Migration Patterns of Taricha torosa in Tilden Regional Park

Peter Claggett

Introduction

Mankind's encroachment on open space has increasingly led to the disruption of other species. Mitigating human interference with the life cycles of other species should be a major aspect of human commitment to ecological preservation.

Naturalists at Tilden Regional Park in Berkeley, California, are studying the migration patterns of the California Newt, Taricha torosa, to minimize the impact of public park use on T. torosa. South Park Drive, one of the four access roads into the park, transects the migration routes of T. torosa, resulting in the death of thousands of newts each year by motorists using the road. Although newts are found breeding in Jewel Lake, at the northeastern end of Tilden Regional Park, only the South Park Drive newt population has been so impacted by Park users.

As the result of public pressure on the East Bay Regional Park District and the expressed concern of Tilden naturalists, the District commenced a study on T. torosa in Tilden Regional Park in the fall of 1988. It is the objective of the study, and my research, to find out information on the distribution of newts along South Park Drive and on their direction of travel. This information will allow park officials to consider newt safety in their future park plans. Their present policy is to close South Park Drive during, and immediately following, rainfalls.

My study assessed the movement patterns of newts crossing South Park Drive. From these data alternative protective measures to road closure can be pursued.

Past Studies

No studies of this nature have been done before on Taricha torosa. However, much is now known about the migration patterns of Taricha rivularis (the Red-bellied newt). Adult T. rivularis migrates on land parallel to drainages and streams or may just travel overland (Twitty et al., 1966). Orientation towards traditional breeding ponds or streams may be

triggered by olfactory cues and/or by the initial autumnal rains (Twitty et al., 1967). Therefore, this study was begun after the first autumnal rains.

It is thought that T. rivularis and T. torosa may time their activity in coordination with the time of sunset. Newts are presumed to have photoreceptors in the pineal region, on the back of their head behind their eyes. These receptors may serve as a guidance mechanism in response to directional information provided by polarized light (Stebbins, 1988, pers. comm.). Based on this assumption all my research took place during or after sunset.

Background

Tilden Study Site: Tilden Regional Park lies in a valley enclosed by the Berkeley Hills to the west and the San Pablo Ridge to the east (Figure 1). Seasonal drainages are located on the western side of San Pablo Ridge and form the upper reaches of Wildcat Creek. Several of these drainages, as well as Big Springs Creek, cross under South Park Drive in culverts.

South Park Drive is the only southern access road to the Park. Nine picnic areas lie along the western side of the road. These areas are often reserved by organizations for daytime use. Thus, South Park Drive is heavily traveled the year round. From Grizzly Peak Blvd. to the Botanic Garden, South Park Drive descends with a moderate slope. All the drainages crossing this road flow in the southwest direction, from San Pablo Ridge to the golf links west of the road. Big Springs Creek is the only drainage which flows all year. It flows under South Park Drive and into the golf links where several ponds are located along its path.

Newt Behavior: The California newt, Taricha torosa, is in the family Salamandridae. Adult T. torosa range in snout-vent length from 56mm to 87mm, sub-adults range from 38mm to 56mm, and all newts under 38mm are considered juveniles (Stebbins, 1988, pers. comm.). T. torosa, like most newts, go through an aquatic phase and a terrestrial phase. Each year, near the time of the first autumnal rains, the newts begin activity on the surface of the ground. From September through February the newts travel overland, often remaining close to drainages. During this period they remain in their terrestrial phase, which is marked by rough, sometimes bumpy, skin. Much of the day is spent under the shelter of rotted logs, leaf litter, or rocks. Most overland travel occurs only after a rain (Twitty et al., 1967). From late January through March the newts arrive at their breeding ponds or streams.

After entering the water the newts bodies adapt to a temporary aquatic life. I assume that it takes several weeks for the newts to prepare themselves for breeding. Once they have entered the water, their skin becomes swollen, smooth, and water resistant. Their tails swell to serve

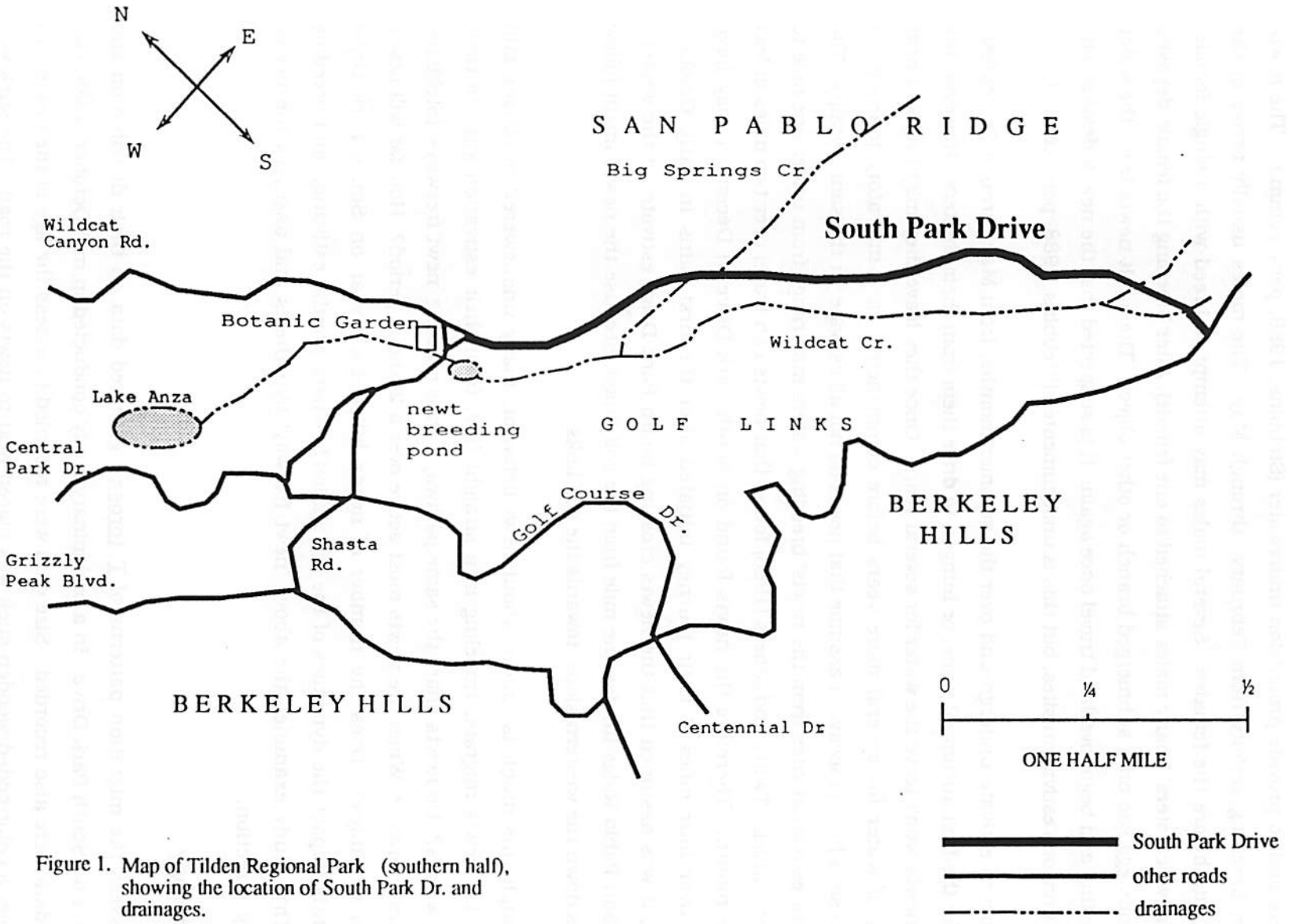

Figure 1. Map of Tilden Regional Park (southern half), showing the location of South Park Dr. and drainages.

source: modified from a map published by the East Bay Regional Park District.

as rudders and to provide propulsion underwater (Stebbins, 1988, pers. comm.). The newts engage in breeding activity from February through May. The males usually arrive at the breeding site before the females. Several males may attempt to breed with a single female, forming 'newt clusters' (many males attached to one female). After breeding the female deposits a gelatinous egg sac on a submerged branch or other object. The adult newts leave the water after breeding and begin overland travel once again. It is suspected that the newts' destinations are their previous estivation sites, but this is undocumented (Stebbins, 1988, pers. comm.).

The newts estivate underground over the summer months, from May through September, waiting for the first autumnal rains, or hunger, to drive them from their shelters. However, the juvenile newts won't leave the water for several years. Once they leave they might remain near the body of water for several more years before commencing on a migratory journey to estivation sites further away. I assume that newts do not all estivate at the same locality. The distance of estivation sites from the newts' breeding waters may range from under one mile to over several miles. Twitty and others (1966) found that newts can travel over two miles in less than one month. Therefore the newts found on South Park Drive in December may have traveled over four miles if their journey initiated after the first rains in early October. However, it was assumed that the newts crossing South Park Drive estivate on the western slope of San Pablo Ridge (under one mile from the golf links), because the newts might follow drainages down the western slope towards the golf links.

Although this much is known about newt behavior, many unanswered questions still remain. Do newts migrate, traveling in a straight line, from their estivation sites to their breeding waters? Do newts share the same pathways, thus creating 'newt freeways' (Stebbins, 1988, pers. comm.)? When are newts most active over a 24-hour period? How far will newts travel on dry days? Does the number of newts killed each year on South Park Drive significantly impact the dynamics of the population? Where are the estivation and breeding sites? This study examines the above 'newt freeway' hypothesis and assesses the newts' migrating direction.

Methodology

To assess the migration patterns of T. torosa I gathered data on their distribution and orientation on South Park Drive. In a preliminary study conducted in mid October, 1988, size and sex data were also recorded. Size data were recorded to assess the age of the newts. To assess age, a color-coded wooden stick was placed next to newts on the road. The stick was color coded so that newts could easily be classified as adult, sub-adult, or juvenile. However,

these measurements were abandoned because the additional time required to gather size data would decrease the accuracy of the distributional data collected during that same period. To gain an accurate assessment of the number of newts crossing the road at any one time, data collection should be recorded for a minimal amount of time. Sex data were not collected after the preliminary study because only some of the male newts had enlarged cloacal glands, clearly identifying their sex. Sexing females and males with unenlarged cloacal glands is difficult, requiring adequate lighting, a magnifying glass, and a trained eye.

In the follow-up survey, distribution and orientation data were collected on the newts crossing South Park Drive. The data were gathered over one to two hour periods, on nine evenings, from December through March (Table 1). I collected data on rainy evenings, beginning at sunset to several hours after sunset (based on the photoreceptor concept).

Starting at the north end of the road, I walked southward carrying a flashlight or wearing a headlamp to reveal the position of newts travelling across the road. When a newt was seen, I quickly approached it and placed a 6" wooden stick, with a painted red tip, behind the newt, the red tip pointing in the direction of travel. This procedure was repeated for each newt seen along the road. When I arrived at the south end, I began back-tracking, moving northward. When I found one of the wooden sticks, I mapped the location of the stick relative to the position of survey discs (numbering 1-250), which Tilden naturalists had placed every 30 feet along the road. I also recorded the compass orientation of the stick in degrees. Although newts often deviated from this direction after being approached, the data are representative of the newts' initial direction of travel.

On March 5,6, and 8, the culvert under South Park Drive for Big Springs Creek and the culvert for run-off near survey disc number seven were briefly examined to determine if newts traveled through them. A flashlight illuminated the culverts to reveal any newts present.

Data

Data on 214 newts were gathered on the following nine evenings (Table 1). Weather data were provided by the U.C. Berkeley Weather Station.

Date	Time	Temp (°F, 8pm)	Precip. (in.)	No. of newts seen
Dec. 19	7:30-9:30pm	51°	0.20	28
Dec. 20	7:00-8:30pm	48°	1.17	37
Feb. 2	9:00-10:00pm	44°	0.51	30
Feb. 3	7:30-8:30pm	41°	0.32	2
Feb. 18	5:30-6:30pm	51°	0.18	36
Mar. 1	5:30-7:30pm	49°	0.39	39
Mar. 5	5:45-7:15pm	55°	0.28	24
Mar. 6	5:40-6:40pm	56°	0.07	13
Mar. 8	6:00-7:30pm	58°	0.25	5

Table 1. Data collection dates, times, weather conditions and the numbers of newts seen on those dates.

Orientation: Directional data were recorded on 120 of the 214 newts observed in the study between December and March (Table 2). If newts were disturbed and changed their orientation as they were approached, or if they were dying from recently being run over, then their orientation was not recorded. The majority of newts studied stood motionless, in push-up position, as I approached and began recording data. Newts were observed for up to 5 minutes. Since South Park Drive extends in the northwest and southeast directions (Figure 1), the newts will travel either southwest, towards the golf links, or northeast, towards San Pablo Ridge, if they move straight across the road. During the preliminary study, in October and November, 41 live newts were surveyed (Table 3) of which only 12 (29%) were moving in the south to west directions, towards the golf links, and 23 (57%) were moving in the north to east directions, towards San Pablo Ridge. The remaining 6 (14%) newts were traveling either up (southeast) or down (northwest) the road. However, out of the 120 newts surveyed in the follow-up study, 77 (64%) travelled towards the golf links and only 23 (19%) were traveling towards San Pablo Ridge (Table 2). Twenty newts (17%) were traveling up or down the road.

Although this study clearly shows that in the December through March period, the majority of newts were traveling towards the golf links, data from any 300-foot segment of road reveals that the newts in that segment were moving in all directions. For example, between 600 and 900 feet, I observed a total of 17 newts, combined from nine surveys.

Orientation data were recorded on 11 of the 17 newts. They were oriented in the following directions when approached: 1 north, 2 east, 2 south, 1 southwest, 4 west, and 1 northwest.

North	N.East	East	S.East	South	S.West	West	N.West
4	9	10	14	37	25	15	6
	Total= 23				Total= 77		

Table 2. Numbers of newts traveling in eight cardinal directions during the December through March follow-up study. Total number of newts surveyed: 120.

North	N.East	East	S.East	South	S.West	West	N.West
6	10	7	3	4	7	1	3
	Total= 23				Total= 12		

Table 3. Numbers of newts travelling in eight cardinal directions during the preliminary study in October and November. Total number of newts surveyed: 41.

Distribution: Figure 2 presents the numbers of newts found in each thirty-foot interval along South Park Drive, and shows the combined data from nine observation days. Distance was measured starting at the north end of South Park Drive. Data are not shown for survey discs number 241 to 250, a 300-foot segment at the southern end of South Park Drive, between 7200 and 7500 feet, because no newts were found on this segment during the nine observation days.

The newts were evenly distributed over the first two-thirds of the road, up to 4800 feet. From 4800 feet to 7200 feet the distribution was more sporadic. Many newts were found above and adjacent to culverts under the road, but none were found utilizing the drainage culverts. Several newts were observed feeding on the road. They were eating earthworms which crawl onto the asphalt when their tunnels flood from rainfall.

On March 11 newt activity was observed along the section of Big Springs Creek running through the golf course. Newts were seen at four locations along this section. At two of the locations newts in breeding condition were observed. One 'newt cluster' was seen in Wildcat Creek, where it joins the newt breeding pond, indicated in Figure 1. This verifies that some newts are traveling to the ponds and streams on the golf links, and that some must have arrived at these waters in early February since they were already breeding in March.

My impression from the initial data on sex and age was that a majority of adult males were crossing the road in October and November. The age distribution changed in the spring. A higher percentage of juveniles were observed in March than in any other month.

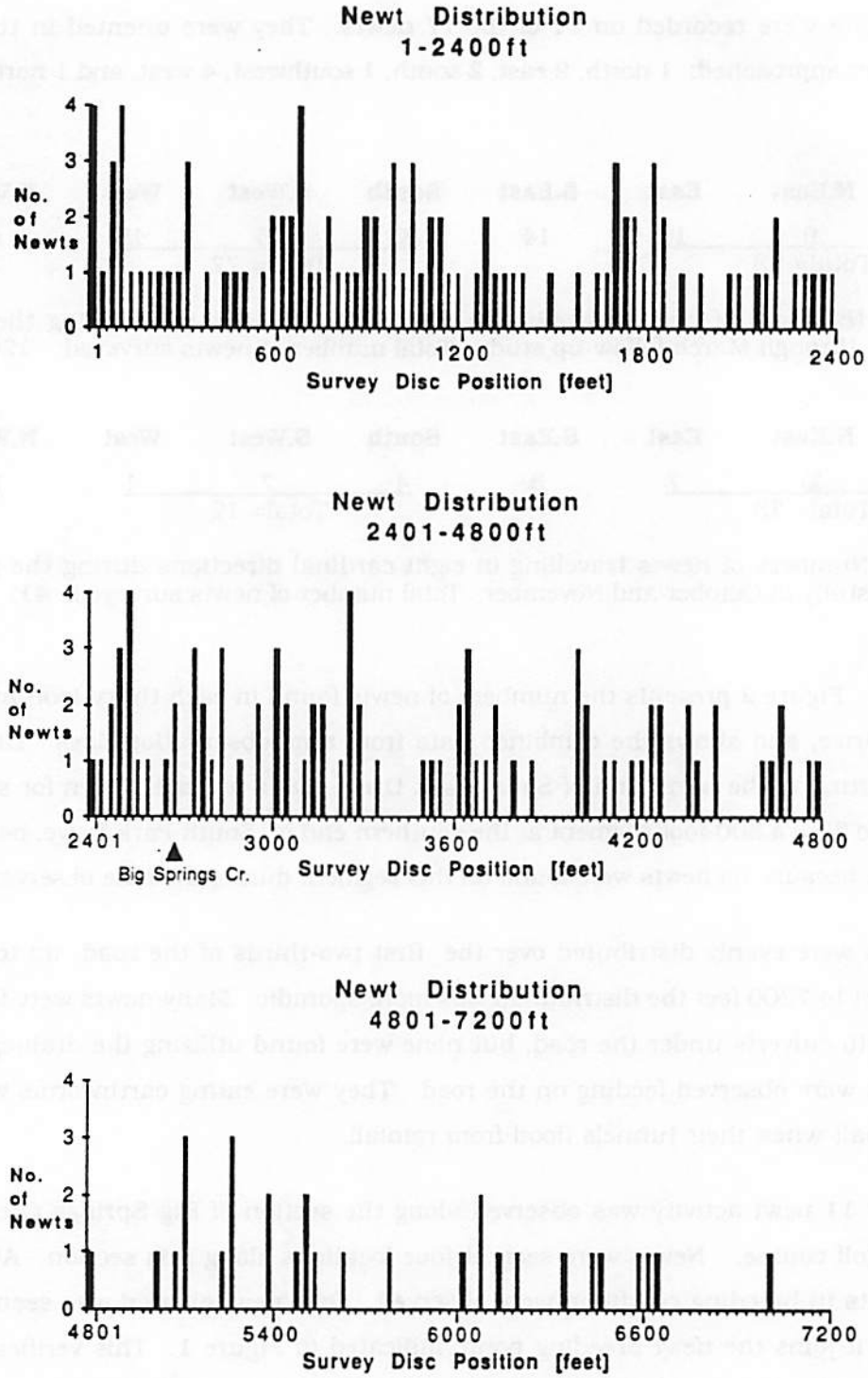

Figure 2. Distribution of newts along South Park Drive. Data are cumulative, representing collection during the nine days listed in Table 1. Each bar represents the number of newts seen in that thirty-foot segment of road. Each thirty-foot segment is designated by the interval between two tic marks.

Tilden Park naturalists collected squashed (run-over) newts on South Park Drive from October through March. They collected over 700 dead newts. On wet days, when the road was open to traffic, up to 50 dead newts were found. Even on dry days, during which the road was always open, several squashed newts were found (Kelley, 1989, pers. comm.).

Discussion

The data support the existence of a newt migration from the western slope of San Pablo Ridge towards the golf links. However, a variety of orientations were observed. This could be due to the existence of several distinct populations of T. torosa residing in Tilden Regional Park (Stebbins, 1988, pers. comm.). The newts crossing South Park Drive, to reach their breeding ponds, may be coming from various estivating ranges for the different populations. However, this hypothesis is neither supported nor unsupported by the data.

Another explanation for the variety of orientation data is that the newts may be trying to pick up olfactory cues, enabling them to orient towards their breeding waters. Or, since newts were observed eating worms on the road, they may remain near the road for several weeks, appearing only to forage for food. During the preliminary survey the newts may have been searching for food and olfactory cues which would explain why a majority of them were not oriented towards their breeding waters at that time.

General observations suggest that adult newts arrive at their breeding waters before the juveniles. There may be several possible explanations, including that juvenile newts are too young to mate, or that they are slower and require more frequent meals than adults. However, the data may misrepresent this pattern. It was very difficult to identify juveniles on the road, especially during the preliminary study when observation skills were not refined.

Figure 2 shows that of the 214 newts surveyed, 148 newts (69%) were crossing the road over the northwestern half, between the botanic gardens and the 3600 foot survey disc. Since the main newt breeding pond is located at the northwestern end of the golf links (Figure 1), the newts probably estivate as near to it as possible. However, since some newts were observed on the southeastern half of the road, they may breed in the southeastern half of Wildcat Creek.

No newts were observed utilizing the drainage culverts, and no 'newt freeways" were found. Therefore, newt passageways installed beneath the road might not be preferred by the newts.

Recommendations

An accurate estimate of the size of the newt population is necessary to assess the impact of traffic on the South Park Drive population. An estimate could be made based on the numbers of newts crossing South Park Drive over several 24-hour periods, on both wet days and dry days, during every month from October to March. The data from a few wet days could represent all the wet days in that month. The same extrapolation could be made on data from dry days. Although newts are rarely active during dry weather, the occurrence of several squashed newts on the road during dry weather is enough evidence to warrant data collection during dry weather. One must then determine if the breeding ponds on the golf links serve the whole South Park Drive newt population or serve a small percentage of that population. If many newts are breeding elsewhere, then traffic on South Park Drive may only pose a minimal threat to the population.

To understand the migration patterns of T. torosa, a study should be initiated to determine at what times, and in what numbers, the newts leave their breeding ponds to return to their estivation sites. In addition, if the estivation sites are located, one could determine when, and under what weather conditions, the newts begin overland travel. The newts should also be observed to determine whether or not they follow a beeline course towards their breeding waters. Since newts are very slow moving amphibians, a tracking device would be useful for this project.

South Park Drive will be closed following each rainfall from October through May for the duration of the District's three-year newt study so that the researchers and the newts will not be disturbed. Since road closure is a costly and time consuming procedure, the District might consider some alternatives. Placing drift nets along either side of the road, leading to tunnels underneath the road, could serve to direct the newts safely to the other side. The tunnels could be placed near pre-existing culverts, since the data show many newts already traveling near the drainages. However the tunnels must not serve as drainages too because newts seem to prefer not traveling in the already existing culverts.

Another alternative would be to construct artificial breeding ponds on the east side of South Park Drive. Over time the newts might adjust their migration patterns and begin breeding in the new ponds. This project would be very costly, yet because road closure is also a costly procedure, the construction of artificial breeding ponds is a viable alternative.

Despite the cost, since road closure procedures have been initiated, the numbers of squashed newts has been greatly reduced. Presently, this is the only feasible measure to reduce the human impact on the South Park Drive population. The resident newt population clearly is benefitting from this initiative.

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