ORIGIN AND EVOLUTION OF TELEOST

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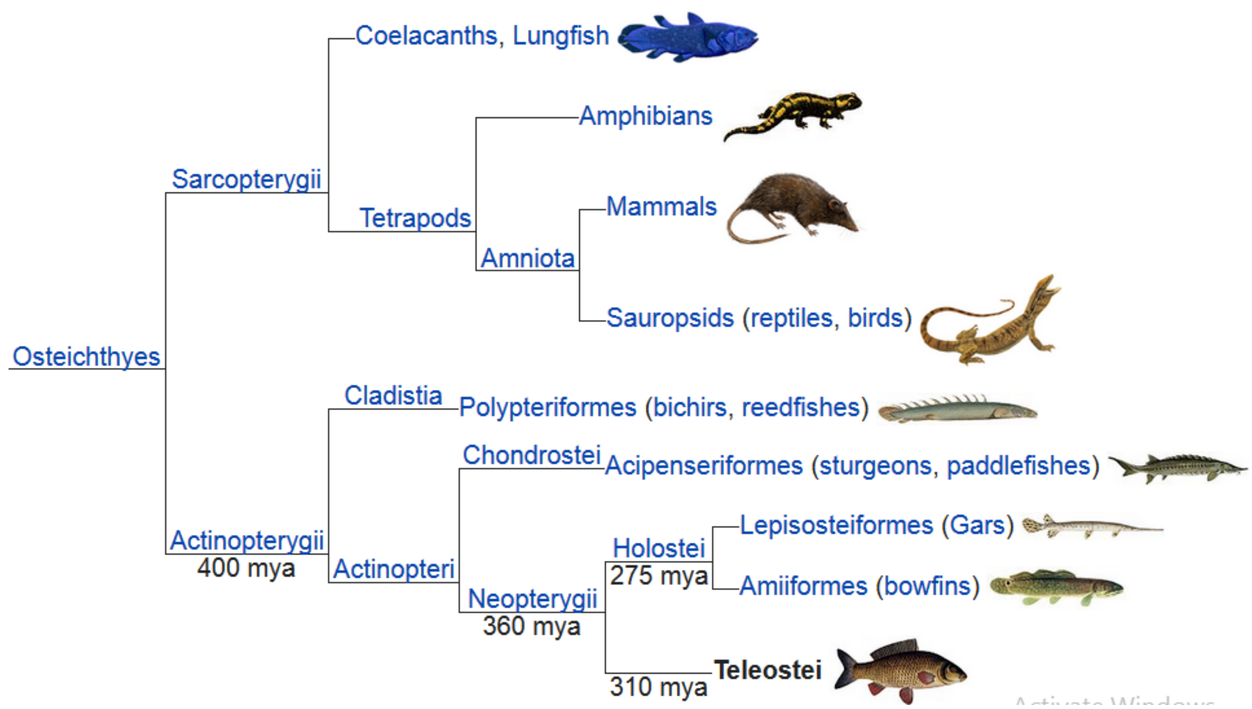
Teleostei (Greek: teleios, "complete" + osteon, "bone"), members of which are known as teleosts, is by far the largest infraclass in the class Actinopterygii, the ray-finned fishes, containing 96% of all extant species of fish. Teleosts are arranged into about 40 orders and 448 families. The difference between teleosts and other bony fish lies mainly in their jaw bones; teleosts have a movable premaxilla and corresponding modifications in the jaw musculature which make it possible for them to protrude their jaws outwards from the mouth. This is of great advantage, enabling them to grab prey and draw it into the mouth. In more derived teleosts, the enlarged premaxilla is the main tooth-bearing bone, and the maxilla, which is attached to the lower jaw, acts as a lever, pushing and pulling the premaxilla as the mouth is opened and closed. Other bones further back in the mouth serve to grind and swallow food. Another difference is that the upper and lower lobes of the tail (caudal) fin are about equal in size. The spine ends at the caudal peduncle, distinguishing this group from other fish in which the spine extends into the upper lobe of the tail fin.

Teleosts have adopted a range of reproductive strategies. Most use external fertilisation: the female lays a batch of eggs, the male fertilises them and the larvae develop without any further parental involvement. A fair proportion of teleosts are sequential hermaphrodites, starting life as females and transitioning to males at some stage, with a few species reversing this process. A small percentage of teleosts are viviparous and some provide parental care with typically the male fish guarding a nest and fanning the eggs to keep them well-oxygenated.

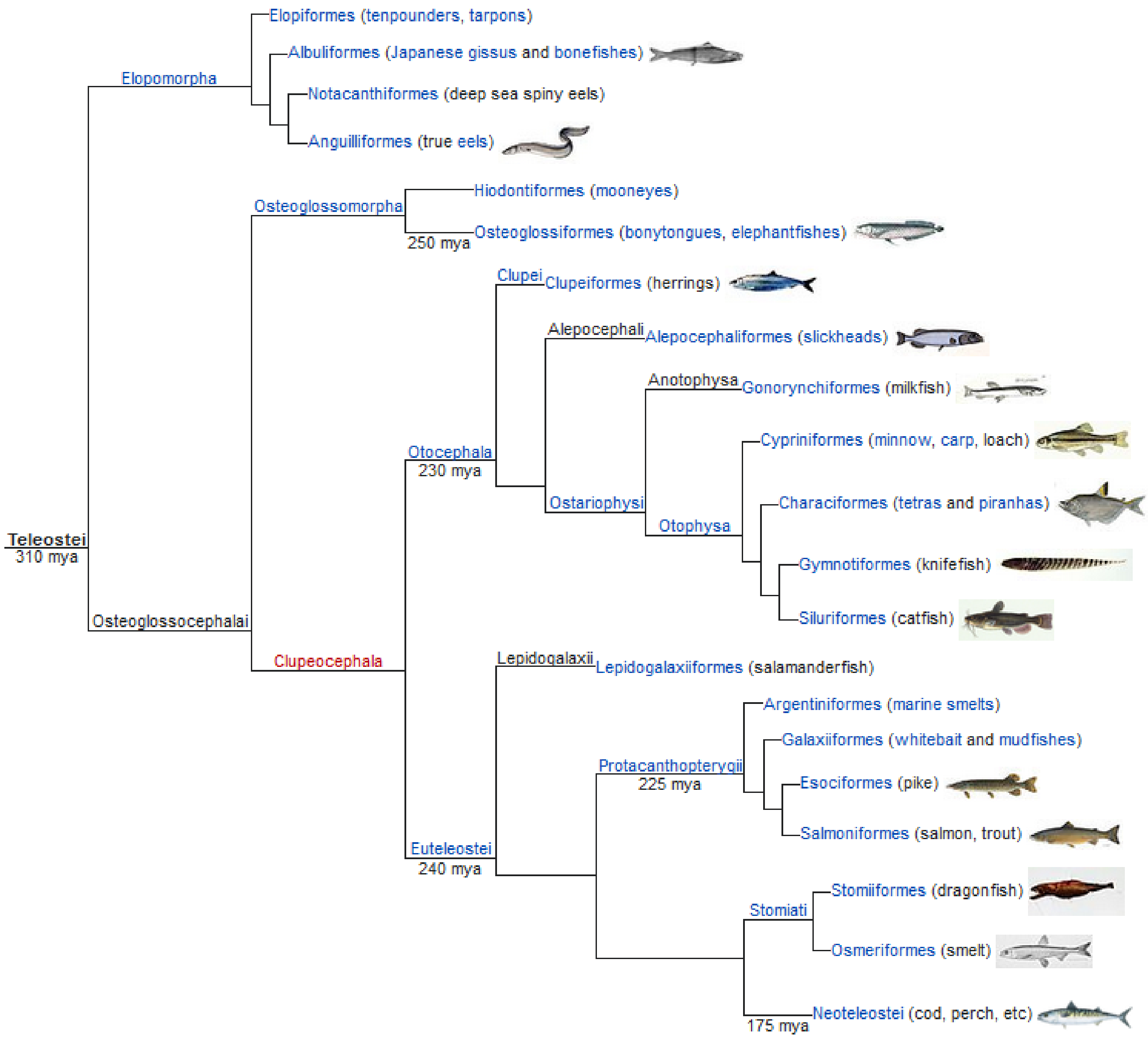
External relationships

The teleosts were first recognised as a distinct group by the German ichthyologist Johannes Peter Müller in 1844. The name is from Greek teleios, "complete" + osteon, "bone". Müller based this classification on certain soft tissue characteristics, which would prove to be problematic, as it did not take into account the distinguishing features of fossil teleosts. In 1966, Greenwood et al. provided a more solid classification. The oldest teleost fossils date back to the late Triassic, evolving from fish related to the bowfins in the clade Holostei. During the Mesozoic and Cenozoic they diversified, and as a result, 96 percent of all known fish species are teleosts. The cladogram shows the relationship of the teleosts to other bony fish, and to the terrestrial vertebrates (tetrapods) that evolved from a related group of fish.



Internal relationships

The phylogeny of the teleosts has been subject to long debate, without consensus on either their phylogeny or the timing of the emergence of the major groups before the application of modern DNA-based cladistic analysis. Near et al. (2012) explored the phylogeny and divergence times of every major lineage, analysing the DNA sequences of 9 unlinked genes in 232 species. They obtained well-resolved phylogenies with strong support for the nodes (so, the pattern of branching shown is likely to be correct). They calibrated (set actual values for) branching times in this tree from 36 reliable measurements of absolute time from the fossil record. The teleosts are divided into the major clades shown on the cladogram.



EVOLUTION

The first fossils assignable to this diverse group appear in the Early Triassic, after which teleosts accumulated novel body shapes predominantly gradually for the first 150 million years of their evolution(Early Triassic through early Cretaceous).

The most basal of the living teleosts are the Elopomorpha (eels and allies) and the Osteoglossomorpha (elephantfishes and allies). There are 800 species of elopomorphs. They have thin leaf-shaped larvae known as leptocephali, specialised for a marine environment. Among the elopomorphs, eels have elongated bodies with lost pelvic girdles and ribs and fused elements in the upper jaw. The 200 species of osteoglossomorphs are defined by a bony element in the tongue. This element has a basibranchial behind it, and both structures have large teeth which are paired with the teeth on the parasphenoid in the roof of the mouth. The clade Otocephala includes the Clupeiformes (herrings) and Ostariophysi (carps, catfishes and allies). Clupeiformes consists of 350 living species of herring and herring-like fishes. This group is characterised by an unusual abdominal scute and a different arrangement of the hypurals. In most species, the swim bladder extends to the braincase and plays a role in hearing. Ostariophysi, which includes most freshwater fishes, includes species that have developed some unique adaptations. One is the Weberian apparatus, an arrangement of bones (Weberian ossicles) connecting the swim bladder to the inner ear. This enhances their hearing, as sound waves make the bladder vibrate, and the bones transport the vibrations to the inner ear. They also have a chemical alarm system; when a fish is injured, the warning substance gets in the water, alarming nearby fish.

The majority of teleost species belong to the clade Euteleostei, which consists of 17,419 species classified in 2,935 genera and 346 families. Shared traits of the euteleosts include similarities in the embryonic development of the bony or cartilaginous structures located between the head and dorsal fin (supraneural bones), an outgrowth on the stegural bone (a bone located near the neural arches of the tail) and caudal median cartilages located between hypurals of the caudal base. The majority of euteleosts are in the clade Neoteleostei. A derived trait of neoteleosts is a muscle that controls the pharyngeal jaws, giving them a role in grinding food. Within neoteleosts, members of the Acanthopterygii have a spiny dorsal fin which is in front of the soft-rayed dorsal fin.This fin helps provide thrust in locomotion and may also play a role in defense. Acanthomorphs have developed spiny ctenoid scales (as opposed to the cycloid scales of other groups), tooth-bearing premaxilla and greater adaptations to high speed swimming.

The adipose fin, which is present in over 6,000 teleost species, is often thought to have evolved once in the lineage and to have been lost multiple times due to its limited function. In Characiformes, the adipose fin develops from an outgrowth after the reduction of the larval fin fold, while in Salmoniformes, the fin appears to be a remnant of the fold.