j14 Varieties of fishes < Osteichthyes, Placodermii, Chondrichthyes, Agnatha >

> According to Micmac Indian legend, the shad was originally an unhappy porcupine who asked the Great Spirit Manitou to recreate it in another form. Manitou obliged by turning the porcupine inside out, dubbing it 'shad' and hurling it into the river. An ichthyologist's actual count of its prickly bones: 769! —Jonathan Reynolds.[1]

Class OSTEICHTHYES (bony fishes) 50,000 species

Be not proud. Most living vertebrates, from teleosts to tetrapods (and so ourselves), are (recall *Figure h 9.1*, p. 444) osteichthyans (bony fishes).[2]

Subclass Actinopterygii (ray-finned fishes—25, 000 species)

The subclass name refers to the skeleton of these fishes being, at least partly, true bone in the place of cartilage. The fins, which extend from the body, are of transparent skin-sheathed flesh supported by a varying number of radiating spines and soft rays.

The most advanced ray-finned fishes are members of the infraclass Teleosti (teleosts). These fishes are those of which we are most familiar[3] as they are often featured in pictures, in aquarium displays, and on your plate. Teleosts have been the dominate fishes in Cenozoic and Mesozoic seas, rivers, and lakes. Examples: 1) *freshwater* bass, pike, and trout, 2) *marine* flounder, herring, sardines, cod, and tuna, 3) *anadromous* (that range productively rich cold-seawater but spawn and breed in productively poor cold-freshwater)[4] salmon, sturgeon, shad, and certain species of eels, and 4) *catadromous* (with a lifestyle in tropical ecologies the reverse of the forgoing) as are *Anguilla* eels (16 species).

Eels (order Apodes), being without paired fins or scales, are the most evolved teleosts.

Living fossils *Calamoichthys* and *Polypterus* (reedfishes) of central Africa, perpetuate the order Paleoniscoids (mostly freshwater ray-finned fishes that were moderately successful during the Paleozoic). Paleoniscoids have asymmetrical tails and diamond-shaped scales that do not overlap. They first appeared in the mid-Devonian. Typical then was *Cheirolepis* (beloved of Hugh Miller, *see* Topic *j16*) that lived in the freshwater environment of the Old Red Sandstone paleocontinent.

Subclass Choanichthyes (nostril-bearing fishes—almost extinct)

Choanichthyes (or Sarcopterygii when the clade considered includes tetrapods and their descendants as us) have been close to extinction (the water bound ones, that is) since the Paleozoic when they were abundant and varied. An ancestral feature of these fishes is a pair of nostril openings in the roof of the mouth. The Greek root *choana* in the subclass name means "internal nostril."

The two principal orders are: Crossopterygii (lobe-finned fishes), and Dipnoi (lungfish).

Class PLACODERMII (plate-skinned armored fishes with jaws but no teeth—extinct)

These have the dubious distinction of being the only group of vertebrates designated as a class to have become extinct.

The longest surviving order of placoderms were the Acanthodians. These, often referred to misleadingly as "bony sharks," dwindled to extinction during the Lower Permian. They had several features that are also typical of higher classes of fishes: paired fins, scales rather than bony plates covered their bodies, and jaws (evolved from the gill supports of ancestral fishes). On each side, a flap covering the gills was with one opening, as in bony fishes. Their body was elongate, and their many fins were supported by sharp spines. They had no teeth but, clearly, were predators.

The most heavily armored orders of placoderms went extinct at the end of the Devonian. Until then, some very large marine Late Devonian placoderms were the dominant aquatic predators that ranged in size from half meter long *Coccosteus*, to giant 10 m long *Dunkleosteus* (also called *Dinichthys*).

Placoderms, during their Devonian heyday, were freshwater and marine fish. Those of order Arthrodires (joint-necked fishes) had bony armor in two parts: a shield over the head and gills, articulated with a shield over the foretrunk. For swift locomotion the tail was unarmored, and so, although vulnerable to attack, flexible. Placoderms appeared late in the Silurian.

Class CHONDRICHTHYES (cartilaginous fishes—700 species)

Chondrichthyes (all are marine), familiar as sharks, skates and rays, continue to be successful and are far from primitive: elasmobranchs have internal fertilization. The great whites stem from the Miocene. Then, the greatest of all, *Carcharodon megalodon*, left six inch, serrated, tooth-blades as abundant evidence of its presence. Like their modern descendants, Miocene sharks (capping even the now vanity of South Beach, Miami, beautiful humankind) were replacing each pearly white every few weeks. Most modern shark faunas became established during the Eocene. Stingrays were in existence soon after the beginning of the Paleocene.

Profligate shedding of teeth, even before they were blunted, began as a feature of Carboniferous sharks when these top predators existed at their greatest diversity. Shark teeth from older strata, by contrast, typically show considerable usage-wear before they were shed. In Devonian seas, sharks were second only to the placoderms. Some, as *Cladoselache*, commonly found in association with placoderm skeletons in Late Devonian black shales, northern Ohio, grew to lengths of more than 1 meter. Primitive forms of sharks first occur in abundance in the mid-Devonian.[5]

Whole shark fossils are rare. The oldest known are from the lower Silurian Llandovey formation of Siberia. They had skin denticles but no teeth or jaws.

From the Late Ordovician Harding sandstone, Colorado, Ivan J. Sansom has described tiny scales that he likens to shark-skin denticles. These shark (?) ancestors could well have been jawless.

Class AGNATHA (jawless fishes—2 extant genera)

Agnatha are represented today by highly evolved, but degenerate in appearance, parasites: the lampreys and the hagfish. These have no hard parts and have left a poor fossil record (a few freshwater and marine Cretaceous fossils of them have been found).[6] However, numerous fossil Agnatha are known from the Devonian when most were covered by bony (or rather, calcified, clumped cartilage cells) armor.[7] These agnatha form a group called *ostracoderms* (bony skin). Their mouths were small and jawless. If any had an internal skeleton, it was cartilaginous.

The predator for the first fish, all of which were tiny (several centimeters in length), would have been aquatic arthropods!—the eurypterids (that in competition with later armored fish evolved to 2.5 m in length).[8] They had predaceous jaws and forelegs with grasping claws. (To compare: the largest marine arthropod today is the—land-bound when adult—robber crab, *Birgus latro*—up to 9 lbs weight and 2 feet in length—that scavenges rotting fruit, eats eggs, baby turtles, and is famous for climbing tall palm trees in search of fresh coconuts to dehusk and pierce through an eye, for the food inside, with its formidable pincers.)[8] The presence of eurypterids, found by Timothy William Stanton (1860-1953) in 1890 at Canton City, CO, in strata above, and with, Paleozoic fish remains, allowed Charles D. Walcott to assign a Middle Ordovician (Trentonian) age to the oldest agnatha.[9]

The term “ostracoderm” is not precisely defined, and is used as a convenience, for a grab-bag of Paleozoic agnatha varieties and fragmental, bony, fish plates, some even as old as the Cambrian. Almost all known agnatha have been found in water-laid sandstones that (being devoid of obvious marine fauna as bryozoans and brachiopods) are deemed to record a fresh, or brackish-water, environment (whence the long-held assumption that vertebrates originated in freshwater). ❑