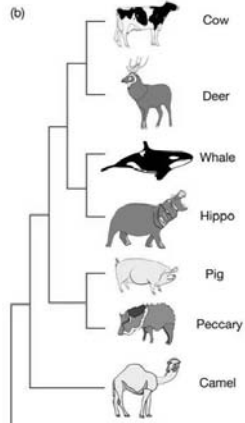


Cetacea

1. Whales are highly specialized.
2. Whales are artiodactyls.
3. Whales and hippos are sister taxa (DNA evidence)



Walking with whales
 Nature 413, 259-260 (20 September 2001)

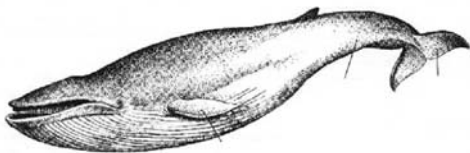
The evolutionary route to a whale.

Diacodexis was a primitive even-toed ungulate (hoofed mammal); *Pakicetus* is one of the terrestrial cetaceans described by Thewissen *et al.*; *Ambulocetus* was amphibious; *Dorudon* was a fully aquatic archaeocete (early cetacean), but retained an articulated elbow and vestigial hindlimbs; and *Balaena* is a recent whale.

Skeletons are not drawn to scale.

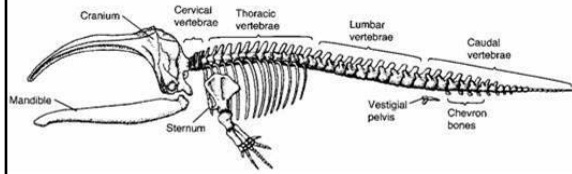
Modern Cetacean Traits, 1

1. exclusively aquatic
2. fusiform body
3. tail with horizontal flukes



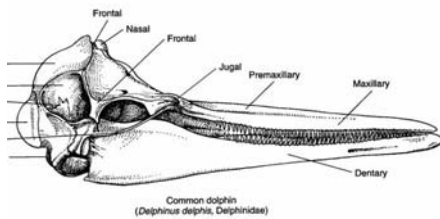
Cetacean Traits, 2

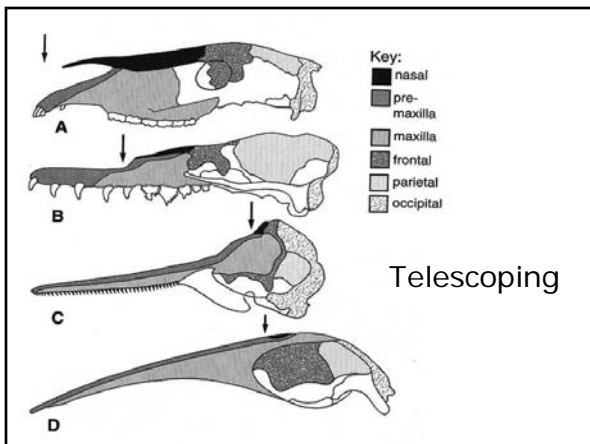
1. pelvic girdle reduced to vestigial
2. paddle shaped, anterior limbs with hyperphalangy



Cetacean Traits, 3

1. highly modified, telescoped skull
 - A.
 - B.





Adaptations For Diving

1. Depths at which cetaceans have been recorded.
 - A. fin whale: 500 m.
 - B. sperm whale: 1134 m

Adaptations for Deep Diving

1. Extra capillaries in the lungs
2. 3 x as much oxygen
3. Twice as high a concentration of red blood cells.
4. 2-9 times as much myoglobin
5. High tolerance to lactic acid.
6. High tolerance to carbon dioxide.

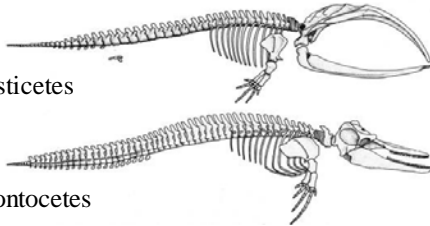
Respiratory and circulatory changes during deep diving

1. Bradycardia:
2. Blood is redistributed .
3. Lungs collapse, do not get bends.

Classification

1. Mysticetes

2. Odontocetes

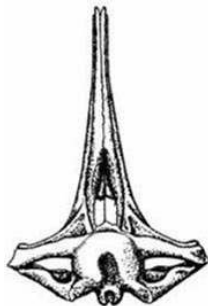


Mysticeti – Baleen whales

- 1. no teeth, except embryologically
- 2. baleen plates of keratin
- 3. Filter feeders

Mysticeti

- 1. Two external nasal openings in symmetrical skull
- 2. Sounds to identify sex, social status and location

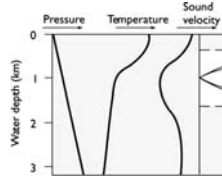


Many Species of Baleen Whales Migrate

1. Migration Routes of Humpback & Gray Whales
 - A. summer at high latitudes
 - B. winter at low latitudes

SOFAR Channel (sound fixing and ranging)

1. Sound velocity increases with increasing pressure, salinity and temperature.
2. Pressure increases and temperature decreases with depth
3. low-velocity zone at the base of the thermocline.



1. large whales utilize the SOFAR channel



Diet Of Great Whales

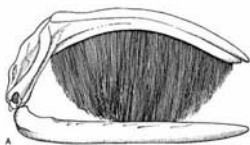
1. most baleen whales
2. Humpback whales
3. Gray whales
4. Sperm whales

Balaenidae (2, 3)

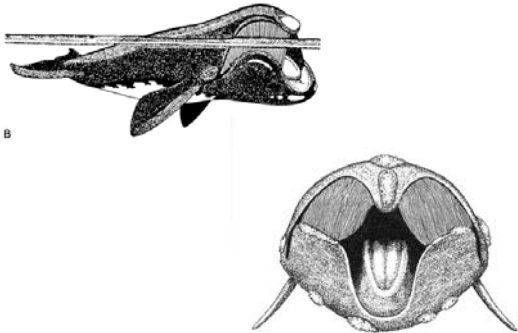
1. Bowhead and right whales
2. up to 18 m and >100,000 kg
3. Huge head
4. Carcasses float;
5. Northern right whale population has declined from 200,000 to 300

Right whales

1. Skimmers that feed largely on copepods
2.
 - A.
 - B.



How Right Whales Feed



Balaenopteridae

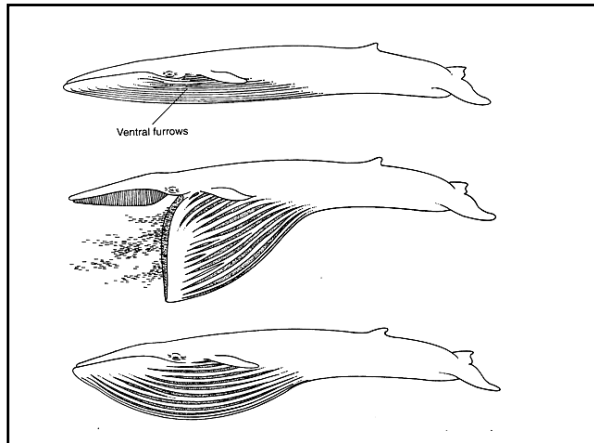
1. Rorqual whales: the fin backed and humpback whales.
 - A. Humpback
 - B. Minke
 - C. Blue
 - D. Fin
 - E. Sei

Balaenopteridae (2, 6)

1. *Balaenoptera acutorostrata* [minke]: 8-10 m, up to 9000 kg. most numerous baleen whales.
2. *Balaenoptera musculus* [blue whale]: up to 30 m, 200,000 kg.
3. *Megaptera novaeangliae* [humpback whale].

Balaenopterids are gulpers

- 1.
- 2.
- 3.
- 4.



Food chain of the blue whale

1. Upwelling
2. Productivity
3. Short food chains

Megaptera novaeangliae

1. Humpback whale
2. 14-19 m.
3. 40,000 kg
4. Vocalizations

Feeding in Humpback Whales

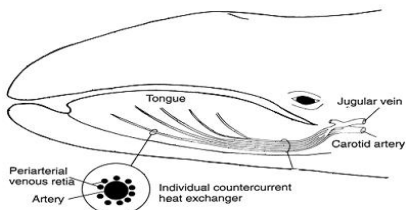
1. Lunge feed
2. Side feed
3. Bubble-net
4. Fluke feed

Eschrichtiidae - Gray whale (1, 1)

1. 14+ m and >30,000 kg
2. 2-4 longitudinal throat grooves.
3. Gulping bottom feeder

Grey whale countercurrent in tongue

1. countercurrent exchange
2. Thermoregulation
3. Heat conservation .



Family Echrichiidae

1. Migratory:
2. Females
3. Numbers have increased greatly
A. >12,000 today.

identifying a wintering gray whale

Odontoceti

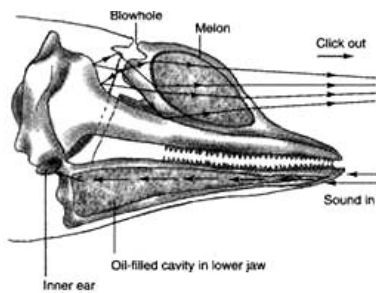
1. teeth present, simple, homodont,
2. Monophyodont
3. no baleen

skull generally asymmetrical around the single external nare



Sounds

1. Intraspecific communication.
2. ECHOLOCATION:



Generation of Odontoceti
echolocation clicks

1. A fatty or oily melon
- 2.
3. acoustic lens.

Odontoceti echolocation

1. Determine:
 - A. Size ,Shape, Distance, Internal structure
2. Return

Delphinidae--dolphins

1. Largest family [17 genera, 34 species.]
2. bottlenose dolphins, pilot whales, spotted dolphins, spinner dolphins, orca whales, etc.
3. Typically highly gregarious

Tursiops truncatus

1. Atlantic bottlenose dolphin, is the common dolphin of the Texas coast.

Differences between dolphins and porpoises

1. Dolphins have:
 - A.
 - B.
 - C.
2. In porpoises (Phocoenidae)
 - A.

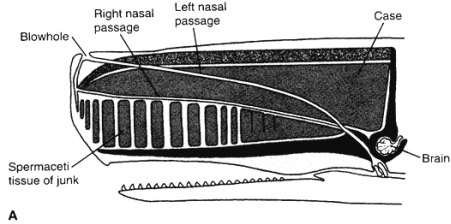
Physeteridae: sperm whales
[2,3]

1. Snout large, broad, blunt,
2. Squid predators
3. Teeth in lower jaw only.
4. *Physeter*: 18 m long, 53,000 kg.
 - A. 2,500,000 originally; 1,500,000 now.
 - B. Dive > 3200 m
5. *Kogia*: 4 m long, 320 kg.

Spermaceti

1. waxy liquid

A. buoyancy regulation and/or echolocation



A

Monodontidae--Narwhal and beluga [2,2]

1. Narwhal

A. Males: spirally grooved tusk.

B.

C. Females: tusks generally absent

D. Sensory function of tusks

Monodontidae

1. Beluga: white whale

A. important economically to Inuits, as a source of blubber, oil, and leather

Platanistidae: long snouted river dolphins [4,5]

1. large rivers of China, India & Pakistan, and Amazon and Orinoco
2. 1-3 m.
3. small eyes or blind

Ziphiidae – beaked whales (18 spp.)

1. among the least known whales.
2. eat squid
3. deep divers
4. Long snout
5. Few teeth

Aftermath of whaling (Table from Carwardine, 1999)

1. Species	Original	Present
2. Sperm whale	2,500,000	1,500,000
3. Blue whale	350,000	6,000
4. Fin whale	600,000	120,000
5. Sei whale	250,000	40,000
6. Bryde's whale	90,000	90,000
7. Minke whale	850,000	750,000
8. Humpback whale	250,000	18,000
9. Gray whale	20,000	20,000
10. Northern right whale	200,000	300
11. Southern right whale	55,000	6,000
12. Bowhead whale	30,000	6,000

Conservation Genetics

Frankham et al. 2002. Introduction to Conservation Genetics. Cambridge Univ. Press

1. Application of genetics to preserve species
 - A. wildlife forensics
 - B. management of small populations
 - C. Identifying and defining units of conservation within and between species

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Wildlife Forensics

- 1.
2. Detection of illegal hunting and sale of meat from protected whales (Baker and Palumbi 1996)
3. IWC moratorium on commercial whaling in 1985
4. "Scientific hunting"
5. Were protected species harvested for meat?

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Genetic Analysis of Whale Meat

- 1.
- 2.
- 3.
- 4.
5. Analysis of 16 Whale Meat Samples

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