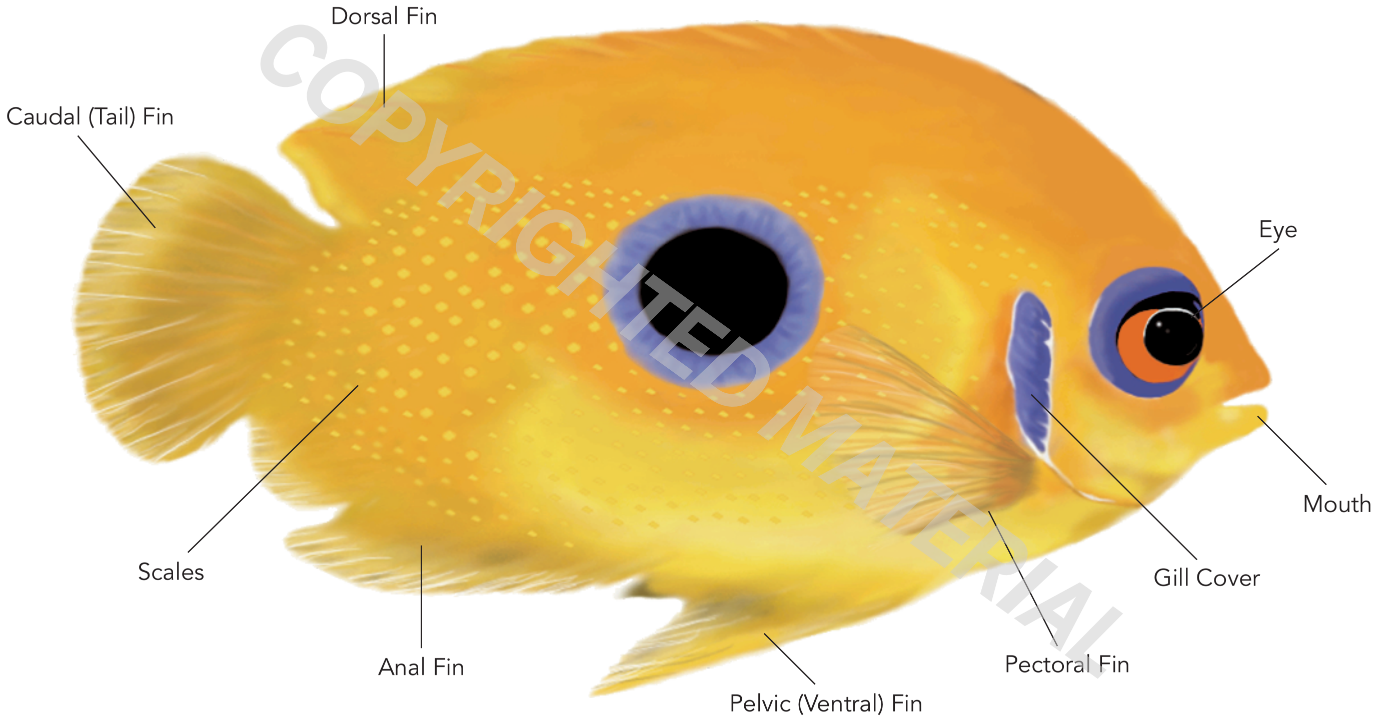
The Saltwater Fish



Chapter 1

Marine Fish Basics

If you are interested in keeping a saltwater aquarium, this is the book for you. Perhaps you've had a freshwater tank and would like to graduate to the more complex marine environment. Perhaps, like me, you are a fish enthusiast. The world of fish is both fascinating and complex. This book will help you to understand that world and will teach you what you need to know to set up and maintain a successful saltwater aquarium. To do that, you'll need a general knowledge of fish, their anatomy and biology. You'll also need a thorough understanding of their proper care and husbandry.

First, we will take a look at fish anatomy and what makes these animals so unique. There are no fewer than 12,000 kinds of saltwater fishes, so it is difficult to describe the "typical" fish. For the most part, however, all fish have some common attributes.

Then we'll examine the aquarium and the importance of meeting the biological needs of fish. As we do, I'll describe the critical differences between freshwater and saltwater aquariums. We'll walk through the basics of aquarium setup and proper maintenance. We'll cover proper nutrition and feeding, fish health and disease, and I'll tell you about some advanced marine aquarium techniques.

The only topic we will not discuss is saltwater fish breeding; so few have been successfully spawned in captivity that this is clearly an endeavor best left to the experts.

Aquarium Fish

The group of aquatic animals we call fish has evolved for more than 400 million years to be the most numerous and diverse of the major vertebrate groups (animals with backbones). Fish live in all the waters of the world, adapting with an incredible variety of forms, lifestyles, and behaviors. From the seasonal freshwater stream, desert spring, and salty bay to the coral reef, open ocean, and deep abyss, fish have found suitable niches. There are well over 20,000 species of fishes that currently inhabit Earth, and many more are being discovered every year.

Salt water covers more than 70 percent of Earth's surface and freshwater only 1 percent, so you would expect that there would be many more marine (saltwater) species than freshwater species of fish. Surprisingly, only 58 percent of the world's fish species live exclusively in salt water. Of these, only about 13 percent are generally found in the open ocean. By far, the majority of marine species live in the narrow band of water less than 500 feet deep along the coastlines of land masses.

As you move into the warm waters of the tropics, fish species diversify and the number of species dramatically increases. Fishes that inhabit the warm waters of the coral reef are usually the most sought after for aquariums because of their incredible beauty. This book will address the characteristics, requirements, and husbandry of these creatures.

Saltwater vs. Freshwater Fishes

The fundamental differences between freshwater and saltwater fish are directly linked to the two environmental extremes in which they live. In general, freshwater fishes are hardier than their marine counterparts, having evolved to withstand the rapid and dramatic changes in water conditions that occur inland. Most marine species have adapted to more or less constant environmental conditions; they have not evolved the adaptive mechanisms to deal with sudden environmental changes, such as those that may occur in the home aquarium. This, of course, makes saltwater fishes more difficult to keep in captivity.

Obviously, salt water contains much higher concentrations of salt (sodium chloride) than fresh water. In addition, many other dissolved elements are present in higher concentrations in salt water than they are in fresh water. These minerals together are called "salts," and the proportion of dissolved salts in water is referred to as its salinity or specific gravity.

Now, a fish is surrounded by the chemistry of the water it lives in. That fish has water and dissolved salts in its body as well. A fish surrounded by fresh water has more salts in its body than there are in the surrounding water, and a fish surrounded by salt water has less salts in its body than there are in the surrounding water. Both these situations can create real problems for the fish, because a process called osmosis causes water to flow through cell membranes from areas of low salinity to areas of high salinity. This means that the fish in fresh water is

All saltwater animals, including this starfish, are specially adapted to be able to regulate the amount of salts in their bodies.

constantly subjected to an influx of water and the marine fish is always threatened by the loss of water. Although anatomically the two groups of fishes are similar in appearance, they have evolved two very different ways of living in these chemically different environments.

Osmoregulation

The process of maintaining water balance in the body is called osmoregulation. You need to understand the basic principles of osmoregulation because it has important implications for fish in captivity. To start with, it explains why freshwater fish cannot be kept in salt water (and vice versa)—because their bodies cannot adapt to the change.

As a way of maintaining their internal salinity, freshwater fish drink very little water and produce large quantities of dilute urine. By contrast, most marine fish drink large quantities of water and eliminate salts in small amounts of highly concentrated urine and feces, as well as at the gills. So the kidneys of these two groups are very different. (Sharks and their close relatives, the rays, are exceptions to this pattern in marine fish. These species concentrate urea in their tissues and blood to offset the loss of water.)

In addition, since marine fish must expend a lot of energy to prevent the loss of water and excrete salt, they require good health and lots of food. Also, marine fish drink large amounts of water, so the quality of the water must be very good. Finally, abrupt changes in salinity will disturb the internal chemistry of marine fish. For these reasons, marine fishkeeping can be more difficult than maintaining a freshwater system. But with a little extra effort, it can be infinitely rewarding.

Fish Anatomy

Despite their differences in osmoregulation, freshwater and marine fish have many similarities. Since water is 800 times denser than air, fish have developed a variety of ways to move easily, breathe, and feed in a dense medium. Let's take a closer look at the unique adaptations that have enabled fish to live so successfully in the water. Anatomical adaptations include body shape, fins, scales, and swim bladder.

Body Shape

A great deal can be learned about a fish by looking at its body form or shape. Fish that are streamlined or bullet shaped are specially adapted to open waters, while flat or stocky fish are well adapted for living on or close to the bottom.

Fins

Almost all species of fish have fins in one form or another. The fins are critically important appendages that enable the fish to propel and stabilize itself, maneuver, and stop. In some cases, fins protect the fish as well. The fins have many shapes and functions, depending on the type of fish and the habitat it lives in. Bottom-dwelling, sedentary, or slower-moving fish have rounded fins, while faster, open-water fish generally have longer, pointed fins.

Fins can be either paired (one on each side of the fish) or unpaired. The pectoral fins are the forwardmost paired fins, and are located on each side just behind or below the gills. They help the fish stabilize itself, turn, maneuver, hover, and swim backward.

The pelvic fins are also paired and vary the most in position. In some fish, the pelvics lie under the fish toward the rear. In others, including many tropical fish, the pelvics are closer to the head, just below the pectorals. The pelvic fins act as brakes and also aid in stabilizing and turning the fish.

The dorsal and anal fins are unpaired fins that protrude from the top and bottom of the fish, respectively. Dorsal fins may be elongated or short, elaborate

The Basics of Fish Anatomy

There are thousands of species of fishes, all uniquely adapted to their particular environments. However, most share fundamental characteristics that enable them to be classified together as fish.

Gills: These enable the fish to take in oxygen from the water.
Fins: These move the fish through the water, providing propulsion and steering.
Swim bladder: This organ fills up with or releases air, thereby controlling the fish's level in the water column.
Lateral line: This sensory organ alerts the fish to movement close by and helps schooling fish move in synchrony.
Scales: These streamline and protect the body of the fish as it moves through the water.

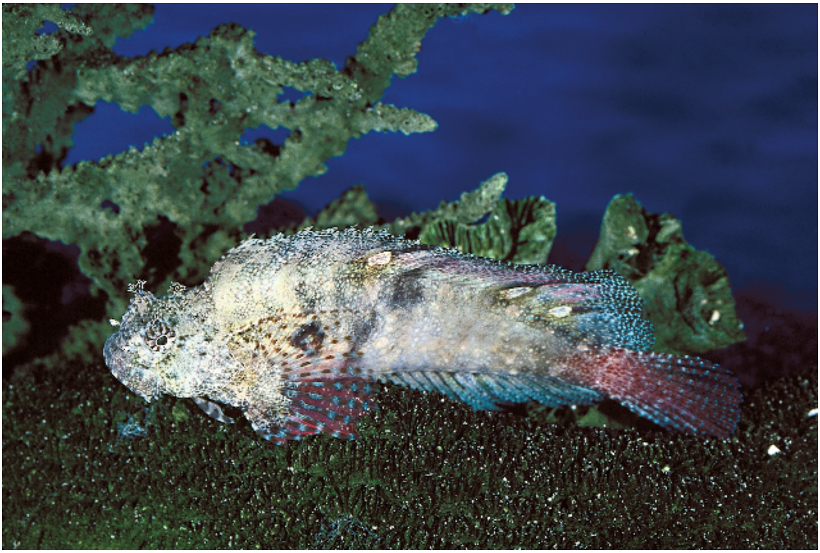
or simple, singular or multiple. Some species of fish completely lack a dorsal or anal fin. Both fins help stabilize the fish and keep it moving straight.

The caudal or tail fin is an unpaired fin that is largely responsible for propelling the fish forward. This fin is the source of forward momentum for most fish and can also assist in turning and braking. The shape of the tail can tell you a lot about the lifestyle of a fish. Faster fish have deeply forked caudal fins, while many deep-bodied fishes and bottom-dwellers have square or rounded tails.

In general, the main supporting structures of fish fins are soft rays. However, anyone who has handled a fish knows that the dorsal, anal, or pectoral fins of many species also have spines. These sharp, bony structures provide protection against predators (and people who try to pick the fish up).

Scales

The bodies of most fish are covered in scales. The scales are made of a hard, bony substance and protect the fish, reducing the chance of injuries and infections. Covering the scales is a very thin layer of epidermal tissue that contains



Fins come in a wide variety of shapes and sizes. This is a Jeweled Blenny.

mucous cells. These cells produce the slimy texture we normally attribute to fish. The mucous coating not only protects the fish against injury and infection, but also helps the fish move more easily through the water, reducing friction between the body and the surrounding water.

Fish scales are translucent and lack color. The vibrant colors of tropical fish come from specialized pigment cells called chromatophores, which lie in the deeper dermal layer of the skin. The color of the fish depends on the types of chromatophores present. Fish that are clear, like the freshwater Glassfish, lack these pigments.

The bodies of sharks and rays are not covered with scales, but with tiny scale-like teeth called denticles. They feel like sandpaper and serve the same role as scales do in other fish.

Swim Bladder

Living in the dense medium of water presents a few problems for fish; one of these is buoyancy. Maintaining a certain level in the water column without having to work too hard is very important to fish. To accomplish this, most species have a special organ called a swim bladder. This gas-filled sac, located in the abdominal cavity, acts as a life vest, keeping the fish wherever it wants to be in the water column. There are many types of swim bladders, ranging from the simple single-chambered sac of the trout to the three-chambered bladder of the codfish. Some fish have a direct connection between the esophagus and the swim bladder, so they simply have to swallow air to fill it. Others must rely on gas exchange from specialized blood vessels in the circulatory system.

In addition to its role in buoyancy, the swim bladder helps to mechanically amplify sound for better hearing in certain species of fish.

However, not all species of marine fish have swim bladders. For example, sharks have large fatty livers instead of swim bladders to help maintain buoyancy. Their skeletons are composed of cartilage, which also reduces their density in water. Many species of tuna also lack swim bladders; their streamlined bodies and forward speed help them maintain their level in the water column.

Mouth and Digestion

Just as the body shape of a fish can tell you a lot about its swimming habits, the mouth can tell you something about how it eats. Generally, bottom feeders have mouths that point downward, while surface feeders have mouths that point up. The size of the mouth is usually directly related to the size of the fish's preferred food. For example, large predators like Sharks and Barracuda have large mouths armed with teeth for consuming other fish. Fish like the Butterflyfish, which normally feeds on small aquatic invertebrates, have smaller mouths.

The shape of a fish's mouth gives you a clue about what and how it eats. This is a Longnose Hawkfish.

Some tropical marine fish have specialized mouths for specific feeding strategies. The sharp "beak" of the Parrotfish is helpful for feeding on the coral reef. The Basking Shark, which feeds on microscopic plankton, has a mouth that opens very wide and specialized gill rakers that enable it to sift the water.

Marine fish have a relatively straightforward digestive system, which varies from species to species. In general, food passes from the mouth and down the esophagus, where it is digested in the stomach and intestines; waste is excreted out the anus. However, some species of fish lack stomachs and have elongated, supercoiled intestines. Others, like Parrotfish, have specialized grinding teeth in their pharynx that are used to grind food. Again, the Sharks and Rays are different in that they have a specialized large intestine called the spiral valve.

Breathing

Like land animals, fish need oxygen to live. However, instead of lungs, fish have specialized organs called gills, which enable them to extract oxygen from the water. The gills of a fish act like our lungs; they provide oxygen to the fish's blood and remove carbon dioxide. This oxygen is then transported by the blood to the tissues of the fish, where it is used to produce energy. Water contains much less oxygen than air, and fish must breathe ten to thirty times more water to get the same amount of oxygen that a land animal would get from air.

Most fish have four gills on each side of the head. The branchial chamber, which holds the gills, is protected by a single gill flap, or operculum. In contrast, Sharks and their relatives possess five to seven gills, each with its own gill slit.

To breathe, the fish pulls water into the mouth and pushes it into the branchial chamber over the gills and out the operculum. As water passes over the membranes and filaments of the gills, oxygen and carbon dioxide are exchanged between the water and the blood. To accomplish this, the gills have a very high number of blood vessels, which carry oxygen to the rest of the fish.

Other Organs

Aside from the notable exceptions outlined above, fish typically possess the general circulatory, digestive, respiratory, and nervous system features that are common to most vertebrates. If you are curious to learn more about these systems, examine the bibliography in the appendix for books that will give you more detailed descriptions of the unique anatomy of fish.

Senses

With few exceptions, fish have five senses that they use to feed, avoid predators, communicate, and reproduce.

Sight

The eyes of most fishes are similar to our own, except they lack eyelids and their irises work much more slowly. Some species of Sharks, however, have specialized upside-down eyelids called nictitating membranes, which protect the eyes. The location of the spherical lenses of fish eyes renders most fish nearsighted. Although it varies from species to species, it is generally thought that fish can detect color.

When it comes to keeping fish in captivity, the aquarist should remember that rapid changes in light intensity can shock a fish. Gradual changes in light enable the fish to accommodate and avoid temporary blindness.

Rapid changes in light intensity can shock a fish. Your fish prefer gradual changes in light. This is a Popeye Catalufa.

Hearing

Water is a much more efficient conductor of sound than air. Therefore, sound carries much farther and faster in water. Fish do not have external ears, but they do have an inner ear that is not noticeable on the outside of the fish. The auditory component of the inner ear consists of the sacculus and the lagena, which house the sensory components of hearing, the otoliths. Sound vibrations pass through the water, through the fish's body, and reverberate off the otoliths in the inner ear. As mentioned previously, in some cases the swim bladder articulates with the ear to amplify sound.

Smell

Fish have external nostrils called nares, which draw water into and out of the olfactory organ located above the mouth and below the eyes. Water flows through the nares and into the olfactory pits, where odors are perceived and communicated to the brain via a large nerve. The olfactory system of the fish is not attached to the respiratory system, as it is in humans, but remains isolated from the mouth and gills. Smell is particularly important to fishes in detecting prey and mates.

Fish have a special sense organ along their sides called the lateral line system, which roughly corresponds with the stripe on this Yellowhead Wrasse.

Taste

This is generally a close-range sense in fishes and is especially helpful in identifying both food and noxious substances. While our taste buds are only found in our mouths, fish also have taste buds on the external surfaces of the skin, lips, and fins. Catfish have special barbels (their "whiskers") that are packed with taste buds and help the fish to detect food items in murky waters.

Touch

Fish have a very specialized organ called the lateral line system, which helps them to detect water movements. Sensory receptors lying along the surface of the fish's body in low pits or grooves detect water displacement and, therefore, give the fish the sensation of touch.

The lateral line is easily visible along the sides of most fish. This unique system helps the fish to detect other fishes, sense water movement and currents, avoid obstacles, and swim in schools. In addition to the lateral line system, Sharks and Rays possess sophisticated sensory organs called the ampullae of Lorenzini, which are capable of detecting weak electrical fields.