Sanddabs — Paralichthyidae

Forever opposite, sanddabs gaze upwards towards the water's surface from their left side, not their right. Two species make their homes in the cold Strait, while in more southerly waters their relatives forage in a warmer ocean. One of the two, distinguished by its spots, is a small fish, while the other, lacking such marks and nearly drab in coloration, grows sufficiently large to attract fishers from above and below. If success is measured in numbers, these bottom-dwellers meet the requirement; they are considered abundant. And there is little confusion when it comes to sanddab selection of a mate. Only a left-eyed fish will do.

The Paralichthyidae family, to which the sanddabs residing in the Strait belong, consists of approximately 110 species, divided into 14 genera; these are flatfish with eyes on the left side. The family name is derived from the Greek for "seaside" and "fish." It is a member of the Pleuronectiformes order, a group with 16 families and approximately 800 species. Most of these are right-eyed flatfish, while the Paralichthyidae are predominantly left-eyed. This means that they lie on their right side on the sea floor, their eyes pointed upwards, having migrated to one side of the face during their lives as juveniles.

Most commonly species of subtropical or tropical waters, sanddabs are widely distributed throughout the Atlantic, Pacific, and Indian Oceans. Of the 24 species, only two are resident in the Salish Sea. Both range from cold northern Pacific waters to southerly, warmer seas. These are the Pacific Sanddab (*Citharichthys sordidus*), the larger of the two, and the very similar Speckled Sanddab (*Citharichthys stigmaeus*). Technically difficult to distinguish from one another, with differences in eye size relative to the snout an important feature, as well as numbers of scales along the lateral line and other details, the Speckled Sanddab does typically have dark spots on its fins and blotches on the eyed side. The two also differ in maximum size and age.

Pacific Sanddab (Citharichthys sordidus)

Common on muddy and sandy bottoms, the Speckled Sanddab tends to reside in more shallow waters than the Pacific Sanddab, most often in less than 197 feet (60 m), although records exist for fish residing as deep as 1,200 feet (366 m). The larger Pacific Sanddab goes deeper, sometimes to 1,800 feet (549 m). The Speckled Sanddab is sometimes found on rocky substrate or in eelgrass and kelp. Both can alter their body color to match their surroundings.

The sanddab genus name is a derivative of "*Citharus*," an Atlantic founder, and means "a lyre-like musical instrument," in reference to the shape of the body. "Ichthys" is Greek for "fish."

Not as complimentary as the genus name, the Pacific Sanddab's species name "sordidus" is in reference to what is considered a very drab color on top; the underside of the fish is white to pale brown. This is a medium-sized flatfish, with a maximum length of 16 inches (41 cm), and a potential life span of 13 years. The females are typically larger than the males, maturing at about 9 inches and spawning in late spring to fall. Born armed with spines and speckled with tiny spots, the young are symmetric, swimming upright like most other fish. Migration of the juvenile's eyes to the left side of the head begins when they are less than a half-inch in length. These youngsters reside in pelagic waters for as long as 271 days, eventually settling as the eyes complete their migration, but often residing in shallow waters less than 30 feet (9 m) deep.

The Speckled Sanddab species' name, "*stigmaeus*," is also descriptive, meaning "speckled" in Greek. This small fish can be 8 inches (19.2 cm) in length, only half that of its close relative. The larvae are also small and can remain pelagic for as long as 324 days, beginning metamorphous at about an inch in length. Juveniles are sometimes present in tidepools and eelgrass. Speckled Sanddab are tolerant of nearly freshwater conditions and of low temperatures. They live up to 4 years, with females sometimes maturing at a petite 2 inches in length. These small fish feed during the day, often digging in the bottom for potential prey.

Both the Pacific Sanddab and Speckled Sanddab eat invertebrates and occasionally small fish. They are considered an important part of the oceanic food chain, impacting the abundance of their own food sources while providing nourishment for many animals, including larger fish, such as Pacific Hake, salmon, as well as other flatfish. Birds also find them tasty, and large mammals such as sea lions and porpoise snack on sanddab. As might be expected, their value as a prey fish for larger species does vary with location, but they are present in the stomachs of many studied, with the larvae providing sustenance for many fish species.

The importance of these small fish to the balance of the oceanic animal and plant community has only recently been studied, and such research has not historically been part of fishery planning. Considered common, with healthy populations, the sanddabs have a surprisingly long commercial fishing history.

Commercial and Recreational Fisheries

Small and delicious, the Pacific Sanddab was first commercially fished in 1892 in California waters. By the second decade of the twentieth century, the fishery was taking about 1,325 tons a year, a number that remained high until the 1990s. The discards were always significant, as only the larger fish were desirable, most of them caught in bottom trawls. A decline in the fishing take began as the century waned with numbers reaching as low as 224 tons. Today, the stock is considered stable and has been increasing in recent years.

It should be noted, however, that sanddabs are part of the "other flatfish complex" for federal regulatory purposes. Other members include the Rex Sole, Sand Sole, Starry Flounder, and four other flatfish species. What this means is that the sanddabs and their cohorts can be fished to the 25 percent level of unfished numbers. Today this low number has not been reached, but a serious look at the status of the Pacific Sanddab was not undertaken until 2013.

This study is long, with numerous graphs and tables, but a few items stand out. One is that sanddab discards are very high and not separated by species. Additionally, stock estimates from Mexico and Canada were not included in the assessment. Specifics of Pacific Sanddab genetics are unknown, important to the consideration of the species as a single stock. The excessive discard rate is reflected in the estimated landings. For example, in 2012 the total Pacific Sanddab take was 359 tons; of this, 175 were commercial landings. In other words, over 184 tons were discarded. It is unknown how many were Speckled Sanddab. This high number is in part a reflection of a fishery that is oriented towards the largest fish. The smaller are not as easy to market.

Like so many other fish species, estimation of stock recruitment, spawning biomass, overfishing levels, and other population factors are the output of modeling, in the case of the sanddab done with the "depletion-based stock reduction analysis (DBSRA)." This method is considered particularly applicable when data is very incomplete. Management has been deemed good, at least until 2013, when the assessment was published, with predictions close to actual numbers.

Of course, as with other fish, to an extent sanddab population estimates depends on surveys that are variable in predicting biomass. It has been noted that independent surveys tend to be higher than model estimates; however, they are more limited in scope, being confined to certain depths and location. Which is correct – the model or the survey data? And if so, which survey input should be given the most credence? Additionally, sanddab data is recent and nearly overburdened with uncertainty. Conclusions from the 2013 assessment included several recommendations, such as the acquisition of more data, acknowledgement that estimations from recreational take are not always available, and that specifics of discard size, not to mention species has been lacking, at least until 2013. Calculated uncertainties are distressingly large. Hopefully, lack of data, inaccuracies in modeling and surveying, and inadequate research of sanddab ecology will not lead to the overexploitation of these fish. Certainly, conservation should be of equal concern with the concept of "potential fishery."

Transitional Species, and the Living Fossil

Based upon analysis of small ear bones (otoliths), the origin of the Pleuronectiformes Order, which includes the sanddabs, has been placed at approximately 50 million years ago. Considered anatomically similar to perches, the order is represented in all of the world's oceans, including the Antarctic. One species makes a living near hydrothermal vents on the ocean bottom, but most are fish of relatively shallow waters, including the continental shelf. And whether settling on their right side or left side, they are asymmetric, forever confined to swimming and resting on one side, their eyes firmly rotated to their odd position.

Intriguing to the layperson and researcher alike, the question of how such a configuration could evolve is perplexing. It seems unlikely that the transition was quick; more plausible is that it occurred over millions of years. Researchers conclude that a 50-million-year history would provide ample time. And, as it turns out, there is a possible transitional fish, with origins dating nearly back to the beginning of the Pleuronectiformes Order. Until recently this fish was considered just symmetrically "regular," its possible links to the strange flatfish unknown. Then someone took a closer look.

Named the *Amphistium*, a genus name meaning "on both sides" and "sail" and designated with the species name *paradoxum*, or "extraordinary," it is a solitary, extinct species. But it does share features with flatfish, including spines on a few vertebrae and some asymmetry in the positioning of the eyes. *Amphistium* swam upright, one eye located on the "conventional" side. The other eye, however, was

placed on top of the head. The *Amphistium* view of the world was skewed by any account, and balance was probably aided by keeping the tail in contact with the ocean floor. Although not necessarily an ancestor to modern flatfish, the *Amphistium* reveals how transitional forms may have played a role in the development of the unique flatfish lifestyle.

Although the *Amphistium* is long extinct, there is at least one ancient lineage with modern representatives that resemble flatfish but are still considered transitional. These are the Spiny Turbots, the sole members of the Psettodoidei, the second and much smaller suborder of the Pleuronectiformes. There are three members of the only genus, the *Psettodes,* so this is indeed a reduced group. They are less asymmetric than the flatfish and the eyes can be on the right or left side. There are spines on the dorsal and anal fins. These fish often swim upright and are not always in contact with the bottom. Warm water dwellers, the Spiny Turbots are very ancient, with fossils dated to approximately 45 million years ago. Most importantly to those interested in flatfish evolution, they still exist.

Thus, transitional forms, in the sense that the fish resemble in form and lifestyle the modern flatfish are evident in the fossil record and in the presence of an ancient lineage today. Whether or not there is a direct link between modern flatfish and these unusual fish with intermediate anatomical features is a subject of active research. It is possible that the evolutionary pathway was not direct from one to the other. However, the Spiny Turbot and the long-extinct *Amphistium r*eveal how flatfish could have acquired their most unique form. Popular for their taste, subject to intense fishing and conservation and restoration as well, the flatfish remain enigmatic to humans while maintaining a lifestyle highly successful on a global scale.

They stood side-by-side at the shore, one more than six feet tall, the other less than five. Calm water reflected the rays of a cool summer sun and in the distance the dim sounds of a busy world mixed with the calls of gulls nearby, and the occasional hum of an airplane. Yet here was repose from a more frenetic life, and as if in acknowledgement of a desire for simplicity, in their hands the two held long poles, simple forms that were equalizers of stature and age. These people were fishers, and as they tossed their lines into the shallow waters, their hope was to bring home an odd creature tuned by the ages, a strange fish with eyes on both sides of its head. In a moment of success, the smaller of the two humans linked herself to a past as old as humanity. It was profound, that connection. But at the time it was landing the beautiful fish that commanded her attention.