Oceanography Chapter 15: Marine Animals

Heterotrophic – cannot synthesize their own food
Eat autotrophs or lower level heterotrophs
True multicellular critters arose 700-900 MYA (Proterozoic Eon)
>about 2 BY after cyanobacteria put out enough free oxygen into the atmosphere

- O_2 Revolution - 1% to 20 % in 1.5 BY
- O_3 formed – allow for critters to leave the water 400 MYA

Early views of life
Burgess Shale of B.C. "It's a Wonderful Life"
Ediacara Hills of Australia
Chengjiang beds of SW China

Phylum- group of critters that share similar architecture, level of complexity and evolutionary history (phylon- tribe)

- 90% of all living animals are invertebrates
- 33 invertebrate phyla (show you 9)

Phylum Porifera (Pons = holes, ferre – to bear)-aka {Sponge Bob}

- nearly all of the 10,000 species are marine
- Size: bean to a small car $\Rightarrow$ Have spicules made of spongin ($CaCO_3$, $Si0_2$)
- Widespread
- Shapes $\Rightarrow$ Branching, vase-like, encrusting
- Suspension Feeders – strain plankton (400 gallons)
- No digestive system, no circulation, respiratory or nervous systems

Phylum Cnidaria (old Coelenterata)

- 9000 species – jelly fish, sea anemones, corals
- cnidoblasts – stinging cells (Figure)
  (knide – nettle, blastikos – blast upward)
- Also have migratory cells which move nutrients around
- Cells
  1. Gastrodermis – digestion and reproduction
  2. Epidermis – protection and capture of prey

- Radial symmetry – body parts radiate from a central axis like spokes on a wheel
- No exeretory or circulatory system
- Primitive network of nerves
- Two forms (of body)
  1. Medusae – jelly fish
     - Biggest – cyanea – 12 ft bell, 59′ tentacles
     - Sea Wasp – 50 ft tentacles can kill you in 3 minutes (Chironix)
  2. Polyp – many footed
     - Fixed typically
     - Corals, sea anemones
     - Corals – solitary – 12 inches diameter

- Colonial – ant sized – Hermatypic
    - Zooxanthellac- dinoflagellates – symbiotic
    - Prefer clear water
    - Higher salinity – therefore, freshwater is deadly

Worm Phyla

- Transition to more advanced
- Bilateral symmetry – left side, right side
- Have head with sensory tissue
- Some flow through digestive systems and excretory systems

1. Simplest – **Platyhelminthes** – flat worms

Platys – flat Helmins- worm

- Parasites – tapeworms of vertebrates
- Most are free- living scavengers and predators
- Few are greater than 1 ¼ inches in length
- Most primitive with a central nervous system with brain and light sensitive eye spot
- Larger flatworms lack a true respiratory an excretory system
- Eliminate wastes by diffusion through cells
  (therefore, their body can be no more than a few cells thick)

2. **Nematoda** (Round worms) (nematos – thread)

- Flow through digestive tract (mouth, butt)
- Plentiful in almost all habitats
- Most of the 12 k species are free living
  Although some are parasitic (sushi)
    - Plentiful  1 meter square by 4 cm thick=4,420,000 critters

3. **Annelida** Cannelus – ring

- Includes earthworm
- Advanced, segmented (Metamerism)
    - Each segment can have its own nervous, muscular and repro tracts

  Class Polychaetae (chaetae – bristles)
  (Figure) – most important marine annelid
    - 1-15 cm (1/2 to 6 inches)
    - Feather duster- catches food
    - Some are mobile, others in tubes

ADVANCED INVERTEBRATES

Phylum Mollusca (Molluscus – soft bodied) - Figure 15.10

- Contains 80k (second to Arthropoda)
- Clams, snails, octopus, squid
- Most are marine and have a shell –internal
  -external
- Some species –acute eyesite, intelligence - octopus
- Probably came from a common ancestor of annelids
- Bilateral, heads, digestive tracts, nervous systems (a few are segmented)
- Structural diversity, can achieve great size

1. *Gastropoda* – Snails
   - Abalone, conch, limpet, garden snail
   - Grazers, suspension feeders, predators and a few are planktonic
   - Beautiful shells – outside – shock absorber
     middle- $CaC0_3$ – strength inside- smooth
   - Some do not have shells – Nudibranch (Figure)
2. *Bivalvia* – twin shells
   - Clams, oysters, mussels
   - Surrender mobility for protection, suspension feeders
3. *Cephalopods* (head foot- literal)
   - Nautilus, Octopus, Squid
     ⇓ ⇓ ⇓
     external none small one (shells)
   - Squid and octopus more advanced
   - Secrete an ink roughly their body size
   - Squid – 59 feet long
   - Squid – largest invertebrate
   - Octopus- most intelligent – keen eyesight
   - Only 450 species of cephalos now

Phylum Arthropoda

- Arthron (joint) poda – foot
- Lobsters, shrimps, crabs, krill, barnacles
- Million of species
- Most successful phyla
- Krill-greatest biomass
- Variation of annelid – per or pairs of legs (or appendage) per segment
- All are bilaterally symmetric
- Do not have good nervous system, intelligence or eyesight
- But do have 3 major advances
  1. Exoskeleton – form fitting external covering
  2. Striated Muscle – Quick, strong, lightweight form of muscle that makes rapid movement and flight possible
  3. Articulation – ability to bend appendages at specific points
- Exoskeleton – made of chitin (N rich carb)
- Molting – replacement of exoskeleton
- Largest class – *insecta* – all marines ones are water striders
- *Crustacea* – 30 k – primarily marine – gills
  - Lobsters, crabs
  - Bodies – 16 to 20 segments
  - Big – King Crab – leg span of 12 feet
  - Heaviest- lobster (48 lbs) feed 10 people
  - Dominate oceans

Phylum Echinodermata

- Echinos (hedgehog, skim)
- Lack eyes, brains
- 6000 species
- Radial symmetry (Pentamerous)

- Five classes
  1. Asteroidea – sea stars – water vascular system
  2. Ophiuroidea – Brittle stars – leave an arm
  3. Echinoidea – sea urchins, sand dollars
  4. Holothuroidea –sea cucumbers

Figures 15.18-15.20 (15.18 - Sea Star, 15.19 – Water vascular, 15.20 – Brittle stars)

PHYLUM CHORDATA

- Posess notochord
- 40k species
- about 5% lose notochord – invertebrate chordates

1. Invertebrate chordates (Figure 15.22)

- Tunicates – sea squirts
- Suspension feeders – look like sponges
- Amphioxus (sharp at both ends)
- Invertebrate with some vertebrate features

2. Vertebrate chordates
   a. *Fish* – possess gills, fins
      - More than all other vertebrates combined
      - Length – 0.4 inch to 60 feet
      - Weight – 0.1g to 45 tons
      - Speed – 75 mph (120 km/hr)
      - Cold blooded – ectothermic
      - 40% freshwater, 60% sea water
      - 500 MYA first appeared, exploded 410 MYA
      - Devonian Period (age of fish) – 408 –360 MYA
        1. Class Agnatha – hagfish, lanpreys ↵ (Figure 15.25)
        - Fewer than 50 species
        - Slime to protect
        - Lanpreys - parasitic
        2. Class Chondrichthyes
        - 280 MYA appeared
        - sharks, slates, rays, chamaeras
        - active
        - cartilage skeleton
        - sharks, rays – neg. buoyancy (no gas bladder) - (they'll sink)
        - diversity
        - more people are killed by dogs each year than killed in the last century by sharks

        Sharks
        - 80% of shark species are less than 2m long as adults
        - Great White – 23 feet, 3000 lbs
        - Mako- little one (13 feet) – attack small boats
        - Largest – Whale Shark (60 feet, 90K pounds)

3. Class Osteichthyes
   - 27K bony fish
   - 90% are Teleostei (Perfect bone)

(cod, tuna, halibut, perch) – Figure 15.29

   - 77 million tunas eaten
   - Adaptations – camouflage, schools, speed, gas-filled swim bladders

<u>The problems of Fishes</u>

1. Viscosity, Shape and Propulsion
   - Small ones – difficult
   - Streamlined-tuna (Figure 15.30)
   - Eel like movement – not as efficient (Figure 15.31)
   - Fastest 75 mph
2. Maintenance of level
   - Cartilaginous Fish – swim constantly (no gas bladders)
   - Gas bladders – swim bladders
   - Fastest fish: no swim bladders
3. Gas Exchange
   - Gill membrane take in dissolved 0_2
   - Active fish – bigger – gill area
4. Osmotic Considerations
   - Osmoregulators
   - Freshwater would gain water
   - Saltwater would lose water
5. Feeding and Defense
   - Lateral line system – defects low frequencies
   - Cryptic coloration (camouflage)
   - Turbot (Fig 15.34)
   - schools
   - Flying Fish

Amphibians

   - 2000 species exist – most are terrestrial

Marine Reptiles

   - Turtles, sea snakes, marine lizards, marine crocs
   - Salt glands- excrete salts from body fluids

Sea Turtles – 8 species of these

   - Non retracting
   - Figure 15.36 – Green one (Chelonia)
   - Largest – Atlantic Leatherback (61/2 feet, 1300 lbs)
   - Lay eggs on the beach they were hatched
   - Ascension Island – studied there

Marine Crocs

   - Mangrove swamps, reefs
   - 23 feet, over a ton

Marine Birds

1. Tubenoses – Albatross (12 feet wing span, 22 lbs)
   (rarely flap- aerodynamic wings)
2. Pelicans – throat poaches, webbed feet
   - Light delicate
3. Gulls including Terns
4. Penguins – only southern hemisphere

MARINE MAMMALS

- Most advanced vertebrate group – 4300 species

All marine mammals possess:

1. Streamlined Body Shape – with limbs adapted for swimming
   - Drag is reduced by hair or slippery skin
2. Generate internal body heat –high metabolic rate
   - No marine mammals are smaller than a sea otter
     (small ones would lose heat too fast)
3. Respiratory System is modified to collect and retain large quantities of 0_2
   - Empty lungs completely more easily
   - Could hold breath longer and utilize 0_2 – whales
4. Osmotic Adaptations – skin is impervious to water
   - Take in little water
   - Excrete salty pee

Three main Orders:

1. Cetacea – whales, dolphins, porpoise
   - Thought to have evolved from hoofed land animals related to horse/sheep
   - Range in size from 1.8m (6ft) to 33m (110 ft) weigh up to 110 tons
   - Nostrils at top of head

Suborders of Cetacea (Fig 15.39)

1. Odontoceti – toothed whales
   - Include Orca, Dolphin, Porpoise
   - High brain weight to body weight ratio
   - Largest – Sperm Whale – 60 feet - dives deep (3740 ft)
     (can dive to 3740 feet)
   - Search for food by echolocation (Fig 15.40)
   - thought to use sound offensively as well
     - Dolphins – 229 decibels
     - Sperm Whales- 260 decibels
2. Mysticeti- baleen whales
   - No teeth
   - Eat krill (filter feed), and lots of it
   - Feed close to the surface
   - Blue Whale- largest – babies can grow at 9lbs per hour
   - Social structure – Humpback, Bowhead

2. Order Carnivora
    a. Suborder Pinnipedia – wing foot – seals, sea lions, walrus
        - Leave ocean to mate and raise young
        - Appeared to have evolved from the same stock as modern bears
            1. Seals – covered with short coarse hair without soft under fur, no ear flaps
                - Rear appendages for swimming- not useful on land
                - Diving record – 5120 feet – elephant seal
            2. Sea Lions – have hind limbs with a greater range of motion (for use on land)
                - Small ears, soft under fur
                - Use front flippers for propulsion
            3. Walruses – much larger
                - 2 tons
                - dig up clams with mouths
                - use tusks for moving too

    b. Suborder Fissipedia (Split foot)
    (cats, dogs, coons, bears)
        1. Sea Otters – smallest
            - Densest and warmest fur
            - Active & cute
        2. Polar Bears – eat seals, beached whales
            - Can swim 62 miles of open water
            - 8ft tall, 1800 lbs
        3. Order Sirenia
            - Sirius -mermaid
            - Dugongs and Manatees
            - Herbivorous – (only ones)
            - Graze on sea grasses, marine algae
            - 10K world wide
            - largest (15 feet, 1500 lbs)