Taxonomy, Anatomy and Biology of Bivalve Molluscs: Hard Clam

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SHARKS AQUACULTURE LIFE TRAINING

Taxonomy

- Science of defining and naming groups of biological organisms on the basis of shared characteristics and evolutionary relationships
- Branch of biology that names and identifies organisms
- A scheme of classification from broader categories to specific ranking



Taxonomy

- Kingdom: Animalia
- Phylum Mollusca (35 phylums)
 - Latin for "soft things"
 - Largest most diverse marine phylum
 - 25% of named marine organisms
 - About 100,000 recognized species



Class - Bivalvia (clams, oytsters, mussels and scallops)





mussels





Classes in Phylum Mollusca

- Gastropoda snails
- Cephalopoda squids, octopus
- Polyplacophora chitons
- Scaphopoda tusk shells



• Bivalvia - clams, oysters, scallops, mussels









Class Bivalvia – 20,000 described species

Clams



Oysters



Scallops



Mussels





Bivalve form





- Two valves, halves , or shells
- Bilateral symmetry both sides the same size
- Compressed laterally (sideways)
- Shell
 - Joined by hinge ligament
 - Held closed by adductor muscles



Bivalve form (continued)

• Mantle

- Encloses body and water space
- Foot
- Gills
 - Filter feeding
 - Gas exchange









Clam Taxonomy

- Subclass Heterodonta clam-like with large hinge teeth
- Order Veneroidae
- Family Veneridae
 - Venus or "heart" clam
 - Side view is cardioid (heart-shaped)
 - 53 genera and about 500 species
 - Most are edible and support valuable fisheries and aquaculture industries worldwide





Clam Taxonomy

- Genus: Mercenaria Species: mercenaria
- Latin for "commerce"
- New England Indians made valuable beads called wampum from shells, especially the purple color, and used for trading currency







Mercenaria in history



Mercenaria permagna embedded in limestone with calcite crystals collected from Fort Drum quarry in Florida

- Several species known only from fossils
- Found during Pleistocene epoch
- 780,000 to 1.8 million years ago



Clam Common Names

- Northern hard clam or hard clam
- Quahog
 - Derived from Native American words - "closed" and "shell"
- Other names refer to size
 - Chowder
 - Cherry
 - Top neck
 - Middle neck
 - Little neck



External Clam Shell Anatomy



- Two fused siphons extend from posterior end of shell into water
 - "little" necks
- Two muscles keep valves closed
 - Predators or adverse environmental conditions



- Muscular foot extends beyond shell for burrowing into bottom
- Mouth near foot area anterior end of shell

External Clam Shell Anatomy



- 1. Left valve or shell
- 2. Anterior or head
- 3. Posterior or tail
- 4. Dorsal or upper
- 5. Ventral or lower
- 6. Umbo ("beak")
 - Oldest part of the shell
- 7. Growth ring

Northern hard clam, Mercenaria mercenaria

Clam Growth

- Shell consists of calcium carbonate in a crystalline form
- Concentric rings indicate general growth pattern
- New shell forms at the ventral end by secretion of a protein matrix and calcium by the mantle
- When growth stops, a ring is formed



Southern Quahog, Mercenaria campechiensis

Clam Shell Coloration

White - new growth

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Orange-brownish – exposed to air, "oxidized"

Black - just harvested, "reduced"

Clam Shell Coloration



- Notata markings
 - Controversy on whether subspecies or natural form
- Chestnut-colored, chevron-shaped ("zigzags") markings
- 1-2% occurrence in "wild" clams
- Bred into cultured clams as a marketing tool

Clam Measurements



- Shell length
 - Longest dimension
 - From anterior to posterior ends
 - Used in seed sizes
- Shell Height
 - From dorsal (umbo) to ventral

Clam Measurements



Shell Width

- Shortest dimension
- Across hinge
- Used in market sizes for cultured product
- For "wild" harvest, must be >1"
- Use calibers to measure



Internal Clam Shell Anatomy



 Inner surface of left valve

- 2. Post. adductor muscle
- 3. Ant. adductor muscle
 - Hold valves shut

4. Hinges

- •Ligament holds valves together
- Interlocking teeth prevent valves from side slipping when opening and closing
- 5. Teeth along ventral margin
 - Prevent valves from sliding when closes
- 6. Where siphons sit
- 7. Umbo
- 8. Pallial line
 - Where mantle is attached to shell

Internal Clam Shell Anatomy



1. Mantle

- Covers visceral or body mass
- Holds in fluid
- Secrets new shell
- 2. Ant. adductor muscle
- 3. Post. adductor muscle
 - Hold valves shut
- 4. Pericardium cavity
 - Region covered with thin, dark membrane
 - Contains 2-chambered heart and kidney in a fluid-filled sac
- 5. Mantle edge
- 6. Siphons
 - Left and right mantles join to form siphons

Internal Clam Anatomy

adductor

- Remove mantle to observe thickened region
 - Gonadal tissue (reproductive system)
 - Palps (digestive system)
 - Kidney and anus (excretory system)
 - Gills (respiratory system)



Digestive and Respiratory Systems



Siphons

- Incurrent- incoming water contains oxygen and tiny food organisms
- Excurrent- metabolic wastes are expelled

• Gills

- 2 pairs on each side
- Filter out food particles and provide for gas exchange
- Labial palps (2)
 - At ends of gills provide for food sorting prior to entering mouth

Feeding



Filter feeder Can clear 5 gallons per day of particles as small as 2 microns

- Cilia on incurrent siphon and gill filaments move water through animal
 - Microscopic hair-like appendages
- Mucous on gills trap entering particles
- Particles moved by food groove toward labial palps
 - Like a conveyor belt
- Labial palps sort out food before entering mouth
 - Rejected matter (silt, excess phytoplankton) dropped into mantle and released as pseudofeces

Feeding

- Interesting feature
- In the stomach is a "crystalline style"
 - Thin, glass-clear organ looks like a worm
 - Contains digestive enzymes
 - Also grinds phytoplankton like a mortar and pestle













Clam example - animation

- <u>http://www.biology.ualberta.ca/facilities/multimedia/?Page=252</u>
- <u>http://www.biology.ualberta.ca/facilities/multimedia/uploads/zoology/Clam.h</u> <u>tml</u>

Water flow in a eulamellibranch bivalve (clam; phylum Mollusca)



Reproductive System

- Gonadal tissue grows throughout visceral mass and foot
- Separate sexes
- Usually protandric spawns as male first year
- Second year about half become female at 20-35 mm









Internal Clam Anatomy



Class Exercise

- External (outside) clam shell
 - Coloration, find growth rings, umbo
 - Measurements with calibers
- Internal (inside) clam shell
 - Identify muscle scars and hinge ligament
- Internal Clam Anatomy
 - Identify muscles, mantle, siphons, foot
 - Lift off mantle -
 - Find gills, labial palps, heart
 - Lift up gills -
 - Find stomach and intestines



Clam - External Features

umbo





Oyster Comparison

SHELL LENGTH



Another important bivalve found in Cedar Key -Eastern oyster *Crassostrea virginica*



Oyster Comparison

dorsal



ventral





Clams provide food, jobs and ecosystem services

