

Outline

Employing Genetics To Study Whales

An Informal Introduction

Whales Are A Resource

- Many populations and species depleted due to past commercial whaling operations.
- Subsistence hunting still ongoing in many parts of the world, as well as scientific whaling, and some unknown degree of illegal whaling.
- Whale watching a source of income in many developed as well as underdeveloped countries.

Whales are interesting from a basic scientific point of view

- Very different system compared to “standard” terrestrial or fresh water models. Also different from many marine organisms
 - Active dispersal at all life stages
 - Wide ranges of movement in an environment with few barriers
 - Long life-span and presumably some degree of “culture” among individuals

Basic Aspects

- Advantages
 - Taxonomically closely related species-complex
 - Many truly cosmopolitan species, i.e., many different levels of evolutionary divergence
 - Mating and foraging tempo-spatially separated in many species
- Disadvantages
 - Difficult to observe and tag directly
 - Highly political due to very different cultural views on exploitation of whales
 - “Pop science”

Marine Mammals – Very Different Creatures Than Bugs and Plants

- Finite population sizes
- Overlapping generations
- Small litter size

– For instance:

- Humpback whales in the north Atlantic number some 10,000 individuals. Females mature at the age of six and give birth to one calf every second year. The life expectancy is supposedly 30 years, but not known.

Interacting Levels and Processes

Biopsy Collection

Genetic Analyses Conducted

- Analysis of Maternally and Bi-parentally Inherited Genetic Markers

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The Humpback Whale

Megaptera novaeangliae

- Cosmopolitan species
- Weight: ~40 tonnes
- Length ~45' or 15 meters
- Age at maturity: 6-7
- Extensively harvested in all oceans during the 19th and early-mid 20th century
- Protected in the US under the endangered species as well as the marine mammal protection act
- International trade regulated by CITES (for all cetacean species)

East-west Cline in Estimates of Genetic Diversity in the Maternally Inherited Mitochondrial Genome

Genealogy Of Mitochondrial “Alleles”

Divergence Estimates

Calves Stay With Their Mother the 1st Year

Identification Of Mother Calf Relations

Maternally-directed Site-fidelity to Summer Feeding Grounds

- Individual humpback whales appear to return to the same high-latitude feeding ground every spring throughout its life
- The feeding ground of choice is that to which the calf migrated to with its mother
- Cultural transmission

Effects of Pleistocene Glaciations On Genetic Diversity

Divergence On An Evolutionary Time Scale

Individual-based Analyses

- Insights on an ecological time scale
 - Individual identification
 - 6-15 microsatellite loci
 - Estimation of abundance and individual ranges of movement
 - Identification of close relatives
 - 20+ microsatellite loci for parent-offspring detection
 - Estimation of abundance
 - Reproductive success -> selection
 - Population structure
 - Estimation of demographic parameters

North Atlantic Humpback Whale

Different Number of Males and Females on the Breeding Grounds

- Abundance estimates of each sex were estimated from with the samples collected on the breeding ground during 1992 and 1993
 - 4,804 males (95% CI: 3,374 - 7,123)
 - 2,804 females (95% CI: 1,776 - 4,463)
- Even sex ration in calves and among feeding ground samples
- Difference in male and female abundance probably due to

“temporal fidelity” in migration timing among females
Temporal Fidelity

Thank You