Chapter Overview

• Pelagic animals use a variety of adaptations to help them survive.
• Marine mammals share similar characteristics with land mammals.
Marine Animals Avoid Sinking

• May increase buoyancy
• Use of gas containers
  – Rigid gas containers, e.g., cephalopods
  – Swim bladders – slow-moving fish
Avoiding Sinking

• Ability to float
  – Zooplankton – some produce fats or oils to stay afloat

• Ability to swim
  – Nekton – larger fish and marine mammals
Floating Zooplankton

- Microscopic zooplankton have shells or tests.
- Highly abundant in oceans
Floating Zooplankton

• Radiolarians
  – Silica tests
  – Intricately ornamented
  – Spikes on test increase organism’s surface area
Floating Zooplankton

• Foraminifers
  – Very small
  – Planktonic most abundant, benthic most diverse
  – Calcium carbonate tests that are chambered
Floating Zooplankton

• **Copepods**
  - Microscopic
  - Shrimplike crustaceans
  - Segmented bodies, jointed legs
  - Most of ocean’s zooplankton biomass
Macroscopic Zooplankton

• Krill
  – Crustaceans
  – Resemble mini shrimp or large copepods
  – Abundant near Antarctica
  – Critical in Antarctic food chains
Floating Macroscopic Zooplankton

• Cnidarians – soft bodies, stinging tentacles
  – Hydrozoan (Portuguese man-of-war)
    • gas-filled float
  – Scyphozoan (jellyfish)
    • Soft, low-density bodies
Swimming Organisms

• Nektonic
• Fish, squids, sea turtles, marine mammals
• Swim by trapping water and expelling it, e.g., some squid
• Swim by curving body from front to back
Swimming Motion and General Fish Features

Alternate contraction and relaxation of the myomeres sends a wave of body curvature back along the body to produce a forward thrust.
Fin Designs in Fish

- Paired vertical fins as stabilizers
- Paired pelvic fins and pectoral fins for “steering” and balance
- Tail fin (caudal) for thrust
Fin Designs in Fish

• Rounded caudal fins
  – Flexible
  – Maneuver at slow speeds

• Truncate fins and forked fins
  – Useful for both maneuvering and thrust
Fin Designs in Fish

- **Lunate fins**
  - Rigid, little maneuverability
  - Efficient propulsion for fast swimmers

- **Heterocercal fins**
  - Asymmetrical
  - Lift for buoyancy (shark)
Adaptations for Finding Prey

• Mobility
• Lungers wait for prey and pounce (grouper).
  – Mainly white muscle tissue
• Cruisers actively seek prey (tuna).
  – Mostly red muscle tissue
Lungers and Cruisers
Lungers and Cruisers
Lungers and Cruisers

• Red vs. white muscle tissue
• Red – smaller fibers than white
  – Higher concentrations of myoglobin
    • Red pigment with oxygen affinity
  – Supplies more oxygen
  – Higher metabolic rate for endurance
Adaptations for Finding Prey

- Swimming speed
- Speed generally proportional to size
- Can move very fast for short time (mainly to avoid predation)
Cold-Blooded vs. Warm-Blooded

• Most fish are cold-blooded – poikilothermic
  – Bodies same temperature as environment
  – Not fast swimmers

• Some are warm-blooded – homeothermic
  – Found in warmer environments
  – Helps them capture prey
Adaptations of Deep-Water Nekton

• Mainly fish that consume *detritus* or each other
• Lack of abundant food
• Bioluminescence
  – photophores
Adaptations of Deep-Water Nekton

- Large, sensitive eyes
- Large sharp teeth
- Expandable bodies
- Hinged jaws
- Counterillumination
Deep Sea Nekton
Adaptations to Avoid Predation

• Schooling
  – Safety in numbers
  – School may appear as single larger unit
  – Schooling maneuvers confuse predator
Adaptations to Avoid Predation

• **Symbiosis** – two or more organisms mutually benefit from association

• **Commensalism** – less dominant organism benefits without harming host
Adaptations to Avoid Predation

- **Mutualism** – both organisms benefit
  - Example: clown fish and anemone
- **Parasitism** – parasite benefits at expense of host
Marine Mammals

• Land-dwelling ancestors
• Warm-blooded
• Breathe air
• Hair/fur
• Bear live young
• Mammary glands for milk
Major Marine Mammal Groups

Marine mammals of Class Mammalia

Order Carnivora
- Sea otter
- Polar bear
- Pinnipeds
  - Walrus
  - Seals
  - Sea lions/Fur seals

Order Sirenia
- Manatee
- Dugong

Order Cetacea
- Odontoceti: Toothed whales
  - Porpoises
  - Dolphins
  - Sperm whale
- Mysticeti: Moustached whales
  - Blue whale
  - Finback whale
  - Right/Bowhead whales
  - Humpback whale
  - Gray whale
Order Carnivora

• Prominent canine teeth
• Sea otters
• Polar bears
• Pinnipeds
  – Walruses
  – Seals
  – Sea lions
  – Fur seals
Order Carnivora

• Sea Otters
  – Inhabit kelp in coastal, eastern North Pacific
  – Extremely dense fur, lack insulating blubber
  – Hunted in 1800, made recovery
  – Eat many types of marine animals, use tools
  – High caloric needs
Order Carnivora

• Polar Bears
  – Massive webbed paws
  – Excellent swimmers
  – Thick fur, hollow hairs
  – Eat mostly seals
Order Carnivora

• Walruses
  – Large bodies
  – Adults of both genders have ivory tusks
Order Carnivora

• Seals
  – Also called earless seals or true seals
  – Differ from sea lions and fur seals
Seals vs. Sea Lions and Fur Seals

• Seals lack prominent ear flaps
• Seals have smaller front flippers
• Seals have fore flipper claws
• Different hip structures
• Different locomotion strategies
Order Sirenia

- Herbivores
- Manatees
  - Coastal areas of tropical Atlantic Ocean
- Dugongs
  - Coastal areas of Indian and western Pacific Oceans
Order Cetacea

- Whales, dolphins, porpoises
- Elongated skull
- Blowholes on top of skull
- Few hairs
- Fluke – horizontal tail fin for vertical propulsion
Order Cetacea
Order Cetacea

• Adaptations to increase swimming speed
  – Streamlined bodies
  – Specialized skin structure
    • 80% water
    • Stiff inner layer
    • Narrow canals with spongy material
Order Cetacea

• Adaptations for deep diving
• Use oxygen efficiently
  – Able to absorb 90% of oxygen inhaled
  – Able to store large quantities of oxygen
  – Able to reduce oxygen required for noncritical organs
Order Cetacea

- Muscles insensitive to buildup of carbon dioxide
- Collapsible lungs
- Alveoli – tiny chambers facilitate gas exchange with blood
Order Cetacea

• Physiologically affected by deep diving, but debilitating effects minimized

• **Nitrogen narcosis** – similar to drunkenness, occurs when diving too deep

• **Decompression sickness** – “the bends”
  – Nitrogen bubbles in blood from resurfacing too quickly
  – Bone damage, excruciating pain, possible death
Order Cetacea

- Suborder Odontoceti (toothed)
  - Dolphins, porpoises, killer whale, sperm whale
  - Echolocation to determine distance and direction to objects
  - Determine shape, size of objects
Dolphins vs. Porpoises

- Porpoises
  - Smaller, more stout body shape
  - Blunt snout
  - Triangular, smaller dorsal fin
  - Blunt or flat teeth
Dolphins vs. Porpoises

• Dolphins
  – Larger, more streamlined shape
  – Longer rostrum
  – **Falcate** dorsal fin (hooked)
  – Pointy teeth like killer whales (orca)
Echolocation

- Good vision of marine mammals limited by ocean conditions.
- Dolphins and porpoises emit sounds from blowhole.
- Sound passes through melon – organ on skull.
Echolocation

- Toothed whales send sound through water.
- An evolved inner ear structure may help toothed whales pick up sounds.
- Whale forces air through nasal passage, click travels through spermaceti organ.
Echolocation

- Sound is reflected, returned to the animal, and interpreted.
- Increased marine noise pollution may affect echolocation.
Intelligence in Toothed Whales

• Large brains relative to body size
• Communicate with each other
• Brains convoluted
• Trainable
Order Cetacea

- Suborder Mysticeti
- Baleen whales
- Blue whale, finback whale, humpback whale, gray whale, right whale
- Fibrous plates of baleen sieve prey items
- Vocalized sounds for various purposes
Baleen

- Plates in whale mouths instead of teeth
- Whales fill mouths with water, baleen traps fish, krill, plankton
Baleen
Baleen Whale Families

• Gray whales
  – Short, coarse baleen, no dorsal fin, bottom feeder

• Right whales
  – Long, fine baleen, no dorsal fin
  – North Atlantic and North Pacific right whales most critically endangered whales in world
Baleen Whale Families

- **Rorqual** whales
  - Balaenopterids – long, slender bodies
  - Megapterids – humpback whales
Gray Whale Migration

• 22,000 km (13,700 miles) annual migration from coastal Arctic Ocean to Baja California and Mexico
• Feeding grounds in Arctic (summer)
• Breeding and birthing grounds in tropical eastern Pacific (winter)
Whales as Endangered Species

- Fewer whales now than before whaling
- International Whaling Treaty
- Hunting of gray whale banned in 1938
- Gray removed from endangered list in 1993 as population rebounded
Gray Whale Friendly Behavior
Whaling

• International Whaling Commission (IWC)
  1948 – established to manage whale hunting
• In 1986, 72 IWC nations banned whaling
• Three ways to legally hunt whales:
  – Objection to IWC ban
  – Scientific whaling
  – Aboriginal subsistence whaling
End of CHAPTER 14
Animals of the Pelagic Environment