

# Classification, Evolution and Reproduction of Chondrichthyes

John Francis\*

Department of Zoological Sciences, Gaziantep University, Gaziantep, Turkey

## Commentary

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**\*For Correspondence:**

John Francis, Department of Zoological Sciences, Gaziantep University, Gaziantep, Turkey

E-mail: johnfrancis159@gmail.com

The class of fishes known as *chondrichthyes* (kndrki.iz; from the Ancient Greek ο (khóndros) "cartilage" and ikhths "fish") includes cartilaginous fishes, which have skeletons that are predominantly made of cartilage. They can be compared to *Osteichthyes*, also known as bony fishes, whose skeletons are primarily made of bone tissue. Jawed vertebrates known as *chondrichthyes* have paired fins, paired nares, scales, and a heart with chambers arranged in series. From the 10 cm (3.9 in) finless sleeping ray to the 10 m (32 ft) whale shark, *chondrichthyes* are still alive today.

Elasmobranchii, which includes sharks, rays, skates, and sawfish, and Holocephali, which includes chimaeras (also known as ghost sharks), are the two subclasses that make up this class. The cartilaginous fishes are unique from all other jawed vertebrates within the infraphylum *Gnathostomata*.

## Evolution

Cartilaginous fish are considered to have evolved from acanthodians. The discovery of Entelognathus and several examinations of acanthodian characteristics indicate that bony fish evolved directly from placoderm like ancestors, while acanthodians represent a paraphyletic assemblage leading to *Chondrichthyes*. Some characteristics previously thought to be exclusive to acanthodians are also present in basal cartilaginous fish. In particular, new phylogenetic studies find cartilaginous fish to be well nested among acanthodians, with *Doliodus* and *Tamiobatis* being the closest relatives to *Chondrichthyes*. Recent studies vindicate this, as *Doliodus* had a mosaic of *chondrichthyan* and acanthodian traits. Dating back to the Middle and Late Ordovician Period, many isolated scales, made of dentine and bone, have a structure and growth form that is *chondrichthyan*-like. They may be the remains of stem-*chondrichthyans*, but their classification remains uncertain.

The earliest unequivocal fossils of acanthodian-grade cartilaginous fishes are *Qianodus* and *Fanjingshania* from the early Silurian (Aeronian) of Guizhou, China around 439 million years ago, which are also the oldest unambiguous remains of any jawed vertebrates. *Shenacanthus vermiformis*, which lived 436 million years ago, had thoracic armour plates resembling those of placoderms.

By the start of the Early Devonian, 419 million years ago, jawed fishes had divided into three distinct groups: the now extinct placoderms (a paraphyletic assemblage of ancient armoured fishes), the bony fishes, and the clade

that includes spiny sharks and early cartilaginous fish. The modern bony fishes, class *Osteichthyes*, appeared in the late Silurian or early Devonian, about 416 million years ago. The first abundant genus of shark, *Cladoseleache*, appeared in the oceans during the Devonian Period. The first Cartilaginous fishes evolved from *Doliodus*-like spiny shark ancestors.

### Classification

*Chondrichthyes* is a class of fishes included in the division *Gnathostomata* as they have jaws. The division *Gnathostomata* includes all the vertebrates having jaws. *Gnathostomata* is divided into two super classes, viz. Pisces (having fins) and Tetrapoda (bear limbs).

Pisces is divided into two classes:

- a. *Chondrichthyes*- Cartilaginous fishes
- b. *Osteichthyes*- Bony fishes

*Chondrichthyes* is subdivided into two subclasses:

- a. Elasmobranchii- Sharks and rays, skates, sawfishes.
- b. Holocephali- Chimaeras, also known as ghost sharks.

### Reproduction

Fertilization is internal. Development is usually live birth (ovoviviparous species) but can be through eggs (oviparous). Some rare species are viviparous. There is no parental care after birth; however, some *chondrichthyans* do guard their eggs.

Capture-induced premature birth and abortion (collectively called capture-induced parturition) occurs frequently in sharks/rays when fished. Capture-induced parturition is often mistaken for natural birth by recreational fishers and is rarely considered in commercial fisheries management despite being shown to occur in at least 12% of live bearing sharks and rays (88 species to date).