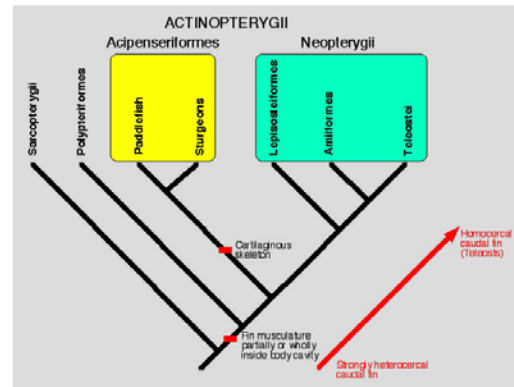


Lecture 9

- Origin of Actinopterygii (ray-finned fishes)
- Late Silurian - Early Devonian - 400 mya
- Monophyly of large assemblage > 23,000 species – we accept monophyly but interrelationships less well established.
- Many confusing attempts to comprehend/classify lower Actinopterygian fishes
- But - if only living members - relationships are, with few exceptions, reasonably well established.

Actinopterygii



Historical Context

- Agassiz (1833-44) compendium fossil fish & Muller's (1845) classification living actinopterygians - 3 major assemblages: Chondrostei (sturgeon/paddlefish), Holostei (Gars/Amia), Teleostei
- Basic divisions of Actinopterygian more-or-less accepted until phylogenetic systematics in late 1960's.
- One of most influential publications - "Interrelationships of fishes" (1973) - Molded contemporary views of Actinopterygian interrelationships by Greenwood, P. H., Miles, S., Patterson, C. eds, J. Linn. Soc. (London) 53 Supplement 1. Academic Press, New York, New York.

Louis Agassiz

- "I have devoted my whole life to the study of Nature, and yet a single sentence may express all that I have done. I have shown that there is a correspondence between the succession of Fishes in geological times and the different stages of their growth in the egg, -- that is all. It chanced to be a result that was found to apply to other groups and has led to other conclusions of a like nature."

Louis Agassiz, 1869





- Problems associated with poorly preserved fossil taxa - Schaeffer's on Chondrosteian interrelationships. Concluded many of old groups – "chondrostei" were paraphyletic but unable to do much more
- Gardiner & Schaeffer reanalyzed major lower Actinopterygian – "Interrelationships of lower Actinopterygian fishes" 1989 Z. J. Linn. Soc. 97:135-187.
- Mammoth work - array of fossils - previously grouped in various "chondrosteans and paleoniscids"

- Basically see: Basal actinopterygians – (1) Cheirolepis (fossil Paleonisciformes), (2) Cladistia, (3) Chondrosteans=Acipenseriformes, (4) Neopterygians.
- 1+2 = Most taxa represented are fossil –
 2 = polypterids living.
 3 = Chondrosteans – 2 living groups
 3a = Acipenseridae - sturgeons (25 recent species);
 Specialized bottom-feeders - bony scutes (retain three heavy layers- ganoine) - Heavily over fished.
 3b = Polyodontidae - paddlefishes - two recent species.
Polyodon spathula - Mississippi River and *Psephurus gladius* - Yangtze River, China. Highly modified planktivores.



Cheirolepis

- **Middle Devonian (398 to 385 mya) to Late Devonian (385 to 359 mya).**
- **Phylogeny:** Actinopterygians = (1) *Cheirolepis* (fossil Paleonisciformes), (2) Cladistia, (3) Chondrosteans, (4) Neopterygians.
- **Description:** Possibly earliest actinopterygian with "standard" dermal skull bones; large orbit; long (~50 cm) body; broad-based pelvic fin; fins other than pelvic fin long; strongly heterocercal tail; fringing scales small or absent; minute scales with two ganoine (probably same as enamel) layers;

Bichirs

Cladistia – Polypterus (bichirs);
 Represented by 10 FW species - tropical Africa and one species - *Erpetoichthys calabaricus* – reedfish.
 - Rope fish

- Highly aberrant Cladistia - numerous uniquely derived features – long, independent evolution:
 - Strange dorsal finlets
 - Series spiracular ossicles
 - Peculiar urohyal bone and parasphenoid
- But retain # primitive Actinopterygian features =
 - heavy ganoid scales (external layer of ganoine)
 - gular plates
 - spiral valve in the intestine
 - lung-like swim bladder
- Regardless of Cladistia, major problems in numerous fossil forms (will not go into).

Sturgeons = Order Acipenseriformes

- Family = Acipenseridae ~ 30 species
- 5 rows bony plates on body
- Caviar and 'isinglass' from swimbladder
- Extremely threatened = dams, pollution, silt & overfishing



Paddlefish= Order Acipenseriformes

- 2 living species = *Polyodon spathula* and *Psephurus gladius*
- Elongate snouts = sensory (not dig) – eats zooplankton and phytoplankton
- Extremely threatened = dams, pollution, silt & overfishing



- D) Neopterygii - Current views - again vary - present that in Lauder and Liem (Gars, Amia and teleosts)
- Three major groups:
 - 1) Ginglymodi - gars (*Lepisosteidae* – 2 genera and 7 spp.)
 - 2) Halecostomi - halecomorphi - several fossils, and amia (bowfin) – traditionally Holostei.
 - 3) Teleostei - subject of much of rest diversity survey – 20,000 + species.
- Old group "holostei" is clearly broken up in this view and we have Amia and teleosts.

Gars = Order Lepisosteiformes

- Gars - Order = Lepisosteiformes, Family = Lepisosteidae
- 2 Family and 7 species (living)
- Hard enameled scales of ganoin
- Ambush predators

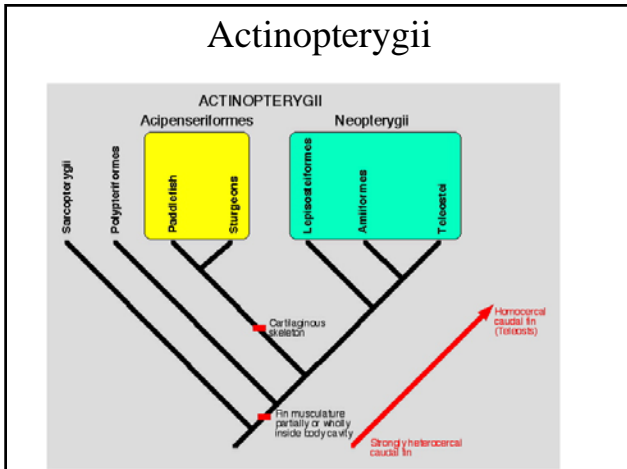


Bowfin = Order Amiiformes

- Bowfin - Family = Amiidae
- 1 Living – *Amia calva*
- Temperate eastern North America
- Scales cycloid – dorsal fin entire length
- Up to 40 inches and 8.5 lbs



Actinopterygii



NEXT - Evolution of particular function in Actinopterygian fishes in context of historical sequence of structural changes within clade

- Function = feeding; specifically the elaboration of inertial suction feeding mechanisms.
- Remember - aquatic medium (800 x dense and 80 x viscous than air). Also oxygen less, temperature stable, hydrate, buoyancy, viscosity (more drag).
- Food acquisition on land = very different than water.

- Also - explore possible implications of very fundamental differences in aquatic versus terrestrial feeding modes - on trophic ecology of vertebrates