

FISH 475: MARINE MAMMALOLOGY, SPRING 2007.  
MIDTERM EXAMINATION.

NAME: **KEY**

UW STUDENT NUMBER: n/a

**PLEASE LIMIT RESPONSES TO SPACE PROVIDED.** 100 points total.

**SHORT ANSWER SECTION. 10 POINTS PER QUESTION. RESPOND TO ALL QUESTIONS IN THIS SECTION.**

1. Indicate the common name(s) associated with the following families that include marine mammals:

Odobenidae: **Walrus**

Kogiidae: **Pygmy sperm whale and dwarf sperm whale (both must be mentioned for full credit)**

Trichechidae: **Manatees**

Balaenopteridae: **Rorquals**

Delphinidae: **Dolphins (“Dolphins and orcas” OK)**

2. Summarize changes over evolutionary time, from the oligocene to the present, in the morphology of long bones (humerus and femur) in the limbs of pinnipeds. What are the likely advantages provided by the changes you describe?

**Summarize changes: Long bones in the limbs have become shorter, thicker (e.g., more stocky), and have developed large flanges over the evolutionary history of the pinnipeds.**

**Likely advantages (full credit for any one of these):**

- **Better structured for attachment of large, powerful muscles for propulsion through the water;**
- **Better leverage and mechanical advantage for propulsion through the water.**
- **Other reasonable explanations also considered.**

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3. Most species of small cetaceans (dolphins and porpoises) and most species of pinnipeds that live at middle or high latitudes give birth to their pups during a fairly narrow time period in late spring or early summer. Why?

**Late spring and early summer typically are periods of maximum biological productivity in oceans at middle and high latitudes. Thus, production of young by marine mammals, which are generally at high trophic levels in marine food webs, is advantageous for at least two reasons. First, the timing allows newly produced young to learn foraging skills at a time when food is likely to be plentiful, and during which foraging mistakes are not too costly as long as lessons are learned quickly. Second, adult females that are nursing young can replenish depleted internal energy stores, lost to the cost of lactation, with relatively minimal effort because of the abundance of prey.**

**Other reasonable explanations also considered.**

4. You are studying beluga whales in Alaska, and you are going to use fatty acids to investigate their diet. How is beluga blubber different from pinniped blubber, and why might this be important to think about when you sample blubber from the whales? List two advantages and two disadvantages of using this technique to study diet.

**How is beluga blubber different from pinniped blubber?**

- **beluga blubber is biochemically stratified, but pinniped blubber is not. Thus, you will need to think about where in the blubber layer you are sampling when collecting samples from beluga whales**

**Advantages:**

- **Using fatty acid methods, one can identify prey by species and proportion. In addition, sampling methods are relatively non-invasive, and one has a reasonable probability of obtaining samples from free-ranging animals.**

**Disadvantages:**

- **Laboratory analyses associated with fatty acid methods are time-consuming and costly. Quantitative fatty acid signature analyses (QFASA) requires a “library” of fatty acid signatures for all possible prey species. Sample collection is more invasive than sampling for scats or spews.**

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5. Name one factor that is a cause of contaminant variation in marine mammal tissues. Based on this factor, describe a scenario that would explain why you detected high or low concentrations in a particular study animal.

**Factors (full credit for any one):**

- (1) age, sex and reproductive status;**
- (2) geographic variation (proximity to point sources);**
- (3) feeding ecology (position in the food chain);**
- (4) temporal (increase/decrease of the contaminant in the environment over time).**

**Scenarios: (full credit for any one):**

- (1) Older animal (high);**
- (2) Feed close to point sources (high);**
- (3) Top of food chain (high);**
- (4) Other reasonable scenarios also considered**

6. Please respond to one of the following two questions relating to the “lab” portion of the course:

- 1) What is the purpose of the “bell” sound produced by walruses?
- 2) Indicate a major disadvantage of using fish otolith data, collected from scats, to characterize diet in pinnipeds.

- 1) Purpose of “bell” sound: Produced by males during the breeding season, as an advertisement of interest and as an attractant to receptive females for purposes of breeding.**
- 2) There are a number of disadvantageous biases associated with use of otoliths to determine dietary composition in pinnipeds (full credit for any one):**
  - Otoliths of different fish species are of different size and thickness. Some are small, and may either be dissolved entirely before defecation, may be modified so much by digestion that they cannot be recognized in the scats, or may be overlooked in the scats. In this case, dietary characterization may over-emphasize the importance of fish species with large, robust otoliths.**
  - The otoliths of fish eaten near the haulout are more likely to be deposited, in scats, while the pinniped is hauled out on land. Pinnipeds foraging far out to sea are likely to defecate at sea, such that there is no chance of recovering otoliths from fish eaten far out at sea.**
  - Other suggestions also considered.**

**“ESSAY” QUESTION Key:**

1. As noted in class, the fossil record for pinnipeds is rather thin. Assume you are interested in pinniped evolution, and have funding to search for additional pinniped fossils. In what geographic locations would you look? Why? In what kinds of habitat would you look? Why?

**The oldest known pinniped fossils are of Oligocene age (25-27 mya) and were found on the Oregon coast. Available material suggests that early pinniped evolution may have occurred in coastal areas characterized by strong and persistent upwelling and cool surface waters, likely associated with high biological productivity near shore. Thus, the best regions to begin looking for pinniped fossils would be continental margins known to have been near upwelling centers during the Oligocene.**

**Pinnipeds typically occur in habitats near safe haulout locations along continental coastlines or nearshore Islands. Thus, sites known to be shoreline habitats during the Oligocene would be the best habitats in which to look for early pinniped fossils. Availability of marine fossils often requires some sort of local process that prevents accumulation of terrestrial soils and vegetation above fossil-bearing strata. Thus, habitats exposed to some sort of hydrological activity, such as stream runoff or shoreline wave erosion, would probably be the most productive places to search for fossil pinnipeds.**

2. The Galapagos Islands, in the equatorial Pacific west of South America, are known to support large populations of pinnipeds and cetaceans. Describe two likely reasons.

**Full credit for *any two* of the following “reasons”. Consideration also is given to other plausible “reasons”:**

**a) Transport of productive, nutrient-laden waters from the strong upwelling regions of the Humboldt Current along the mainland west coast of the South American continent. The nutrient-rich waters support high rates of primary production in the upper water column, leading to the development of productive populations of upper trophic level planktonic populations, such as krill, squid, and forage fish, that provide abundant foraging opportunities for marine mammals.**

**b) Strong upwelling in the equatorial waters of the eastern Pacific produced on a large scale by trade winds. Effects on marine mammals are the same as noted in “a” above.**

**c) Strong localized upwelling within the Galapagos Islands, produced by localized topography and the trade winds. Effects on marine mammals are the same as noted in “a” above.**

- d) Presence of many frontal boundaries in the surface waters of the Galapagos region. The combination of transport from the Humboldt current, large-scale equatorial upwelling, and localized upwelling produces a number of dynamic frontal boundaries that are local concentrations of productivity and food availability, augmenting foraging opportunities for marine mammals.**
- e) Absence of an extended history of human impacts. The Islands have been largely spared major anthropogenic impacts over the course of human history, although there are some recent causes for concern in this context. The lack of anthropogenic intrusion (relatively speaking) has been beneficial to all marine mammals in the region, and especially to the pinnipeds.**
3. The small population of gray whales in the western North Pacific (described by Amanda Bradford in her guest lecture of 13 April 2007) presents an enigmatic pattern. The population is very small, and it is unlikely that the population has overutilized its food supply. Nevertheless, in some recent years (since careful study began in 1995), many of the whales appear to be severely underweight. Describe field research that you would do to explain the enigma.

**In the circumstances described, there are several possible explanations that could be evaluated with appropriately designed research work. Full credit given for lines of research associated with any two of the following potential explanations:**

- a) Evaluation of the food supply: It is possible that the food supply for gray whales (mainly benthic amphipod crustaceans in this case) has been reduced, either by an undetected natural disturbance or by some kind of anthropogenic effect.**
- b) Evaluation of the health of the gray whales on the feeding grounds: It is possible that the whales are suffering from increased incidence of a disease, or from ill effects associated with an anthropogenic intrusion such as contaminants or noise pollution sufficient to cause physiological stress and damage.**
- c) Evaluation of conditions for the whales during migration, or on the breeding grounds: Although the migratory corridors and breeding grounds of western gray whales remain unknown, it is nevertheless that some combination of disease, impaired habitat condition, or anthropogenic intrusion is damaging the whales to the extent that their condition is poor.**

4. Recently some mitochondrial DNA studies have suggested that sperm whales may be more closely related to baleen whales than to other odontocetes. This result is viewed as highly controversial. Why is it controversial? What kind of research would you do to follow up on this work and determine if the conclusions are correct?

**The noted finding is viewed as controversial because all available traditional morphological evidence is consistent with sperm whales as part of the odontocetes, and much more closely related to other odontocetes than to any of the mysticetes.**

**For resolution of the issue, following would be useful lines of research:**

- a) **A repeat of the study that linked sperm whales to the mysticetes, in order to verify that the findings are accurate and properly interpreted.**
- b) **Application of newer, more accurate methods of molecular study of relationships of sperm whales to other whales, and a comparison of the new work to that already published, in order to evaluate the consistency and robustness of the findings;**
- c) **A synthesis of morphological and molecular data into an integrated taxonomic approach, allowing discussion of the issue without the confounding factor of rivalry and suspicion between molecular and traditional morphological taxonomic specialists.**