

## Sharks and Their Relatives

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### Goals of the Sea World Education Department

Based on a long-term commitment to education, Sea World strives to provide an enthusiastic, imaginative, and intellectually stimulating atmosphere to help students reach their academic potential. Specifically, our goals are...

- To instill in students of all ages an appreciation for science and a respect for all living creatures and natural environments.
- To conserve our valuable natural resources by increasing awareness of the interrelationships of humans and the marine environment.
- To increase students' basic competencies in science and other disciplines.
- To provide an educational resource for the entire community.

"For in the end we will conserve only what we love. We will love only what we understand. We will understand only what we are taught."—B. Dioum

The ocean and its inhabitants fascinate us, and this fascination leads to a quest for knowledge and deeper understanding. Although it is our intent to provide you with the most accurate and up-to-date information available, it is possible that some of this information may change as research continues and new discoveries are made. The nature of science is ever-changing.

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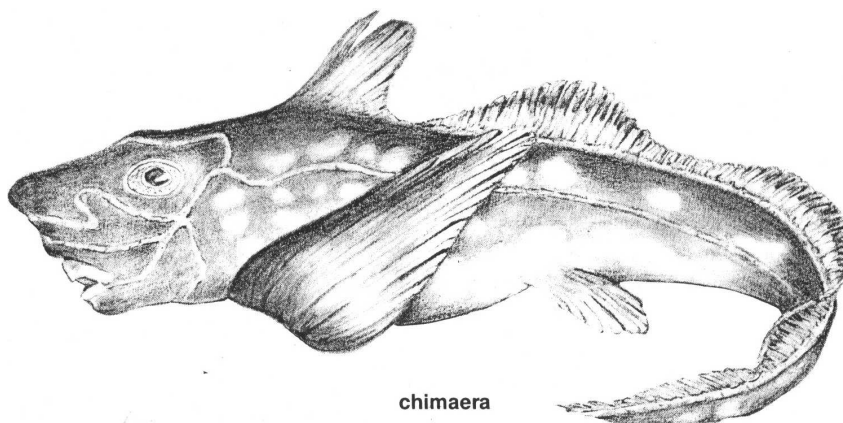
## SHARKS AND THEIR RELATIVES

### I. Scientific Classification.

#### A. Class-Chondrichthyes.

Chondrichthyes are fish with the following characteristics: a skeleton made of cartilage, jaws, paired fins, and paired nostrils. Chondrichthyes are further divided into two subclasses: Holocephali and Elasmobranchii.

1. The subclass Holocephali includes fishes known as chimaeras. They are characterized by the fusion of the upper jaw and cranium (the part of the skull that encloses the brain), one pair of external gill openings, and no scales.



Chimaeras are members of the Class Chondrichthyes.

2. The subclass Elasmobranchii includes sharks and batoids. Elasmobranchs are characterized by cylindrical or flattened bodies, five to seven pairs of gill slits, an upper jaw not fused to the cranium, and placoid scales. (For a description of placoid scales, see section III F.)

**B. Superorders.**

Elasmobranchs are grouped into two superorders: Batoidea (rays and their relatives) and Selachii (sharks).

1. Batoids include stingrays, electric rays, skates, guitarfish, and sawfish. They are characterized by a dorso-ventrally flattened body with expanded pectoral fins fused to the head. All batoids have five pairs of ventral gill slits. There are four orders and about 470 species of batoids.
2. Selachians include all sharks. They are characterized by a fusiform body and five to seven pairs of lateral gill slits. There are eight orders and about 350 species of selachians.

**C. Orders and families.**

For a list of families in their orders, see the appendix on pages 25-26.



Bat rays (*Myliobatis californica*) are batoids. Like other batoids, they have five pairs of ventral gill slits and expanded pectoral fins, which are fused to the head.

**D. Fossil record.**

1. Since cartilage rapidly disintegrates, sharks are seldom preserved as fossils. The fossil record of sharks consists mainly of teeth and spines from their fins.

2. The earliest evidence of the ancestors of modern sharks are isolated spines, teeth, and scales that appeared 350 to 400 million years ago in the Devonian Period, known as the "Age of Fishes."
3. Most of the modern-day shark families had already evolved 100 million years ago, when dinosaurs lived on earth.
  - a. Unlike other animals, sharks have changed very little since.
  - b. The most recently-evolved families of sharks are the sphyrnids (hammerhead sharks) and the carcharhinids (requiem sharks).
4. One extinct shark known today from its enormous fossil teeth, *Carcharodon megalodon* lived in the Tertiary period, 10 to 70 million years ago.
5. The Chondrichthyes did not give rise to the bony fishes, but they arose from a common ancestor.



The enormous fossil teeth of *Carcharodon megalodon* tell us that this extinct shark lived 10 to 70 million years ago.

## II. Habitat and Distribution.

### A. Distribution.

Elasmobranchs inhabit tropical and temperate seas as well as some cold and polar seas and freshwater lakes.

### B. Habitat.

As a group, sharks are adapted for a wide range of aquatic habitats. Various species inhabit shallow coastal habitats, deep-water ocean floor habitats, and the open ocean.

### C. Migration.

Shark migration is poorly understood.

1. Not all species migrate. In species that do migrate, the distance may be short or long.
2. Food availability, environmental cycles, or reproductive cycles probably determine most migrations. Females of many species migrate to specific locations to lay eggs or have pups.

## III. Physical Characteristics.

### A. Size.

Sharks and batoids show great diversity in size.

1. The largest of the sharks is the 13.7-m (45-ft.) whale shark (*Rhincodon typus*).
2. Among the smallest sharks are the 22- to 25-cm (8- to 10-in.) mid-water shark (*Squaliolus laticaudus*) and pygmy ribbontail catshark (*Eridacnis radcliffei*).
3. The largest batoid is the manta ray (*Manta birostris*), which reaches widths over 6.7 m (22 ft.).