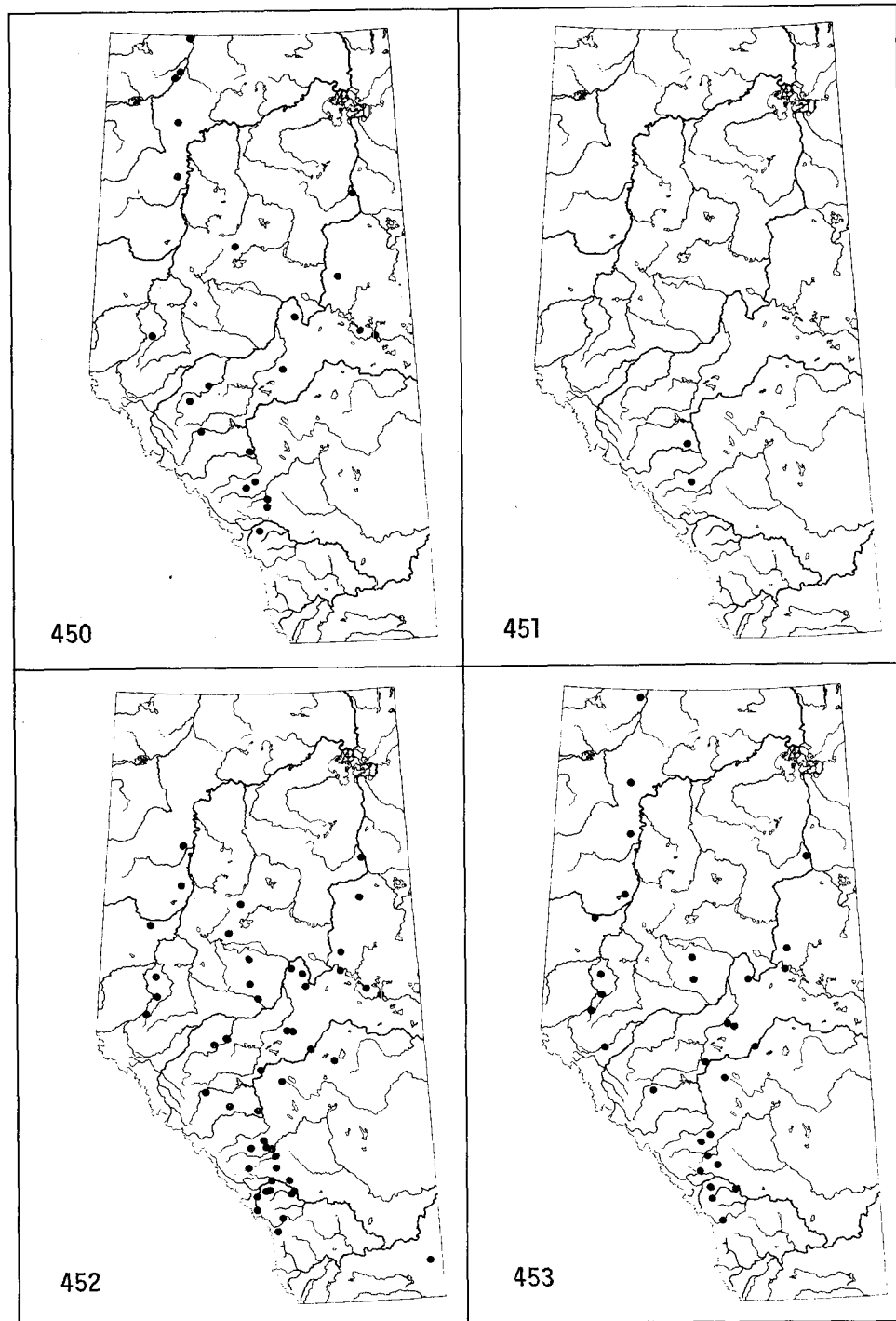


Fig. 450-453. Maps of Alberta collection localities for: 450. *Neoscutopterus hornii*; 451. *N. angustus*; 452. *Colymbetes longulus*; 453. *C. seminiger*.

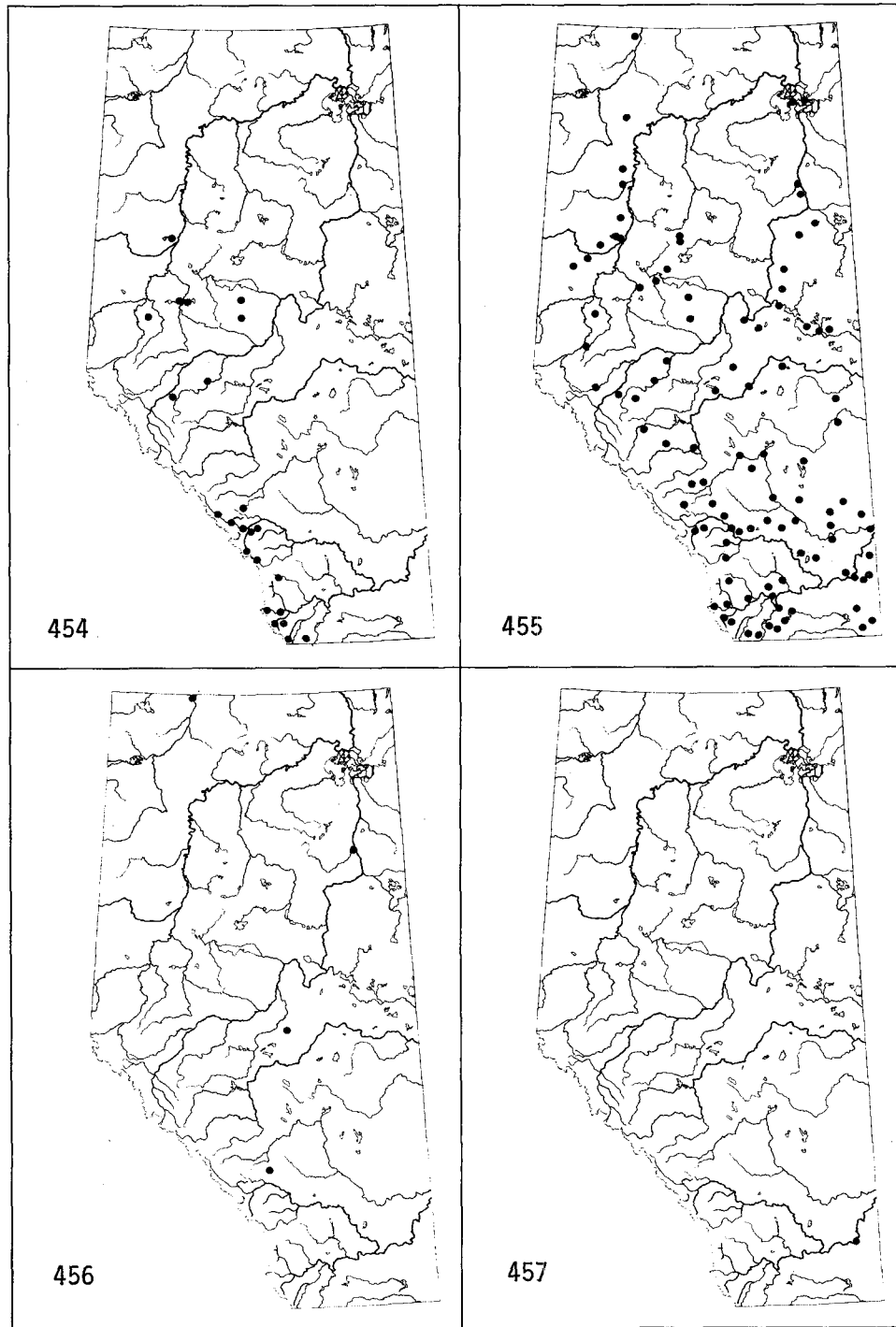


Fig. 454-457. Maps of Alberta collection localities for: 454. *Colymbetes exaratus*; 455. *C. sculptilis*; 456. *Dytiscus harrisii*, 457. *D. hybridus*.



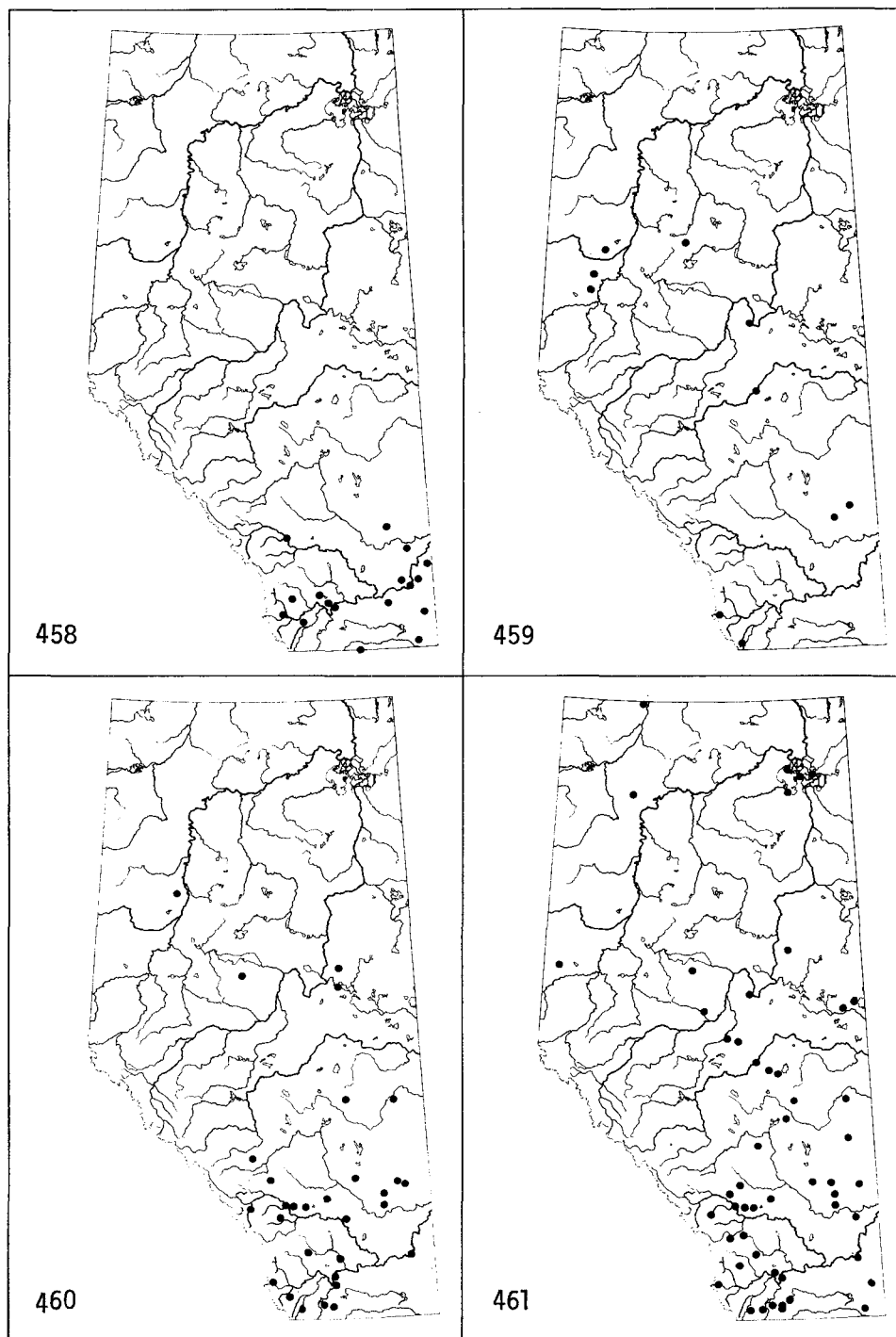


Fig. 458-461. Maps of Alberta collection localities for: 458. *Dytiscus marginicollis*; 459. *D. fasciventris*; 460. *D. cordieri*; 461. *D. circumcinctus*.

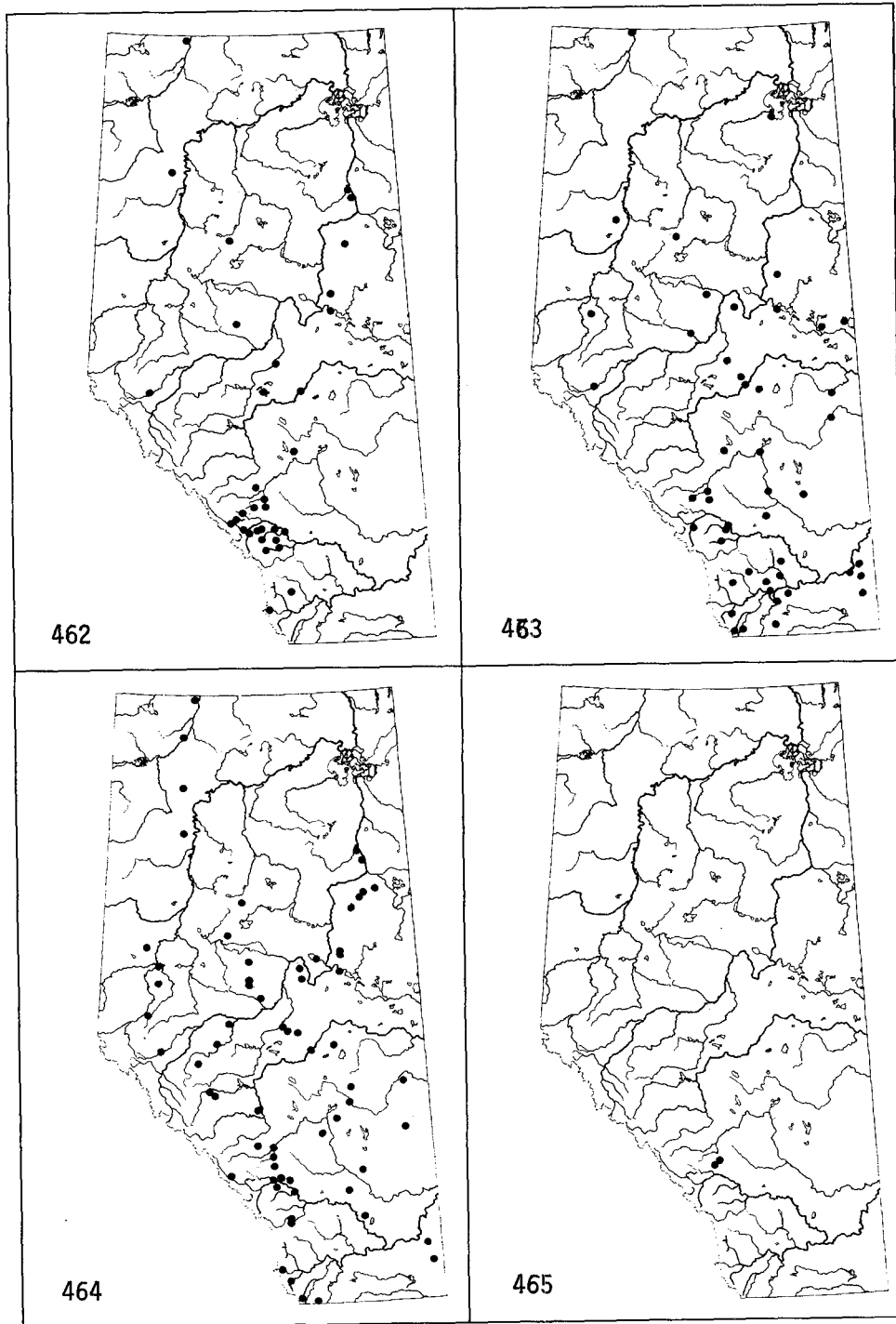


Fig. 462-465. Maps of Alberta collection localities for: 462. *Dytiscus dauricus*; 463. *D. alaskanus*; 464. *Hydaticus modestus*; 465. *Graphoderus liberus*.

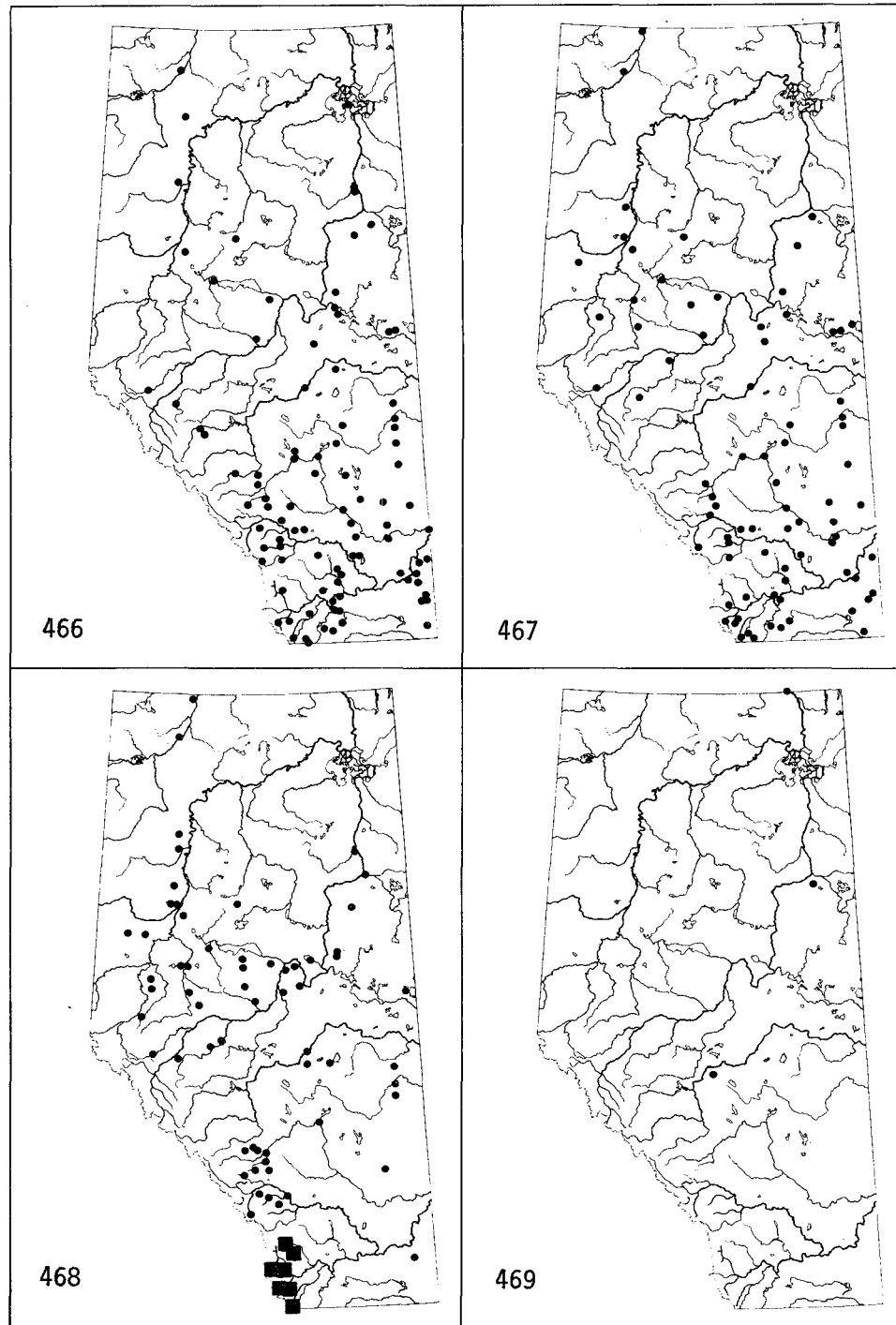


Fig. 466-469. Maps of Alberta collection localities for: 466. *Graphoderus perplexus*; 467. *G. occidentalis*; 468. *Acilius semi-sulcatus* (●); *A. abbreviatus* (■); 469. *A. athabasca*.

Index to Names of Taxa  
(Junior Synonyms and Junior Homonyms are in Italics)

- abbreviatus* auct., Acilius, 409  
*abbreviatus* Mann., Acilius, 409, 410  
*acadianus* J. Balfour-Browne, *Hydroporus*, 290  
*acaroides* (LeC.), *Hygrotus*, 265, 268  
*aequalis* Hatch, *Rhantus* 382, 383  
*aeneolus* Crotch, *Gaurodytes*, 345  
*aeruginosus* , Agabus, 343  
*affinis* Paykull, Agabus, 342  
*affinis* Say, *Hydroporus*, 262  
*affinis* (Say), *Liodessus*, 262, 416, 455  
*ajax* Fall, Agabus, 332, 352, 353, 354, 355, 416, 446, 448, 453, 477  
*alaskanus* J. Balfour-Browne, *Dytiscus*, 394, 395, 397, 402, 403, 404, 416, 451, 489  
*alaskanus* Fall, *Hydroporus*, 279, 285, 321, 322, 418, 444, 470  
*albionicus* Mots., *Dytiscus*, 401  
*alpinus* Crotch, *Hydroporus*, 320  
*ambiguus* (Say), Agabus, 334, 347, 348, 363, 364, 416, 446, 448, 453, 476  
*ambiguus* Say, *Colymbetes*, 347  
*americanus* Sharp, *Hydaticus*, 405, 406  
*angustior* Gyll., *Dytiscus*, 375  
*angustior* (Gyll.), *Ilybius*, 371, 372, 375, 376, 416, 449, 483  
*angustior* Hatch, *Hydroporus*, 279, 286, 325, 417  
*angustus* LeC., Agabus, 384, 385  
*angustus* (LeC.), *Neoscutopterus*, 385, 450, 486  
*antennatus* Leech, Agabus, 329, 330, 368, 369, 445, 446, 448, 454, 482  
*anthracinus* Mann., Agabus, 334, 347, 352, 417, 438, 445, 446, 448, 453, 477  
*anticus* Sharp, *Hydroporus*, 286  
*anxius* Mann., *Dytiscus*, 401, 402  
*appalachius* Sherman, *Hydroporus*, 282, 299, 300, 301, 441, 442, 443, 464  
*approximatus* Fall, Agabus, 335, 362, 363, 364, 365, 418, 448, 454, 480  
*approximatus*, species near, Agabus, 335, 364, 365, 448, 454, 481  
*arcticus* (Payk.), Agabus, 331, 351, 352, 445, 446, 448, 453, 477  
*arcticus* Payk., *Dytiscus*, 351  
*arcticus* Thoms., *Hydroporus*, 295  
*arctus* Melsh., Agabus, 335  
*assimilis* Kby., *Colymbetes*, 382, 383  
*ater* Degeer, *Ilybius*, 429  
*athabascae* Larson n. sp., Acilius, 409, 410, 411, 451, 490  
*atratus* Mann., Agabus, 349  
*audeni* Wallis, Agabus, 332, 358, 446, 448, 454, 479  
*austinii* LeC., *Gaurodytes*, 346  
*austinii* Sharp, Agabus, 334, 346, 347, 418, 446, 448, 453, 475  
*badiellus* Fall, *Hydroporus*, 283, 307, 441, 443, 466  
*belfragei* Sharp, *Hydroporus*, 293  
*bicolor* (Kby.), Agabus, 332, 360, 361, 362, 454, 479  
*bicolor* Kirby, *Colymbetes*, 360  
*bifarius* (Kby.), Agabus, 329, 330, 367, 368, 416, 431, 446, 448, 454, 482  
*bifarius* Kby., *Colymbetes*, 328, 367  
*biguttatus* Kby., *Laccophilus*, 259, 260, 416, 455  
*biguttulus* Thomson, Agabus, 342  
*bimarginatus* Wickham, *Hydaticus*, 405  
*binotatus* Harris, *Colymbetes*, 382  
*binotatus* (Harris), *Rhantus*, 378, 379, 382, 383, 416, 449, 485  
*bipustulatus* L., Agabus, 429  
*bistriatus* auct., *Rhantus*, 381  
*bjorkmanae* Hatch, Agabus, 330, 336, 337, 418, 445, 447, 452, 472  
*borealis* (Fall), *Hygrotus*, 271  
*borealis* Gyll., *Hydroporus*, 279  
*brodei* Gellerman, *Hydroporus*, 318, 319  
*browni* Leech, Agabus, 415  
*brumalis* Brown, *Hydroporus*, 293  
*brunneus* Fab., *Dytiscus*, 328  
*brunnipennis* Aubé, *Hydaticus*, 407  
*bryanti* Carr, Agabus, 355  
*caliginosus* LeC., *Hydroporus*, 304  
*canadensis* Fall, Agabus, 332, 358, 359, 360, 361, 446, 448, 454, 479  
*canadensis* Fall, *Coelambus*, 270  
*canadensis* (Fall), *Hygrotus*, 266, 270, 271, 418,

- canadensis* (Fall), *Hygrotus* (con't), 439, 440, 452, 456  
*canaliculatus* , *Acilius*, 411  
*cantralli* Young, *Bidessus*, 263  
*cantralli* (Young), *Liodesus*, 263, 264, 455  
*carolinus* Aubé, *Dytiscus*, 399  
*carri* Larson n. sp., *Hydroporus* 284, 307, 308, 309, 415, 441, 442, 466  
*catascopium* Say, *Hydroporus* , 316, 317  
*chalconotus* Panzer, *Dytiscus*, 328  
*churchillensis* Wallis, *Ilybius*, 376, 449  
*cinctipennis* Aubé, *Hydaticus*, 405, 406  
*cinereus* Horn, *Graphoderus*, 407  
*cinereus* L., *Dytiscus*, 406  
*circumcinctus* Ahrens, *Dytiscus*, 394, 395, 397, 401, 402, 403, 416, 451, 488  
*clavatus* LeC., *Agabus*, 368  
*clavicornis* Sharp, *Agabus*, 368, 370  
*collaris* LeC., *Hydroporus*, 291  
*coloradensis* Fall, *Hydroporus*, 316, 317  
*columbianus* Fall, *Hydroporus*, 261, 270, 281, 294, 441, 442, 462  
*colymbus* Leech, *Agabus*, 333, 415, 447  
*compar* Fall, *Coelambus*, 269  
*compar* (Fall), *Hygrotus*, 266, 267, 269, 270, 439, 440, 452, 456  
*compar* Melsh., *Leionotus*, 398  
*compertus* Brown, *Hydroporus*, 281, 291, 292, 293, 417, 441, 462  
*concinus* LeC., *Hydroporus*, 279  
*confertus* LeC., *Agabus*, 330, 338  
*confinis* (Gyll.), *Agabus*, 332, 361, 362, 417, 446, 448, 454, 480  
*confinis* Gyll., *Dytiscus*, 361  
*conformis* Stephens, *Dytiscus*, 394  
*confluens* Say, *Dytiscus*, 402  
*confluentus* LeC., *Dytiscus*, 403  
*confusus* Aubé, *Ilybius*, 373  
*congener* (Paykull), *Agabus*, 364  
*congener* (Thunberg), *Agabus*, 328, 329, 335, 347, 362, 363, 364, 365, 417, 448, 454, 480  
*congener* Thunberg, *Dytiscus*, 362  
*congruus* LeC., *Hydroporus*, 279, 285, 324, 418, 444, 471  
*conoideus* LeC., *Hydroporus*, 326  
*conoideus* (LeC.), *Laccornis*, 326, 327, 417, 444, 472  
*consimilis* LeC., *Hydroporus*, 286, 287  
*consimilis* Mots., *Rhantus*, 378, 380, 449, 484  
*convexa* (Aubé), *Desmopachria*, 261, 452, 455  
*convexus* Aubé, *Hydroporus*, 261  
*cordata* LeC., *Anisomera*, 327  
*cordaticollis* Reitter, *Gaurodytes*, 328  
*cordatus* (LeC.), *Agabus*, 337, 445, 447  
*cordieri* Aubé, *Dytiscus*, 394, 395, 396, 400, 416, 451, 488  
*coriaceus* Horn, *Colymbetes* (*Scutopterus*), 385  
*coxalis* Sharp, *Agabus*, 328, 332, 415, 427  
*crassipes* Fall, *Carrhydrus*, 369, 370, 449, 482  
*crassulus* Fall, *Hydroporus*, 279, 285, 324, 418, 471  
*criniticoxis* Larson n. sp., *Hydroporus*, 282, 301, 416, 441, 465  
*crotchi* Zaitzev, *Agabus*, 349, 350  
*dahuricus* Aubé, *Colymbetes*, 388  
*dauricus* Anderson, *Dytiscus*, 401, 402  
*dauricus* Gebler, *Dytiscus*, 394, 397, 403, 404, 451, 489  
*dauricus* Mots., *Hydroporus*, 322  
*decipiens* LeC., *Laccophilus*, 259  
*denikei* Wallis, *Ilybius*, 373  
*densus* LeC., *Colymbetes*, 389  
*dentellus* Fall, *Hydroporus*, 282, 295, 296, 416, 441, 442, 463  
*dentiger* Fall, *Coelambus*, 273  
*dentiger* (Fall), *Hygrotus*, 266, 267, 273, 274, 418, 439, 457  
*depressus* auct., *Hydroporus*, 314  
*depressus* Fab., *Dytiscus*, 315  
*depressus* (Fab.), *Hydroporus*, 279, 285, 314, 315, 416, 441, 442, 468  
*despectus* Sharp, *Hydroporus*, 284, 310, 311, 312, 313, 416, 417, 441, 442, 468  
*despectus*, species near. Sharp, *Hydroporus*, 284, 312, 313, 314, 441, 442, 468  
*diffinis* LeC., *Dytiscus*, 403  
*dimidiatus* G. & H., *Hydroporus*, 281, 287, 288, 440, 443, 460  
*discedens* Sharp, *Ilybius*, 327, 371, 372, 373, 417, 449, 482  
*discedens* Sharp, *Rhantus*, 380  
*discicollis* Ancey, *Agabus*, 328  
*discolor* (Harris), *Agabus*, 329, 335, 363, 364, 365, 454, 480  
*discolor* Harris, *Colymbetes*, 363  
*discolor* LeC., *Agabus*, 356

- disintegratus* (Crotch), *Agabus*, 331  
*divisus* Aubé, *Colymbetes*, 382  
*dorsalis* F., *Dytiscus*, 279  
*dubius* Mann., *Agabus*, 349  
*duodecimguttata* Dej., *Cicindela*, 417, 428  
*duodecimlineatus* LeC., *Hydroporus*, 320, 321  
*edwardsi* Wallis, *Hydroporus*, 281, 291, 292, 293, 441, 461  
*elatus* Sharp, *Graphoderus*, 407  
*elegans* Panzer, *Dytiscus*, 314  
*elegans* (Panzer), *Hydroporus*, 279, 285, 314, 315, 416, 441, 442, 469  
*elongatus* Gyll., *Agabus*, 331, 355, 356, 415, 416, 445, 446, 448, 453, 477  
*elongatus* Gyll., *Dytiscus*, 328  
*erichsoni* G. & H., *Agabus*, 329, 330, 340, 445, 446, 447, 452, 474  
*erythrocephalus* L., *Dytiscus*, 279  
*erythropterus* (Say), *Agabus*, 347  
*exaratus* LeC., *Colymbetes*, 386, 387, 388, 389, 390, 418, 450, 487  
*exaratus* Young & Severin, *Colymbetes*, 390  
*falli* (Zimm.), *Agabus*, 331, 333, 342, 343, 446, 447, 453, 474  
*falli* Zimm., *Gaurodytes*, 342  
*falsificus* Brown, *Hydroporus*, 293  
*farctus* (LeC.), *Hygrotus*, 265, 268, 269, 456  
*fasciatus* Harris, *Hydroporus*, 286  
*fascicollis* (Harris), *Graphoderus*, 408, 416  
*fasciventris* Say, *Dytiscus*, 394, 395, 396, 399, 400, 451, 488  
*fenestratus* Fab., *Dytiscus*, 370  
*fimbriatus* LeC., *Agabus*, 348  
*fimbriolatus* Say, *Cybister*, 430  
*flavogriseus* Crotch, *Rhantus*, 382  
*franklinii* Kby., *Dytiscus*, 403  
*fraterculus* LeC., *Ilybius*, 371, 372, 373, 374, 449, 483  
*frontalis* Marsham, *Dytiscus*, 383  
*frontalis* (Marsham), *Rhantus*, 378, 379, 383, 384, 449, 485  
*fuliginosus* Fab., *Ilybius*, 429  
*fuscatus* , *Liodessus*, 263  
*fuscipennis* Payk., *Dytiscus*, 327  
*fuscipennis* Schaum, *Hydroporus*, 282, 301, 302, 416, 441, 464  
*fuscostriatus* Mots., *Dytiscus*, 401  
*fuscus* Fab., *Dytiscus*, 386  
*gelidus* Fall, *Agabus*, 337  
*glabriusculus* Aubé, *Hydroporus*, 283, 303, 416, 443, 465  
*grapii* Gyll., *Dytiscus*, 378, 379  
*griseipennis* LeC., *Agabus*, 356  
*griseostriatus* (DeGeer), *Deronectes*, 434  
*griseostriatus* DeGeer, *Dytiscus*, 316  
*griseostriatus* (DeGeer), *Hydroporus*, 279, 285, 316, 317, 318, 415, 416, 440, 441, 469  
*guttatus* Payk., *Dytiscus*, 328  
*gutticollis* (Say), *Rhantus*, 379, 383  
*harrisii*, Kby., *Dytiscus*, 394, 395, 397, 398, 451, 487  
*hatchi* Wallis, *Dytiscus*, 396, 399, 400, 451  
*hockingi* Larson n. sp., *Hydroporus*, 282, 296, 441, 443, 463  
*hornii* (Crotch), *Neoscutopterus*, 384, 385, 386, 417, 438, 450, 486  
*hornii* Crotch, *Scutopterus*, 385  
*hortense* Hatch, *Hydroporus*, 320, 321  
*hudsonicus* Leech, *Agabus*, 415  
*humeralis* Aubé, *Hydroporus*, 297, 298  
*hybridus* Aubé, *Dytiscus*, 394, 396, 451, 487  
*hypomelas* Mann., *Agabus*, 331, 339, 340, 417, 431, 446, 447, 473  
*hypomelas hypomelas* Mann., *Agabus*, 340  
*hypomelas irregularis* Mann., *Agabus*, 340  
*immaculatus* Hatch, *Rhantus*, 382  
*impressopunctatus* Schaller, *Dytiscus*, 264, 276  
*impressopunctatus* (Schaller), *Hygrotus*, 266, 267, 276, 277, 416, 439, 452, 459  
*inaequalis* Crotch, *Hydroporus*, 267, 268  
*inaequalis* Fab., *Dytiscus*, 264  
*inaequalis* Horn, *Colymbetes*, 389  
*incarinatus* Zimm., *Ilybius*, 373  
*inconspicuous* Fall, *Laccophilus*, 260  
*infuscatus* Aubé, *Agabus*, 332, 353, 445, 446, 448, 478  
*inornatus* Sharp, *Hydroporus*, 298, 299  
*inscriptus* (Crotch), *Agabus*, 335, 363, 365, 366, 448, 454, 481  
*inscriptus* Crotch, *Gaurodytes*, 365  
*inscriptus smithi* , *Agabus*, 417, 481  
*insolens* LeC., *Amphizoa*, 418  
*interrogatus* (Fall), *Coptotomus*, 377, 416  
*interruptus* Say, *Hydroporus*, 316, 317  
*intersectus* Crotch, *Gaurodytes*, 335, 336

- inversus* Sharp, Ilybius, 375  
*irregularis* Mann., Agabus, 339  
*kenaiensis* Fall, Agabus, 330, 338, 416, 446, 447, 452, 473  
*kessleri* Hochhuth, Agabus, 328  
*kincaidi* Hatch, Hydroporus, 321, 322  
*labiatus* Brahm, Dytiscus, 327, 429  
*laevipennis* Blatchley, Hydaticus, 405, 406  
*laevis* Kby., Hydroporus, 279, 285, 320, 321, 415, 444, 470  
*lapponicus* Gyll., Dytiscus, 404  
*lapponum* (Gyll.), Hydroporus, 415  
*laramaeus* LeC., Ilybius, 373, 374  
*latissimus* L., Dytiscus, 397  
*latiusculus* LeC., Acilius, 410  
*latus* Stephens, Hydroporus, 279  
*lecontei* Crotch, *Gaurodytes*, 356, 364  
*leptapsis* (LeC.), Agabus, 331, 350, 351, 446, 448, 453, 476  
*leptapsis* LeC., *Gaurodytes*, 350  
*leptopsis* Leng, Agabus, 350  
*liberus* Say, Dytiscus, 407  
*liberus* (Say), Graphoderus, 406, 407, 416, 489  
*longipes* Sharp, Rhantus, 382  
*longulus* LeC., Colymbetes, 386, 387, 388, 417, 450, 486  
*longulus* LeC., Coptotomus, 327, 377, 378, 416, 449, 484  
*longulus* LeC., *Gaurodytes*, 361  
*luridipennis* LeC., Hydroporus, 310  
*lutosus* LeC., Agabus, 328, 334, 356, 357, 364, 418, 446, 448, 453, 454, 478  
*lutosus lutosus* LeC., Agabus, 357  
*lutosus mimus* Leech, Agabus, 357  
*lutulentus* LeC., Hydroporus, 310  
*macrocheilus* Girard, Catostomus, 418  
*maculicollis* Aubé, *Colymbetes*, 382  
*maculosus* Say, Laccophilus, 259, 260, 455  
*maculosus decipiens*, LeC., Laccophilus, 260, 416  
*maculosus maculosus* LeC., Laccophilus, 416  
*malkini* Hatch, Hydroporus, 293  
*mannerheimi* J. Balfour-Browne, Hydroporus, 282, 297, 298, 299, 417, 440, 441, 442, 443, 463  
*margareti* Larson n. sp., Agabus, 333, 344, margareti Larson n. sp., Agabus (con't), 415, 418, 446, 447, 453, 475  
*marginalis* L., Dytiscus, 394, 395, 397  
*marginicollis* LeC., Dytiscus, 394, 395, 398, 399, 403, 451, 488  
*marginipennis* (Blatchley), Hygrotus, 268  
*maritima* , Cicindela, 428  
*masculinus* Crotch, *Hydroporus*, 278  
*masculinus* (Crotch), Hygrotus, 265, 278, 418, 439, 440, 459  
*mathiasi* Hatch, Hydroporus, 316, 317  
*melanocephalus* Gyll., Hydroporus, 304, 305  
*melsheimeri* Fall, Hydroporus, 296, 416  
*minutus* L., Laccophilus, 260  
*modestus* Sharp, Hydaticus, 405, 406, 416, 435, 438, 489  
*moestus* Curtis, Agabus, 335, 415  
*morio* Aubé, Hydroporus, 283, 304, 305, 416, 465  
*morosus* auct., Agabus, 357  
*morosus* LeC., Agabus, 363  
*mutus* Sharp, Agabus, 360  
*nanus* LeC., *Gaurodytes*, 348  
*nectris* Leech, Agabus, 328, 334, 357, 418, 427, 446, 448, 454, 478  
*niger* Sharp, Hydroporus, 298, 299  
*nigroaeneus* Erichson, Agabus, 340  
*nitida* Babington, *Desmopachria*, 261  
*notabilis* LeC., Hydroporus, 281, 294, 295, 416, 440, 441, 442, 462  
*notatus* Bergstrasser, Dytiscus, 384  
*notatus* Fab., Dytiscus, 383, 384  
*obesus* LeC., Hydroporus, 324  
*obliteratus* Hatch, Agabus, 357  
*oblitus* Fall, Hydroporus, 290, 291  
*oblongulus* Fall, Agabus, 333, 345  
*oblongus* Sharp, *Hydroporus*, 326  
*oblongus* Stephens, Hydroporus, 325  
*obscureplagiatus* (Fall), Hygrotus, 270  
*obscurus* Sharp, Rhantus, 382  
*obscurus* Strum, Hydroporus; 307  
*occidentalis* Gordon & Post, Hydroporus, 299, 300  
*occidentalis* Horn, Graphoderus, 406, 408, 490  
*occidentalis* Sharp, Hydroporus, 282, 300, 305, 417, 441, 442, 464  
*ontarionis* Fall, Agabus, 329, 334, 354, 446, 448, 453, 478  
*ooligbuckii* J. Balfour-Browne, Dytiscus, 404

- ooligbuckii* Hatch, *Dytiscus*, 404  
*ooligbuckii* Anderson, *Dytiscus*, 404  
*ooligbuckii* LeC., *Dytiscus*, 403  
*ooligbuckii* Kby., *Dytiscus*, 401, 402, 404  
*oregona* LeC., *Cicindela*, 417, 428  
*oregonensis* Crotch, *Acilius*, 410  
*oregonensis* Richardson, *Ptychocheilus*, 418  
*ovoideus* Crotch, *Gaurodytes*, 361, 362  
*ovoideus* LeC., *Agabus*, 361  
*pacificus* Fall, *Hydroporus*, 292, 417  
*pacificus* Leech, *Laccornis*, 326, 327, 417, 444, 472  
*palliatius* Horn, *Hydroporus*, 293  
*palustris* Wallis, *Agabus*, 338  
*parallelus* LeC., *Agabus*, 335  
*parallelus* Say, *Hydroporus*, 316, 317  
*parvulus* Mots., *Dytiscus*, 404  
*patruelis* LeC., *Hydroporus*, 271  
*patruelis* (LeC.), *Hygrotus*, 266, 267, 270, 271, 418, 439, 440, 452, 457  
*paugus* Fall, *Hydroporus*, 281, 289, 290, 416, 440, 461  
*paykulli* auct., *Colymbetes*, 387, 388  
*perplexus* Sharp, *Graphoderus*, 406, 407, 408, 416, 490  
*persimilis* Fall, *Hydroporus*, 291  
*pervicinus* Fall, *Hydroporus*, 284, 310, 311, 312, 418, 442, 467  
*phaeopterus* (Kby.), *Agabus*, 333, 359, 360, 361, 362, 363, 417, 454, 479  
*phaeopterus* Kirby, *Colymbetes*, 359  
*picatus* Kby., *Hydroporus*, 277  
*picatus* (Kby), *Hygrotus*, 266, 267, 276, 277, 416, 417, 439, 440, 459  
*picea* Zaitzev, *Agabus*, 349  
*piceolus* Zaitzev, *Agabus*, 349  
*picipes* Kby., *Colymbetes*, 375  
*pisobius* Leech, *Agabus*, 333, 345, 346, 417, 446, 447, 453, 475  
*placatus* Fall, *Hydroporus*, 286  
*planusculus* Fall, *Hydroporus*, 281, 291, 292, 293, 416, 441, 462  
*plebeius* Sharp, *Rhantus*, 382, 383  
*pleuriticus* LeC., *Ilybius*, 371, 372, 375, 417, 449, 483  
*polaris* Fall, *Hydroporus*, 302, 415  
*productotruncatus* Hatch, *Hydroporus*, 321, 322  
*prosternalis* Sharp, *Deronectes*, 316, 317  
*pseudoconfertus* Wallis, *Agabus*, 330, 337, 338, 416, 446, 447, 452, 473  
*pseudovilis* Young, *Hydroporus*, 293  
*puberulus* LeC., *Hydroporus*, 303, 304  
*puberulus* Mann., *Hydroporus*, 301  
*pubescens* Gyll., *Hydroporus*, 279  
*pubipennis* Aubé, *Hydroporus*, 286  
*pulcher* Mots., *Hydroporus*, 315  
*pulverosus* Stephens, *Dytiscus*, 378  
*punctatissimus* Aubé, *Hydroporus*, 286  
*punctatus* , *Agabus*, 343  
*punctatus* Say, *Laccophilus*, 267  
*punctilineatus* Fall, *Coelambus*, 275  
*punctilineatus* (Fall), *Hygrotus*, 265, 267, 275, 418, 439, 440, 452, 458  
*punctulatus* Aubé, *Agabus*, 328, 333, 344, 345, 346, 419, 446, 447, 453, 475  
*quadrifaculatus* Aubé, *Ilybius*, 371, 372, 376, 417, 418, 449, 484  
*quadrifaculatus* Horn, *Hydroporus*, 279, 280, 318, 319, 417, 418, 440, 441, 470  
*quebecensis* (Brown), *Hygrotus*, 271  
*raffrayi* Sharp, *Agabus*, 329, 429  
*rainieri* Hatch, *Hydroporus*, 321, 322  
*recta* LeC., *Anisomera*, 336  
*recticollis* Fall, *Hydroporus*, 321, 322  
*recticollis* Hatch, *Hydroporus*, 320  
*rectus* Fall, *Hydroporus*, 284, 309, 416, 442, 467  
*regularis* LeC., *Ilybius*, 328  
*reticulatus* Aubé, *Agabus*, 348  
*reticulatus* Kby., *Colymbetes*, 351  
*rivalis* Gyll., *Hydroporus*, 279, 285, 323, 324, 325, 418, 438, 444, 471  
*rossi* Leech, *Hydroporus*, 292  
*rotundatus* LeC., *Hydroporus*, 314  
*rubyi* Larson n. sp., *Hydroporus*, 281, 290, 440, 461  
*ruficapillus* Mann., *Hydroporus*, 305, 306  
*rufilabris* Sharp, *Hydroporus*, 299  
*rufinasus* Mann., *Hydroporus*, 283, 303, 443, 465  
*rufiplanulus* Fall, *Hydroporus*, 289, 290, 291  
*rugicollis* Kby., *Colymbetes*, 407  
*rugipennis* Sharp, *Colymbetes*, 389, 392  
*rusticus* Sharp, *Hydroporus*, 310, 311, 313  
*salinarius* Wallis, *Coelambus*, 278  
*salinarius* (Wallis), *Hygrotus*, 265, 278, 418,



- salinarius* (Wallis), *Hygrotus* (con't), 439, 440, 459  
*sayi* J. Balfour-Browne, *Hygrotus*, 264, 267, 268, 416, 439, 452, 455  
*scapularis* Mann., *Agabus*, 352  
*scitulus* LeC., *Hydroporus*, 279, 285, 320, 322, 323, 324, 416, 444, 471  
*scrutator* Sharp, *Hydroporus*, 286  
*sculptilis* Harris, *Colymbetes*, 386, 387, 389, 391, 392, 393, 416, 418, 438, 450, 487  
*sellatus* LeC., *Hydroporus*, 272  
*sellatus* (LeC.), *Hygrotus*, 265, 266, 272, 418, 419, 439, 440, 457  
*semiclarus* Fall, *Hydroporus*, 320, 321  
*seminiger* LeC., *Colymbetes*, 386, 387, 388, 450, 486  
*semipunctatus* (Kby.), *Agabus*, 332, 342, 344, 417, 474  
*semipunctatus* Kby., *Colymbetes*, 341  
*semipunctatus* Sharp, *Agabus*, 342, 446, 447, 452, 453  
*semirufus* LeC., *Hydroporus*, 288  
*semisulcatus* Aubé, *Acilius*, 409, 410, 411, 417, 451, 490  
*semivittatus* Fall, *Coelambus*, 275  
*semivittatus* (Fall), *Hygrotus*, 266, 267, 275, 418, 439, 440, 458  
*septentrionalis* auct., *Hydroporus*, 322, 323  
*septentrionalis* Gyll., *Hydroporus*, 432  
*seriatus* (Say), *Agabus*, 331, 335, 336, 446, 447, 452, 472  
*seriatus* Say, *Colymbetes*, 335  
*seriatus* intersectus, *Agabus*, 416  
*seriatus* seriatus, *Agabus*, 416  
*sericans* Sharp, *Rhantus*, 383  
*sericeus* LeC., *Hydroporus*, 288  
*serricornis* Payk., *Dytiscus*, 327, 368, 370  
*serripalpus* Say, *Coptotomus*, 377  
*sharpi*, Fall, *Agabus*, 342  
*signatus* Mann., *Hydroporus*, 282, 298, 299, 416, 441, 442, 464  
*signatus* Sharp, *Hydroporus*, 299  
*similis* Kby., *Hydroporus*, 276  
*sinuatus* LeC., *Colymbetes*, 379  
*sinuatus* (LeC.), *Rhantus*, 378, 379, 449, 484  
*smithi* Brown, *Agabus*, 365, 366  
*snoqualmie* Hatch, *Hydroporus*, 279, 285, 319, 320, 322, 323, 418, 444, 470  
*solitarius* Sharp, *Hydroporus*, 288  
*solus* Leech, *Agabus*, 415  
*spenceri* Leech, *Deronectes*, 318  
*spenceri* (Leech), *Hydroporus*, 279, 285, 318, 418, 440, 441, 469  
*stagnalis* auct., *Dytiscus*, 405  
*stagnalis* Fab., *Hydaticus*, 405, 406, 435  
*stagnalis* G. & H., *Hydroporus*, 281, 289, 290, 291, 416, 440, 461  
*striatellus* LeC., *Hydroporus*, 279, 285, 315, 417, 441, 469  
*striatus* Aubé, *Agabus*, 335  
*striatus* L., *Dytiscus*, 386  
*stridulator* Sharp, *Agabus*, 341  
*stridulatus* Zimm., *Agabus*, 341  
*strigatus* LeC., *Colymbetes*, 388  
*strigulosus* (Crotch), *Agabus*, 334, 347, 348, 349, 418, 446, 448, 453, 476  
*strigulosus* Crotch, *Gaurodytes*, 348  
*striola* Gyll., *Hydroporus*, 283, 306, 416, 441, 443, 466  
*subaeneus* Erichson, *Ilybius*, 371, 372, 374, 375, 416, 449, 483  
*subfasciatus* LeC., *Agabus*, 351  
*subfuscatus* Sharp, *Agabus*, 347, 364  
*sublimbatus* LeC., *Dytiscus*, 400  
*subopacus* Mann., *Agabus*, 349  
*subopacus* Mann., *Agabus*, 381  
*subtilis* Erichson, *Agabus*, 328  
*subtonsus* LeC., *Hydroporus*, 306  
*subvirescens* Fall, *Hydroporus*, 415  
*suffusus* Sharp, *Deronectes*, 316, 317  
*sulcatus* L., *Dytiscus*, 409, 411  
*superioris* J. Balfour-Browne, *Hydroporus*, 281, 288, 440, 443, 460  
*suturalis* LeC., *Hydroporus*, 272  
*suturalis* (LeC.), *Hygrotus*, 266, 272, 416, 439, 457  
*suturellus* Harris, *Colymbetes*, 381  
*suturellus* (Harris), *Rhantus*, 378, 379, 380, 381, 449, 485  
*suturellus* Wallis, *Rhantus*, 380  
*sylvanus* Hilsenhoff, *Acilius*, 410  
*tademus* Leech, *Hydroporus*, 282, 297, 298, 417, 441, 442, 463  
*tartaricus* LeC., *Hydroporus*, 283, 313, 314,

- tartaricus LeC., *Hydroporus* (con't), 416, 468
- tenebrosus LeC., *Hydroporus*, 284, 310, 311, 416, 442, 467
- thoracicus Harris, *Dytiscus*, 407
- tostus LeC., *Colymbetes*, 380
- transpunctatus Chandler, *Hydroporus*, 284, 308, 441, 442, 467
- transversalis Pontoppidan, *Dytiscus*, 405
- triseriatus Kby., *Colymbetes*, 389, 392
- tristis Aubé, *Agabus*, 331, 349, 350, 415, 418, 446, 448, 453, 476
- tristis Payk., *Dytiscus*, 305
- tristis (Payk.), *Hydroporus*, 283, 305, 306, 443, 466
- triton Fall, *Agabus*, 331, 343, 418, 445, 446, 447, 452, 474
- tumidiventris Fall, *Coelambus*, 274
- tumidiventris (Fall), *Hygrotus*, 265, 274, 418, 439, 440, 458
- turbidus LeC., *Hydroporus*, 269
- turbidus (LeC.), *Hygrotus*, 266, 269, 416, 439, 452, 456
- undulatus Say, *Hydroporus*, 280, 286, 287, 416, 440, 443, 460
- unguicularis Crotch, *Hydroporus*, 273
- unguicularis (Crotch), *Hygrotus*, 265, 267, 273, 439, 440, 458
- unguicularis Thomson, *Agabus*, 342
- vancouverensis Leech, *Agabus*, 340, 431
- vandykei Leech, *Agabus*, 338, 339
- varians LeC., *Hydroporus*, 305, 306
- velox Leech, *Agabus*, 342
- velutinus Aubé, *Hydroporus*, 286
- ventralis Mots., *Dytiscus*, 403
- verisimilis Brown, *Agabus*, 330, 338, 339, 417, 446, 447, 452, 473
- verticalis Say, *Dytiscus*, 395, 396
- verus Brown, *Agabus*, 330, 368, 370, 415
- vexatus Sharp, *Dytiscus*, 403
- vilis LeC., *Hydroporus*, 291, 292, 293, 436
- viridianeus Crotch, *Ilybius*, 374
- vittatus LeC., *Hydroporus*, 280, 287, 440, 443, 460
- vittula Erichson, *Hydroporus*, 306
- wallisi Hatch, *Rhantus*, 378, 379, 380, 381, wallisi Hatch, *Rhantus* (con't), 382, 449, 485
- yukonensis Fall, *Hydroporus*, 320, 321
- zimmermanni Wallis, *Rhantus*, 381, 382
- zonatus Hatch, *Graphoderus*, 407
- zonatus (Hoppe), *Graphoderus*, 408
- zonatus Zimm., *Graphoderus*, 407

## KEYS

- Key to *Acilius* species, 409
- Key to *Agabus* species, 329-335
- Key to *Colymbetes* species, 386-387
- Key to Dytiscidae genera, 257
- Key to *Graphoderus* species, 406
- Key to *Hydroporus* species, 280-286
- Key to *Hygrotus* species, 264-267
- Key to *Ilybius* species, 371-372
- Key to *Laccophilus* species, 259
- Key to *Laccornis* species, 326
- Key to *Liodes* species, 262
- Key to *Neoscutopterus* species, 384-385
- Key to *Rhantus* species, 378-379

## GENERA

- Acatodes* Thomson, 327
- Acilius* Leach, 248, 250, 255, 258, 406, 409, 411, 429, 451  
key to species, 409
- Agabinectes* Guignot, 328
- Agabus* Leach, 246, 248, 250, 258, 261, 327, 328, 329, 338, 341, 343, 345, 347, 350, 353, 363, 368, 370, 427, 428, 429, 431, 445, 446, 447, 448, 452, 453, 454  
key to species, 329-335
- Agaporus* Zimmermann, 248, 325, 427
- Anagabus* Jakowlew, 328
- Anisomera* Lec., 327
- Apator* Semenov, 328
- Arctodytes* Thomson, 328
- Asternus* Guignot, 328
- Bidessus*, 428, 436
- Carrhydrus* Fall, 258, 369, 370
- Coelambus* Thomson, 248, 264, 427, 435
- Colymbetes* Clairville, 248, 250, 256, 258, 384, 386, 428, 430, 437  
key to species, 386-387
- Copelatus*, 248, 256, 436
- Coptotomus* Say, 254, 255, 258, 373, 377
- Cybister*, 434
- Cymatopterus* Boisduval & Lacordaire, 386

- Deronectes* Sharp, 279, 319, 431  
*Desmopachria* Babington, 248, 257, 261, 436  
*Dichodytes* Thomson, 328  
*Dichonectes* Guignot, 328  
*Dytiscus* L., 248, 250, 251, 255, 256, 258, 394, 395, 397, 398, 403, 404, 434, 435, 451  
 key to species, 395-397  
*Eriglenus* Thomson, 327  
*Gaurodytes* Thomson, 328, 437  
*Graphoderes* Thomson, 406  
*Graphoderus* Dejean, 248, 250, 255, 258, 406, 409, 435  
 key to species, 406  
*Heteronychus* Seidlitz, 328  
*Heterosternus* Zimm., 279  
*Hydaticus* Leach, 248, 258, 405  
*Hydronebrius* Jakowlew, 328  
*Hydroporus* Clairville, 246, 248, 257, 279, 300, 301, 303, 304, 313, 314, 321, 323, 325, 328, 427, 428, 429, 430, 431, 435, 436, 440, 441, 442, 443, 444  
 key to species, 280-286  
*Hydrovatus*, 248, 436  
*Hygrotus* Stephens, 248, 257, 264, 267, 268, 272, 277, 278, 384, 425, 439, 440, 443, 452  
 key to species, 264-267  
*Ilybiosoma* Crotch, 328  
*Ilybius* Erichson, 248, 258, 350, 370, 371, 372, 375, 427, 435, 437, 449  
 key to species, 371-372  
*Laccodytes* Reg., 258  
*Laccophilus* Leach, 248, 250, 257, 259, 261, 436, 437  
 key to species, 259  
*Laccornis* Des Gozis, 248, 257, 325, 417, 431, 444  
 key to species, 326  
*Leionotus* Kby., 394  
*Liodessus* Guignot, 257, 262  
 key to species, 262  
*Macrodytes* Thomson, 394, 397  
*Matus*, 248, 436  
*Meladema* LeC., 384  
*Nartus* Zaitzev, 378, 379  
*Nebria*, 337  
*Nebriogabus* Guignot, 328  
*Necticus* Hope, 327  
*Neoscutopterus* J. Balfour-Browne, 258, 384, 450  
 key to species, 384-385  
*Neptosternus* Sharp, 258  
*Oreodytes* Seidlitz, 279, 319  
*Parasternus* Guignot, 328  
*Potamodytes* Zimm., 279  
*Potamonectes* Zimm., 279  
*Pseudoscutopterus* Hatch, 384  
*Rantogiton* DesGozis, 378  
*Rhantus* Dejean, 248, 258, 378, 379, 384, 435, 437, 449  
 key to species, 378-379  
*Scutopterus* Sharp, 384  
*Scytodytes* Seidlitz, 328  
*Suphrodytes* DesGozis, 279  
*Xanthodytes* Seidlitz, 328
- SUBFAMILY  
*Colymbetinae*, 258, 327, 328, 373, 378, 384  
*Dytiscinae*, 258, 327, 394, 405, 406  
*Hydroporinae*, 257, 261, 326, 327  
*Laccophilinae*, 254, 257, 258, 327
- FAMILY  
*Dytiscidae*, 254, 415, 419, 425, 426, 427, 429, 430, 431, 432, 434, 435, 436, 437