Pacific Hake — *Merluccius productus*

Named for its resemblance to a different species, living in a school, spawning in a group, and commercially appealing only by the thousands, the Pacific Hake seems to lack its own identity. Sometimes it does not even recognize its own, cannibalizing smaller hake, perhaps when hungriest, or just by chance encountering and consuming its offspring. Not that it is the only species to eat its kind, but the method does seem a bit counterproductive.

Once considered part of the Cod Family (the Gadidae), even the newer family name (Merlucciidae) refers to similarities to other fish; "lutui" means "pike." Hake flesh is mild but fragile, meaning that rather than being served as a fillet on a plate, or as Fish-and-Chips, it is most likely to end up smashed together with other unfortunate hake and processed into fish paste, a more marketable product.

If deprived of its own identity, safety may nevertheless be in numbers for the hake, which is amongst the most common of the "Groundfish" community (those fish that live and feed at the bottom) along the western North American coast. Here offshore fishing takes this species by the thousands of tons.

Yet, despite the Pacific Hake's fecundity, or maybe because there were so many in the 20st century, as with so many fish species, a falling population seems the norm rather than the exception, and at least one distinct group, that of the Gulf of Georgia and Puget Sound, is considered a "species of concern." Fish managers consistently declare the hake population healthy, but as recently as 2002 the species was considered overfished.

Smaller in size than in the past, and sometimes isolated, the individual fish, previously only noted amongst a cast of thousands, now takes on new importance. The goal to ensure great schools that ply the ocean's depths and support a large fishery is not abandoned. Yet history reveals the advisability of a commitment to preservation rather than exploitation.

A member of the same order as Pacific Cod (*Gadus macrocephalus*) — the Gadiformes — the Pacific Hake (*Merluccius productus*) is a medium-sized fish with a fast growth rate, reaching an average size of 13-15 inches (34-40 cm) and a weight of 1.4 pounds (.64 kg), with a maximum length of 3 feet (91 cm) and 2.65 pounds (1.2 kg.) Distinguished by two dorsal fins, two long pectorals, and a truncated caudal fin, the hake is silvery on the back and whitish below. A projecting jaw, a large mouth that is black on the inside, and sharp teeth further distinguish the hake. Fish of the inland salt waters tend to be smaller than coastal inhabitants.

One of the first fish species to occupy the inland saltwater sea after the Pleistocene glacial maximum, the Pacific Hake was probably resident in Puget Sound by 12,000 years ago. Their present range is the eastern Pacific from the Gulf of Alaska to Baja California. Research has divided the Pacific Hake into three distinct population segments (DPS) — the Gulf of Georgia (including Puget Sound), the offshore coastal group, and the northern Gulf of California population. Those found in the eastern Strait of Juan de Fuca are members of the Puget Sound DPS.

Pacific Hake is best known commercially as the largest groundfish fishery in the offshore coastal waters of North America. Consumed more for its use as a paste rather than as fillets, it is also labeled as the Pacific Whiting or Jack Salmon. Although the white flesh is tasty, it is delicate, collapsing quickly into a mushy substance, unappealing to the human consumer, and requiring quick processing for commercial and recreational anglers alike. Offshore fish are also infected with a "myxosporidian" parasite which marks the flesh with telltale black spots. Thus, given the mottled and soft flesh, the Pacific Hake is more commonly sold as surimi (fish paste), fishmeal, or fertilizer.

Pacific Hake — *Merluccius productus*

Schooling by the thousands, particularly along the continental shelf, in the past, the Pacific Hake was a species of vast numbers. Although considered to be a demersal fish, one that occupies seafloor habitat, studies suggest that the Pacific Hake is also a pelagic species, moving up-and-down throughout the water column, and feeding nocturnally on fish and invertebrates. Observed as deep as 3,280 feet (1,000 meters), a more typical oceanic depth is 750 feet (228 meters). In the Strait of Georgia, where excellent habitat is available in deep basins with depths of 1.380 feet (420 m), although schools are most frequently encountered at depths at less than half the maximum.

Pacific Hake (*Merluccius productus*)

The most significant spawning areas for the Washington and Oregon coastal DPS are located in southern California, where large numbers congregate from January to March. Spawning has also been observed off the west coast of Vancouver Island, as well as in the Strait of Georgia between February and April. This activity often takes place more than once each year, complicating estimates of maturing fish.

Growth of the Pacific Hake Fishery and International Regulations

The 20th century was a time of rapid technological development, when natural resources, particularly those of the sea, were subjected to an unprecedented exploitation. New commercial opportunities seemed boundless. For the rapidly expanding fisheries, keen to find new resources, it was inevitable that the size of the Pacific Hake population would attract attention. Prior to 1966, the catch was small but, in a stunningly rapid development, in large part due to the presence of Asian trawlers and processing ships in the eastern Pacific, the catch seemed to grow exponentially. Few regulations were in place to ameliorate the impact, but the expanding fishery did not go unnoticed. Historically, nations with Pacific coastlines had expressed concerns over their “rights” to the resources of the sea, but international agreements were both inconsistent and always subject to conflicting interests. Exacerbating many of these conflicts was the old concept of “freedom of the seas,” in which nations resolved their differences without interference from the international community.

However, at the end of World War II, when the United States claimed resource rights to the outer edge of the continental shelf, other nations as well began the attempt to regulate the seas, as many expanded their jurisdictions to the 12-mile nautical line off the coast, and often beyond. Disputes increased, and by 1967 at least one national leader was calling for the intervention of the United

Nations. In 1973, a Conference on the Law of the Sea was held in New Work; nine years later the work culminated in a constitution adopted by 160 nations. One of the most key features, the Exclusive Economic Zone (EEZ) granted countries the right to manage all resources up to 200 miles from shore. Such a ruling would have an enormous impact on fisheries, because nearly all fishing grounds fell under the authority of a coastal nation.

Prior to this 1982 Law of the Sea agreement, mining, drilling, fishing — all these activities and more constituted an international free-for-all in the unregulated seas. In the Western Hemisphere, American and Canadian fishery managers gave the impression of having few conservation concerns, but eventually it was difficult to ignore the decline in fish populations, including the Pacific Hake. Offshore, trawlers plied the waters unfettered. The effects of this incredibly intense fishing limited only by vessel size and processing availability meant, quite simply, that stocks would inevitably become depleted, often sooner rather than later. Exploited fish species simply could not recover.

Thus, the Law of the Sea was welcomed by many nations, but by the time it was ratified the United States had already enacted the Magnuson-Stevens Fishery Conservation and Management Act (MFCMA). Passed in 1976, this ground-breaking legislation was designed to regulate and maintain sustainable fisheries and included a 200 nautical mile limit to the seas of the United States. The Act set down standards applicable to the goal of rebuilding fisheries and preventing overfishing. Fishery management councils were created, and authority given to manage catch and to promote scientific research. Thus, by the time the United Nations passed its own covenants pertaining to resource utilization, plans for regulating offshore fisheries were being implemented by the United States.

That such regulations as the MFCMA were necessary is clearly demonstrated by many fisheries, including that of the Pacific Hake. Just 12 years prior to the MFCMA, a scant 484 tons of Hake had been harvested. But by 1976, at least six foreign nations were fishing off the coast, taking as much as 262,000 tons annually, although the exact amount is unknown. While the catch declined for many nations, because of restrictions imposed by the MFCMA , the opportunity for American interests to take up the slack was quickly seized, with a nearly uninterrupted impact not only for of Pacific Hake but other fish species as well. And for a period of several years after the Act's implementation, American fishing vessels continued to use foreign processing ships for their own catch. This method ended only when all foreign fishing within the Pacific waters of the United States ceased in 1989. By the time of this closure, American factory trawlers were now present on the open sea, and by 1991 all sea operations were domestic. Meanwhile, shore processing increased marketing opportunities while contributing an economic boost for local communities. Sustaining this American fishing boom was the Pacific Hake, a fish with seemingly infinite numbers.

Now, too, the use of hake for surimi (a paste made from fish or other meat, or foods that use it) began, adding to demand both domestic and abroad. Increased marketability implied more regulations; in particular the allocation of fish between shore and sea processing facilities as well as the catch itself were put in place. Yet such efforts, as necessary as they were for distributing the harvest, were only a start in the attempt to regulate and preserve the hake population.

What did this fishing bonanza mean for the species? Clearly, such a take could not be sustained. Spawning would reflect numbers decreased by harvesting, and this would mean fewer fish to catch. It was clear that to maintain a fishery of optimal size and sustainability, better knowledge of hake biology and population dynamics was required, and intervention became more of an issue, as at the very least regulations regarding allocation of fish between shore and sea processing facilities, as well as the catch itself were clearly necessary. Two countries, the United States and Canada, were now so fully involved

with exploiting this abundant fish that by 2003 an agreement for co-management was hammered out. Known as the Pacific Hake/Whiting Treaty, and signed by leaders of both countries, the treaty set up committees assigned with the responsibility of managing the Pacific Hake harvest. Both countries would commit to full involvement with decisions, including sharing information, and implementing scientific principles while supporting research. It was clear that to maintain a fishery of optimal size and sustainability, better knowledge of hake biology and population dynamics was required.

The Ups-and-Downs of the Pacific Hake Fishery – 21st Century Realities

The reality is that as with all marine resources the Pacific Hake supply fluctuates owing to many natural factors, such as water temperature and food supply. At the start of the 21st century, particularly good spawning success and subsequent high juvenile recruitment contributed to a robust fishery.

These bountiful years for North American commercial Pacific Hake fishing culminated in a maximum catch in 2017 when 486,064 tons were landed. This number confirms the value of the Pacific Hake fishery: in 2018, the industry brought in more than $72 million in wages alone in the United States. And the benefit of such commercial fishing is also evident in companion industries such as local suppliers, shipyards, and other businesses.

The fishery is important in Canada as well; together both countries have exported more than $100 million, primarily to Ukraine, South Africa, and Nigeria. Offshore processors freeze hake for selling as fillets both locally and internationally, and the fish is also sold as paste, surimi, and fishmeal as well, the latter widely utilized in aquaculture, an ironic end for the Pacific Hake.

In retrospect, a decline in hake numbers seemed inevitable. The excellent yearly recruitment of juvenile fish declined in response to fluctuating female biomass. Additionally, average fish size decreased, an indicator of the increased catch, as well as a natural factors.

Nevertheless, the catch has remained high, and while acknowledging an up-and-down trend, fishery managers have stated that, incomplete knowledge of hake ecology notwithstanding, Pacific Hake numbers are sustainable.

Meanwhile, east of the large offshore coastal fisheries, at least one population, that of Puget Sound, has not recovered from historic overfishing. Designated as its own Distinct Population Segment, the Puget Sound Pacific Hake is considered a “Species of Concern” by the EPA. At one time, this group spawned primarily near the mouth of the Stillaguamish River at Port Susan, north of Seattle on the eastern shore of the Sound. A fishery targeted at the Port Susan hake took them in large numbers during the 1960s, with the catch peaking in 1968 at more than 7 million pounds of fish.

With such fishing pressure, it was not surprising that the Pacific Hake sharply declined in the Salish Sea and was so diminished that by 1991 hake fishing was suspended in Puget Sound, a restriction in place today. However, recreational Pacific Hake fishing is permitted in the Strait where additional depth restrictions of 120 feet on are in place to protect several species. Daily catch in the region is a limit of two fish, the same as many other bottomfish.

Determination of Sustainability

An important task for the Pacific Hake management team is specifying a maximum annual catch. Set at more than 551,000 tons at its highest, such annual limits are derived from a combination of factors, including estimating the maximum that will push spawning biomass below what is considered

desirable. As with many species, the amount is determined and limited by the so-called "F-40" calculation. This number is defined as the rate of fishing mortality estimated to reduce the spawning potential to a 40 percent level of an unfished stock.

One problem with estimating Pacific Hake at any level is the cyclical nature of juvenile recruitment. Th hake reaches maturity at 4-5 years of age and can live to 20 years, although this is considered an absolute maximum. Thus, as with many other species, a reduced Pacific Hake population does not recover on an annual basis but takes a few years to do so. This makes the impact of intense fishing more difficult to predict for fishery planners, for whom the annual estimation of population size is of primary importance in setting quotas. It has been reported that recruitment variability in Pacific Hake is high, more so than most other groundfish species, also making prediction problematic. Additionally, populations cannot be determined with confidence until fish are approximately three years old.

Other factors may also affect Pacific Hake numbers and distribution. Global warming is at least a moderate concern for this fish as it prefers the bountiful resources of cool water. In recent years, hake have been observed farther north than in the past; for example, the species has established a more permanent presence off the west coast of Vancouver Island. This is the most northerly extent for the hake; it is absent from Alaska.

Additionally, increased predation from animals other than humans is a factor that can affect more than a single species. In the Gulf of Georgia, growing numbers of Pacific Hake have contributed to an increase in Harbor Seal numbers, a consumer with an appetite for other fish as well, such as endangered salmon. The attempt to achieve a balance in the fishing industry is also an ongoing concern. The impacts of overfishing are well-known, as intense harvesting has affected many fish species. Because they are so numerous, Pacific Hake may historically have been viewed as of less concern, but as the most widely fished commercial species, at least in terms of the catch, it seems advisable that the Pacific Hake should be monitored as carefully as any other.

In 2021, the commercial Pacific Hake fishery landed 326,629 tons, more than 100,000 tons less than the high point of 2017. Hake biomass had decreased in 2020-2021, in part because of the high catch rate of four years earlier. The total allowable catch was 473,880 tons. The reduced numbers were in part a reflection of the reduced spawning biomass, a number which admittedly is difficult to predict and thus prone to large error. It seems unlikely that the greatest catch will be duplicated.

Considered stable and successfully managed, the Pacific Hake will undoubtedly continue to support one of the largest commercial fisheries in the eastern Pacific. Yet much of its continuance depends on prediction accuracy and biological understanding. Prediction and the designation of maximum take will remain in the realm of managers and scientists, but the future, as with so many ocean species, relies on the agreement and input of many people representing large and small interests alike. Hake fishing is a big business, to a great extent driven by international sales. It can be hoped that increased knowledge and sensitivity to the variable dynamics of the Pacific Hake will ensure its future to the best of humanity's abilities. For, as with all other resources, the hake's fate, at least for the present, rests with us.