The Marine Food Web
by Tony Corey with Dave Beutel

Big fish eat little fish; that's how the food cycle works. Of course, there's more to it than that.
A whirlwind spiral up the marine food chain goes like this:

Phytoplankton—microscopic plants drifting in the water—feed the copepods and other grazers that feed the small menhaden and crustaceans that feed the stripers and bluefish that feed the tunas and swordfish that feed us.

Taking it a little more slowly and stopping at each trophic level *(feeding level),* we start with the **primary producers.** Single-celled plants, microscopically small **phytoplankton** floating in the upper layers of the ocean, use the sun's energy to photosynthesize chemical compounds, such as carbohydrates. These carbohydrates can be eaten for energy, and these plants—mostly diatoms and algae—are the foundation of the ocean's entire biological community.

Taking advantage of this abundant plant life, **zooplankton**—animal planktonic forms—drift through the water grazing on the phytoplankton. These "grazers" include copepods and larval stages of fish and benthic, or bottom-dwelling, animals that make up the **second trophic level.**

Zooplankton range from microscopic copepods to more substantial coelenterates, including jellyfishes, ***all drifting passively*** on the ocean currents. The larger zooplankton may be food for proportionally larger animals, such as baleen whales and other marine mammals. Still, the most abundant zooplankton are the copepods. By sheer biomass and their trophic position, **copepods are the crucial link** between the primary producers and the rest of the ocean food web. They make up most of the animal mass in the ocean.

Copepods and other plankton, both animal and plant, nourish fi**lter-feeding organisms** that strain their food directly from the water. This **third trophic level** includes molluscan bivalves, amphipods, and larval forms of many fish and crustaceans as well as small fish such as alewife and menhaden. These finfish are schooling fish, and they can make a significant dent in the zooplankton population. A single adult menhaden, for example, can sift 8 gallons of water a minute. If a school of perhaps 100,000 of these fish passes through an area, it can temporarily decimate planktonic life.

In the same way, a school of bluefish may eat through a school of menhaden, creating the next trophic level. Because **menhaden are the food of choice** for species all the way up the food ladder to apex predators, they are popular bait fish. It is bluefish, though, that feast most voraciously on the menhaden, wasting as much as they consume. The **waste sinks to the bottom**, where it may be eaten by ***bottom-dwelling carnivores, such as lobsters, or decomposed by bacteria*** and ultimately returned to a nutrient form usable by plants.

The bluefish, striped bass, and fluke that feed on bait fish are among the most popular recreational fishing targets. Like species at successively higher trophic levels, these predators are food for every level along the way. Not only are they hunted from the water but also from the sky, ***plucked by ospreys, cormorants, and other sea birds.*** Their primary predators, though, are larger fish, the game fish that migrate from coastal to deep ocean waters in search of sustenance. Among these **high-level hunters** are tunas, sharks, and billfishes such as swordfish. These animals are both dominant predators in the marine environment and prey for other large animals at the ***apex of the food web.***

At this level of predation, the hunt is cutthroat and circular. Marine apex predators are opportunistic feeders—they eat what is available. This means they may sometimes eat each other: The bluefin tuna that is such a prize for humans is also a target of toothed whales, swordfish, sharks, and even other tuna. Sharks, depending on the species, eat seals, tuna, and other sharks.

Opportunistic feeders may also eat larval forms of their own predators: Squid, for example, feed on juvenile bluefish but become the quarry for adult bluefish. At the extreme, opportunistic feeders may eat the larval forms of what they eventually become: *Lobsters, for instance, are notoriously cannibalistic.*

Even animals that have no immediate predators ultimately *contribute nutrients* to the food web. Large whales and sea turtles, while not specifically targeted for consumption, *do produce waste.* The waste may be either *excretions from digestive processes or dead tissue.*

It is eventually broken down by **decomposers—bacteria,** *primarily*—in a process that releases nutrients that plants can use to start the whole cycle again.

Organisms higher up the food ladder tend to be larger in size and fewer in number than those at lower levels. This is partly a function of the many trophic steps required to meet advanced energy needs. **Because the efficiency rate at each trophic level is only about 10 percent,** each succeeding level supports a smaller total biomass to compensate for the 90 percent loss of food value.

So if it takes 100,000 pounds of phytoplankton to feed 10,000 pounds of copepods, and these copepods feed 1,000 pounds of silversides, and these silversides feed 100 pounds of mackerel, and these mackerel feed 10 pounds of bluefin tuna, this tuna nourishes only one pound of apex predator at the end of the chain.

When all is said and done, that tuna steak on the dinner plate culminates a web of interdependencies that passes sustenance from a one-celled plant all the way up to the most complex organisms on Earth.