

## **Pacific Halibut (*Hippoglossus stenolepis*)**

*The downrigger wasn't working properly, the giant cargo ships rumbled by a little closer than preferred, and the coastal town's buildings had receded into a blurry haze, with only the mountains behind still etched into the blue sky. With its powerful motor our deep-hulled boat ran swift and sure, but at 20 feet in length fishing in the middle of the Strait was a little tense. Giving up the hope of catching salmon, we turned shoreward towards shallow waters where we could fish far distant from the behemoth ships, rocked by the lapping waves of a calmer sea. In these waters, we would seek flat-bodied fish that lived near the sea floor. Most of these were small, but a large fish, such as the Pacific Halibut, was always a tantalizing possibility. And at the very least, seeing one would in some undefinable way provide us a link to a sea that was, in the end, so deeply foreign to a two-legged land-based mammal.*

*A couple of sizable flounders were soon acquired for our dinner, and as I lowered my line, I was feeling more confident of bringing in a hefty flatfish. After all, the maximum size for a halibut pushed 500 pounds, and although our chances of such an encounter were miniscule, our modest goal of a few more halibut relatives, sized for a small boat, seemed reasonable.*

*As if in answer, something struck my long line. "Struck" might be an exaggeration, but as an easily excitable fisherwoman who with pole in hand could transport herself back to age six when a small trout caught on a short fiberglass rod constituted a successful day, the word seemed apt. The only concern was that there wasn't much movement, just this pole-bending weight. I began to reel in the line. The*



**Sunstar (*Pycnopia helianthoides*)**

*other three people in the boat provided words of encouragement, mixed with a little sympathy that I at last had something on. Ah, the life of a fisher.*

*So, up it came, slowly, heavy, definitely not algae or a similar large mass from the bottom, but still exhibiting an odd behavior. I could see an animal now, colored in a pale warm hue. Definitely not the grayish skin of a Pacific Halibut.*

*The creature had a mouth, and if it had possessed a brain, I imagine a torrent of words would have been aimed in my direction — none of it friendly.*

*What weighed my pole into a hemispheric arch was not a bottom-dwelling fish at all, but rather a boneless Sunstar with multiple arms. Also a creature of the muddy sea floor, it was unharmed, and probably not thrilled with its new boat-bottom habitat. I didn't know whether to be embarrassed or pleased at this new encounter. I had never seen a Sunstar.*

*I photographed it, and soon the Sunstar was back in its home on the bottom, perhaps close to the illusive Pacific Halibut that remained undisturbed, a one-sided creature of the salty sea. I would never know.*

## **Pacific Halibut (*Hippoglossus stenolepis*)**

A member of the Pleuronectiformes order, a group that is most distinguished by the position of the eyes in adult fish, the Pacific Halibut (*Hippoglossus stenolepis*) is a “right-eyed” fish, meaning the eyes peer upward from the right side of the head. Its family name, Pleuronectidae, acknowledges that strange geometry — “pleura” is Greek for “side” and “nekton” means swimmer. The Pleuronectidae family, the flounders, to which the Pacific Halibut belongs, are a group of approximately 93 species, primarily of the Northern Hemisphere although a few are present in southern oceans. These fish are marine for the most part, although some are tolerant of estuarine environments. Potentially large, several are important commercial species, including the Pacific Halibut.

The common name “halibut” is English for “haly” (holy) and “butte” (flatfish); apparently the fish was often eaten on Catholic holy days. *Hippoglossus* is Greek and derived from “hippo” for horse and *glossus* for “tongue,” in reference to the flat, tongue-like form, at least in some person’s imagination; the “horse” resemblance seems quite obscure. *Stenolepis* is Greek for “narrow” and “scales,” for the small scales on both sides of the halibut’s body.

The Pacific Halibut is one of the many flatfish on the planet, and except for the freedom (by comparison) of its juvenile life, this large fish spends much of its adult life on the bottom of the sea, swimming upwards into the water column at times to seek prey, reproduce, or, surprisingly perhaps, given its asymmetric form, migrate in answer to some ancient call. With a large mouth as skewed as the eyes, when food comes within range the halibut moves quickly, grabbing its prey with small, sharp conical teeth which line the upper and lower jaws.

The Pacific Halibut ranges the seas of Okhotsk and Japan east to the Aleutian Islands and Gulf of Alaska, and south along the eastern North American Pacific coast to Baja California, Mexico. It is particularly common in the Strait of Juan de Fuca and along the northern Pacific continental slope, near the edge where the bottom falls away to the ocean’s abyssal depths. This is strictly a marine fish, found at depths of 16 to 6,560 feet (5-2,000 m).

Like most fish, first year Pacific Halibut are symmetric, with eyes on either side of the head, an upright body and fins, and a vertical tail. The young begin life in this regular configuration, but at about six months or so, the one-inch fish metamorphoses to a strange-looking creature with eyes on one side of the body, a horizontal mouth and fins, and because of such radical alterations, a lifestyle that places them on the floor of the sea. It isn’t a bad life, however, as these young fish, now members of the “flatfish” benthic community, are capable of rapid movement and long migrations. Not alone, they settle amongst their smaller cousins of similar habitat, but with more delicate appetites. The young halibut feed on small crustaceans and other invertebrates until large enough to eat fish, or the occasional octopus or crab.

Pacific Halibut are typically dark brown on the upper side and whitish below, but the intensity can vary in response to the color of their habitat. Other flatfish also demonstrate this camouflage capability, a transformation which can take place within minutes. This fascinating color change is sometimes demonstrated in aquariums where the fish are placed in dark and light sands: their color soon modifies to match the substrate.

Most easily identified by the lunate tail, meaning one that is somewhat crescent-like, a shape that contributes to the Pacific Halibut’s swiftness. The body is diamond shaped and the dorsal fin extends from the tail to the back of the large head. The teeth are small, the scales tiny and the mouth of substantial size; this flatfish lacks a swim bladder. Spots on the dark body blend well with sandy bottoms, providing protection, not typically necessary for large fish, but also offering concealment, an important adaptation for surprising potential prey.

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If a maximum size of 8.8 feet (2.67 m) and a hefty 500 pounds (230 kg), is sufficient indication, then the sea floor habitat clearly offers plentiful prey for the one-sided halibut. One of the largest flatfish on the planet, Pacific Halibut shows a preference for cold waters.

Although bottom-dwelling fish eaters, in their adult habitat, Pacific Halibut are not completely sedentary. Instead, they lift off and migrate, sometimes long distances; in particular, the younger fish are known to travel in a clockwise rotation in the Gulf of Alaska and Bering Sea; they also disperse to southern and eastern waters when about two or three years old.

In the deep waters of the northern Pacific, the Pacific Halibut spawns from November to March. Breeding is preceded by an ascent terminating with the laying of multiple batches of eggs in pelagic waters. Numbering from 102,000 to a whopping 4,00,000, and left unguarded by both male and female, the eggs hatch within about 15 days. The larvae are carried away from the spawning site by currents and live near the surface until their eyes move to one side of the head. Then, joining the adults, the juveniles settle to the ocean floor, typically in shallow waters. Within a year or two the juveniles may join the adults in long migrations.

Female halibut are slower to mature than males, perhaps not surprising given the number of eggs they produce, reaching reproductive age in 8 to 12 years. However, their growth rate is greater than the male, and in time the females are much larger than their partners. Both are voracious predators and of sufficient size to be safe from most attacks, although they are prey for substantial predators, such as sharks and whales. And, of course, humans.

### **A Tasty Fish**

The Pacific Halibut has long been fished for its white, tasty flesh, and a meal of fresh halibut is one to remember. Low in oil and high in protein, halibut provides many essential vitamins and minerals (although less than salmon) for the human body. It has been consumed by coast dwelling native peoples for thousands of years; in particular, the Makah fished for halibut in rich banks off Cape Flattery primarily during spring, consuming it fresh and drying it for use over the long winter ahead. Today, it is regularly offered in fish n' chip dineries and served in restaurants worldwide.

As a delectable and abundant fish, for many years the Pacific Halibut has supported a large commercial and sport fishery, particularly in Alaska. International agreements specify the annual catch, which ranges in the thousands of tons; approximately 18 percent of the total allowed tonnage is designated for sport fishing. Most of these fish are relatively small (up to 20 pounds), but record-setting halibut can weigh in the hundreds, and large fish are occasionally caught.

In Washington state, Pacific Halibut fishing is regulated by quota, with designated marine areas closed as that number is reached. Generally, fishing is open from April through September, typically restricted to three days or sometimes less each week. Anglers may catch one fish per day, of any size; reporting is required. The Washington State Department of Fish and Wildlife states that the halibut is at target levels, according to standards set down by the International Pacific Halibut Commission (IPHC). This number is defined in terms of a spawning potential ratio (SPR), meaning that the target fishing level (including commercial, recreational, subsistence, bycatch) is estimated based on a lifetime spawning of a cohort (or group) of fish relative to an unfished population. Thus, this ratio is always less than 100 percent. It is currently set at 43 percent.

Estimates of Pacific Halibut stock are based on modeling, historic fishing trends, current numbers, and recruitment dating back eight or nine years. In other words, the current prediction of an increase in

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the halibut population in 2022 is in large part estimated based on a good spawning year in 2012. Thus, the biomass of Pacific Halibut is expected to be less in 2023.

The IPHC was founded in 1927, its creation stipulated in a treaty between the United States and Canada. This agreement was implemented largely in response to the sharp decline in Pacific Halibut stocks brought about by a few decades of intensive fishing. Lacking regulatory power in the early years, the commission was seemingly powerless to stop the continuing decline in halibut populations; only in 1937, when such authority was granted, did the trend slow. Nevertheless, Pacific Halibut numbers have historically continued to decline, with even the best estimates of spawning biomass in the first two decades of the 21<sup>st</sup> century at less than one-half the level of the late twentieth.

The fate of the Pacific Halibut depends on the IPHC. Its regulations, based upon modeling and data will always be in the realm of a statistical approach. Hopefully, dedication to preservation of the species and a willingness to sometimes make hard decisions and seek ongoing scientific insight of a fish with a potentially long lifespan placed under constant pressure. Without a doubt the taken fish get younger, and influences such as global warming may be the hardest subject to assess.

Responsibility assigned to a dedicated commission offers hope for a fish much prized by anglers and an important player in a large commercial industry. Meanwhile, the example of the larger and closely related Atlantic Halibut (*Hippoglossus hippoglossus*) serves as a constant warning. Historically fished to near extinction, in 1996 this halibut was placed on the IUCN “red List” of endangered species. In the past, a native Atlantic Halibut on the menu was not unusual; today the fish offered at a supermarket or in a restaurant is more likely a product of aquaculture or another species altogether. The increasingly common method of producing fish for human consumption, aquaculture may preserve the species in pens, but in the sea where it evolved, at least in the foreseeable future it seems unlikely that the Atlantic Halibut will recover to its former abundance. The fate of its Atlantic cousin should continue to serve as warning to those who control the destiny of the Pacific Halibut.

### **Puzzling Asymmetry**

The large size of Pacific Halibut may indicate a successful strategy, but flatfish asymmetry, such as that of this species, has puzzled scientists for many years. How could Darwinian natural selection explain the transformation of a “normal” fish to a strange being with both eyes on one side of the head? Some creationists claimed that such a radical change proved that evolution could not have been involved. However, the discovery of a 45-million-year-old flatfish fossil that was undergoing metamorphosis when it died provided evidence of a transitional form although it did not answer the question of why or how this radical alteration might occur. And such a transformation is not just a matter of flipping on its side; much more is involved. As the halibut age from juvenile to adult, the bones on the left side of the skull grow faster than the opposite side, causing the eye and nose to migrate. This radical rearrangement involves an alteration of muscles as well and influences brain structure and sense of smell. As the fish changes, the gray body alters to a pale underside and brownish color above, often marked with spots and speckles.

Seeking explanations, experiments on larval flatfish revealed that when denied light the fish became disoriented, not knowing up from down. Most fish rely on the inner ear when darkness falls, but young flatfish ear bones function differently from birth, a hard-wired feature that probably contributes to the developing asymmetry of the fish. Content to float and feed in the surface waters during the day,

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at night the small fish bob or sometimes sink, unlike more conventional fish which have no trouble staying upright.

Flatfish may be an anomaly in the sea, occupying a permanent place at the bottom, but other fish of regular conformation are also known to flip on their sides and bury themselves in soft substrate, primarily as an escape from predators. But taking the role of hunter rather than prey is also possible from a hiding place, and in their adult form the Pacific Halibut employs a most successful strategy for acquiring a meal.

Not confined to the sea floor, the lopsided halibut can be amazingly quick, and enjoys a very cosmopolitan diet. Using the fin beneath their bodies, the fish push off to snatch a meal. Fully satisfied for a time, it settles back down on the bottom, slithering into the soft substrate, hidden from view. Or perhaps it undulates away, carried by the power of its own body, aided by current, to occupy another place, eyes pointed upward, looking in full symmetry at the sky.



**Pacific Halibut (*Hippoglossus stenolepis*) showing one of its bulging eyes**

### **An old idea with a twist**

Halibut and its kin are not the only flattened fish to inhabit the floor of the sea. Nor are they the oldest. Ray fish diverged from their shark forebearers over 400 million years ago and have persisted throughout a long and dynamic record of planetary change. Like the halibut, they can reach a hefty size, measured in thousands rather than hundreds of pounds and growing to lengths approaching 30 feet; such dimensions are sometimes achieved by the Giant Manta Ray, a tropical species that is known to

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venture into temperate waters. Closer to home, the Big Skate (*Beringraja binoculata*) can achieve a maximum size of 8 feet.

But the ancient rays resemble the more recent flatfish in form only, as not only do they lack bones — like their shark cousins their “skeleton” is made of cartilage — but they have a symmetry and swimming mode completely unlike the halibut. Rays seem to fly with “wings” of modified pectoral fins, triangular appendages of sufficient size to allow the occasional leap from the surface of the sea. The eyes of a ray are nicely separated, not scrunched together, and the symmetric mouth is beneath, positioned for feeding off the ocean floor. It is obviously a form that works well, as the lengthy occupation of the sea by rays makes the halibut seem an infant by comparison.

The beauty of a ray’s flattened symmetry is clearly lacking in the halibut, with its lopsided mouth and bulging eyes, its smaller undulating fins, and its speckled body. Yet those fins and ungainly shape carry the halibut to places it might not be expected, such as the water column well above the sandy bottom or shallow seas where it can pursue fishes of a size that matches appetite. The Pacific Halibut can live long, 55 years or more, and, unlike the slow-growing rays, achieve maturity relatively quickly. Not content to live in one place only, it sets off on long migrations, where cool waters provide abundant food and the opportunity to perpetuate a new idea, given birth by forces barely understood by humans and of no consequence to the halibut.

*For all its strange appearance, the halibut form works, with the number of members in its family a testament to adaptation to a niche dictated by physical and biologic factors, including continental movements, alterations in ocean currents, the rise and decline of thousands of species in a dynamic environment. Such ongoing alterations offer opportunities for those poised to adapt to change. Such was the case with the halibut, a benefactor of an unprecedented idea, an asymmetry of form in a symmetric world.*