Gadus chalcogrammus —Walleye Pollock

By Susan McDougall

The most social of fishes, the Walleye Pollock gathers in immense schools in the cool waters of the northern Pacific. Perhaps the numbers are simply a measure of fecundity, as adults are capable of multiple spawning events throughout much of the year. Yet such productivity does not go unnoticed, and the pathway to maturity is difficult at best. Predators (including members of their own species) circle round the fleeing juveniles, while the adult fish feed not only large mammals and birds, but provide a livelihood for many human fishers, and food for millions of people throughout the world. If you have eaten a fish "finger," a fish sandwich, or indulged in crispy, hot fish 'n chips, the tasty white meat was very likely a Walleye Pollock.

Most closely related to a species of colder waters and icy boundaries, the Walleye Pollock is not a "pollock" at all, but rather a cod; the genus name "gadus" is shared with several well-known species such as Pacific Cod and Atlantic Cod, while the family — Gadidae — counts as its members other fish of the Salish Sea —Tomcod is one well-known inhabitant. Nevertheless, with only 22 species worldwide, it is a small family, although one well-known to humans for its long history as an important and sustaining food.

Also known as "Alaska Pollock," a name more commonly used in the marketplace, the origin of "Walleye" is obscure, while "Pollock" refers to two North Atlantic species, both members of the Gadidae family. *Chalcogrammus* is Greek for "brass" and "mark." Whatever its name origin, to most of the world the Walleye Pollock is Alaska Pollock — the two are the same species.

And it is the Alaska Pollock that supports one of the largest fisheries on the planet, most of it based in Alaska, with Russia the second largest supplier of a fish consumed in quantities unimaginable a century ago. In the Strait, Walleye Pollock is caught as an individual fish large enough to provide a family meal; in Alaska, the fish supports an industry that processes it by the ton.

Walleye Pollock— *Gadus chalcogrammus*

In common with other cod species, Walleye Pollock has three stout dorsal fins. It is elongated and spindle-shaped, thickest near the first dorsal fin with a long, pointed snout, many small jaw teeth, and a slightly forked caudal fin. The eyes are large, and the scales small and rounded: the fins lack spines. An attractive species, the Walleye is silvery olive-green to brown above with dark mottling, accented by brassy or copper-colored blotches while the belly is white.

Large specimens can reach 36 inches (91 cm) in length, with a maximum weight of 8.6 pounds (3.9 kg). Most adult fish are much smaller, being a foot or so in length and weighing 1-3 pounds. Females are larger than males and mature later. Walleye Pollock are oviparous, meaning the eggs have no embryonic

development within the mother, and are externally fertilized. Eggs are released throughout the water column to depths of 1,312 feet (400 m), rising towards the surface as they develop. Juveniles (one inch or so in length) tend to move to nearshore waters or sometimes subtidal habitats, seeking shelter in kelp or eelgrass: as they grow, the young settle into deeper water. Adults often move towards the surface at night.

Spawning most often occurs from January to September, with length of the season varying amongst locations. The female lays from 60,000–1,400,000 eggs in multiple batches, releasing them every few days for a month. Fidelity to spawning sites has been observed, possibly in areas where the fish were born. Walleye Pollock tolerates a wide range of temperatures, but studies indicate that larval mortality is extremely sensitive to environmental conditions. The response of juveniles and adults to climate change is a particular concern, given the size and importance of the Walleye Pollock fishery. Studies that include spawning responses to laboratory experiments are part of the effort to understand the adaptability of a species that varies so widely in abundance.

Forming large schools, Walleye Pollock adults tend to congregate over soft bottom habitat, offshore to the continental shelf, open oceans, and near shore estuaries as well; they often occupy deeper waters in winter. They are both demersal (living near the bottom) and pelagic, sometimes inhabiting waters as deep as 3,936 feet (1,200) meters. Their diet is cosmopolitan, with juveniles eating a variety of small invertebrates; adults include shrimps, fishes, and squids among other large prey marine to their diet. In turn, they are preyed upon by salmon, flatfish, birds such as murres and puffins, and mammals ranging in size from river otters to whales.

Walleye Pollock is a widely distributed cod, thriving in the cool seas of the northwestern Pacific, east to the Bering Sea and Gulf of Alaska, and south along the coast and inland waters to Carmel, California. The largest schools are found in the Okhotsk Sea and the eastern Bering Sea. This region is home to immense schools, which are harvested by the millions. Named the Alaska Pollock for marketing purposes, the size of this fishery stands in sharp contrast to the depauperate state in more southerly waters, such as those of Puget Sound.

Puget Sound and the Loss of the Walleye

Fishing for Walleye Pollock in Puget Sound is not permitted in the 21st century. In fact, with the collapse of a formerly robust fishery, the species has nearly disappeared from the waters of the Sound. Much of the take, which ultimately proved unsupportable, occurred during the late 1970s; Walleye fishing peaked at about 25 million pounds annually.

Part of the reason for the increase in Walleye Pollock fishing at this time was the Boldt decision in 1974 which placed further pressure on species other than salmon. However, it is difficult to determine the full impact of the new regulations resulting from the court settlement that allocated half the catch to the tribes. What is known is that between 1970 and 1994 commercial fisheries in the Sound accounted for more than 90% of the bottomfish catch, including Walleye Pollock, as an industry dominated by bottom trawling grew dramatically.

At the beginning of this fishing bonanza, Walleye Pollock was one of several common bottomfish species. The numbers extracted were high — a maximum occurred in 1979 when approximately 29 million pounds of bottomfish were caught. Commercial opportunities soared on a fish population that seemed boundless.

And yet by 1989 bottom trawling had been banned as numbers went into freefall. It was not only commercial fishing that would send the population plunging downward — a significant recreational impact on this tasty cod would also develop in the waters of the South Sound.

Walleye Pollock maximum tale was reached before the cessation of trawling, with numbers of approximately 800,000 annually in the North Sound, a region that is defined by NOAA to include the San Juan Islands and the eastern Strait, from 1978-1981, while in the South Sound pressure on the Walleye Pollock came from both commercial and recreational exploitation. This fishery declined to nearly zero while the take in the North Sound continued after the trawling ban, particularly in the Strait of Georgia. In the South Sound, the fishery was dominated and ultimately driven to small numbers and an ultimate "crash" by recreational harvest.

Located near Tacoma, the recreational fishery contributed to the pressure on the species, harvesting more Walleye Pollock than any other bottomfish. Between 1977 and 1986 approximately 400,000 pounds *per year* was landed. Angler trips increased from near zero in 1971 to over 200,000 in 1983; this did not include shore-based fishing. Of course, the decline began long before the end of this seemingly limitless pollock supply and, unwilling to heed the message or perhaps failing to recognize it altogether, the fishery continued its pressure on dwindling numbers. In 2017, the fish was categorized as "overutilized," and today, some observers believe the Walleye Pollock to be extinct in the South Sound. It has not come back.

The Straits

Shared with Canada, the Strait of Georgia became another important site for Walleye harvest when demand for pollock roe increased. The take increased dramatically in Canadian waters, from approximately 705,000 pounds to over two million in 1981. Such a rate could not be maintained. The stock began a long decline and has never reached the high levels that supported such a fishery.

In the Strait, bottomfish harvest accounted for up to 20 percent of the total from 1990-1994: much of this was in Discovery Bay where commercial fishing closed in 1994. Today the biggest threat to the pollock in the Strait is anthropogenic stress, including climate change, a factor of increasing importance when a species is in decline. As a short-lived bottomfish, Walleye Pollock is particularly sensitive to annual fluctuations in environmental conditions, responding quickly to decreasing quality. Fishing can exacerbate the problem; as the population is reduced due to instability in the environment, harvesting can place more pressure on the species. Such a response may happen quickly in a system where the complexities of fishing management may delay restrictions on a stressed population.

Some immunity from such pressure may contribute to more stability in the American side of the Strait, where only recreational fishing is permitted, with a maximum of two fish per day throughout the year.

Knowledge of the Walleye Pollock population's status depends on fishery reports and occasional bottomfish surveys in the Salish Sea, including the Strait. Such surveys, including one undertaken between 2002 and 2007 have returned depressingly similar results — Spotted Ratfish (*Hydrolagus colliei*) dominate the fish community. However, during the five years of the survey, Walleye Pollock, which accounts for the highest percentage of "codfish," contributed disproportionately to the drop in fish abundance.

Other surveys also reveal the dominance of Walleye Pollock in the codfish population, but these numbers may reflect the declines in Pacific Cod (*Gadus macrocephalus*), a member of the cohort.

In 2000, another survey in the eastern Strait, sponsored by the Washington Department of Fish and Wildlife represented a new effort by including areas on each side of the international border. Results of this survey also demonstrated that second to the Spotted Ratfish, the walleye was the most common species by weight and number in the eastern Strait and the Strait of Georgia. This survey encompassed four depth ranges, to more than 60 fathoms (360 feet). The survey indicated that the greatest pollock numbers resided at the deepest stratum of the eastern Strait. Most of these fish were comparatively small in length and mass.

In this survey Walleye Pollock was much less common in the Canadian Strait of Georgia than in the Washington side of the international boundary. However, the Pollock there were small, averaging only about 5.5 inches (14 cm) in length. The total number over the two main basins of the Strait was estimated at 38.4 million fish, the majority found offshore.

Fish Sandwiches and Fingers

Founded in 1940, McDonald's fast-food restaurant represented a pioneering concept in food services, with the first drive-through opening in 1948. As local outlets increased slowly throughout the country, in time driving by a McDonald's became a common experience. Signs announcing the "number of burgers" sold would be posted below the golden arches, which first made an appearance in 1962. By 1963, a billion burgers had been sold; in 1993 the company quit posting the numbers after the count reached 99 billion. Perhaps the company deemed the announcement a little excessive by that time. In any case, the sales represented a lot of beef-on-the-hoof.

Searching for new products and also acknowledging the need for a meatless meal, in particular, the inclusion of fish as a menu choice would target the Catholic market on Fridays. In 1965, McDonald's introduced the "Filet-O-Fish," a sandwich with the appearance of a burger but consisting of a much different source of protein. Rather than beef, wrapped in the bun was the healthy whitefish — halibut at first in the United States, and then, inevitably one might say, the aggressively marketed and abundant Alaska Pollock became the preferred fish for McDonald's new "burger."

Today, it is estimated that approximately 300 million McDonald's fish sandwiches are sold across America each year. That is a lot of pollock.

By comparison, Americans consume about 55 million pounds of fish sticks per year. Unlike the McDonald's fillet or the Costco "fingers," these fish products are often made from a minced source, a mixture that includes several species, as well as skin, blood, and bones. Most are frozen and cooked in processing, although they may not be completely cooked. Some fish sticks are made from a single species; such is the case with "fish sticks" offered at Costco which are made of breading and Alaska Pollock. And recently, an increasing number of companies have promoted their fish sticks as "pure," with only one species used. In the majority of those sticks, that species is the pollock.

Fish sticks have been a staple in school lunches for many years. The history of such use of processed products, such as Alaska Pollock, dates back to the 1946 National School Lunch Program, signed into law by President Truman. The purpose was to provide lunches to qualified school programs, and at the same time, stabilize food demand (and thus, prices) by purchasing farm surpluses. The subsidy to schools was either cash or food. Implementation of the act has been altered over time, with increased nutrition as a goal and the safety of the food consumed carefully monitored. Sales, studies, competition, controversy — all are part of an act with the lofty purpose of promoting the health of children.

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In September 2023, under the auspices of the National School Lunch Program, the USDA purchased 910,000 pounds of Alaska Pollock for distribution in schools. Earlier in the year, 1.3 million pounds of pollock fish sticks were also acquired for schools and food banks. These purchases are made under the authority of an Act dating to 1935 that sought to promote consumption of local (American) produced food products, including fish. Financial support for the program comes from Custom receipts. Today, the increasing use of Section 32 of that Act to purchase fish has made the government one of the largest customers of Alaska Pollock. In 2022 alone the USDA spent $52 million on bottomfish, including pollock. The plan is to increase the purchase in 2024.

A Billion-Dollar Industry

Originating thousands of years ago to when the first humans made the northeastern Pacific their home, fishing has played an integral part of the local economy of a cold but resource rich land that in time would be named the state of Alaska. For those earliest people who lived near the rivers that flowed into the sea, the annual return of the salmon was vital for sustenance throughout the year. Depending on local resources, other fish species were also important in the diet, and at least one site, located on the Katmai coast, was dominated by fish bones other than salmon; archeological investigations have unearthed cod species, including the Walleye Pollock. In time, much of the site was submerged under rising seas, but it is evident that whitefish such as the pollock were important to the diet of these earliest peoples.

A few thousand years later (the Katmai site was occupied at least 6,000 years ago), fishing the rich bounty of the sea and land is as important as so long ago, although the context has changed. Even for those not directly connected to fishing, what has become a billion-dollar endeavor plays a role in most Alaskan citizens' lives.

For example, in 2019 more than 62,200 people were directly employed in the seafood industry, with another 37,400 full-time "equivalent" jobs adding $2.2 billion to the economy. Fisheries alone hired 31,000 fishers with income estimated at $1.0 billion, and 27,000 processors also employed. There are 8,900 fishing vessels and, in total, the value of the seafood industry is estimated at $5.7 billion. In 2022, the Alaska Pollock fishery caught 2.8 billion pounds of pollock.

These are big numbers indeed: the point of including them is to show that dollar numbers for Alaska fishing are measured in the billions. Of this, except for salmon, the pollock plays the largest role, in terms of dollar worth. As an example, in 2019, when 3,353 million pounds were harvested; sales were approximately $.49 a pound. The vessels that seek the pollock were estimated as worth $484 million dollars alone. Much of the pollock take comes from the Southeast Bering Sea, a productive region located directly north of the eastern Aleutians near mainland Alaska.

Promoting the Product

If you were employed on a 300-foot-long factory ship, it is unlikely that selling the captured millions of fish would be your primary concern. It also seems doubtful that the captain of the massive vessel would be directly involved with the catch. That job assignment rests with organizations whose goals revolve around selling fish, an endeavor that focuses on existing customers and, most importantly, on expanding the market.

Exports and domestic sales of Walleye (Alaska) Pollock and other fish as well depend in large part on a network of support organizations. In 2003, a non-profit corporation named the Association of Genuine Alaska Pollock Producers (GAPP) was created specifically to promote Alaska Pollock around the world. It is the goal of this organization to educate buyers and consumers about the "superior benefits" of "Genuine" Alaska Pollock. Membership includes harvesters, "community development quota groups," processors, and consumers. Associate members are primarily commercial seafood companies, although names such as "Keybank" and "Alaska Ship Supply" give an indication of GAPP's broad base. All of this diverse mix of interests are in some way involved with pollock harvested in the Bering Sea and Gulf of Alaska.

Seeking to expand the pollock market, GAPP vigorously explores new opportunities worldwide; an example of this approach was reported at the 2023 annual GAPP meeting held in Seattle. The gathering brought together old partners as well as new, the latter ranging from Japanese companies to a Colombian promoter of Alaska Pollock products.

Aside from the enthusiasm and the hype at the annual get-together, on a day-to-day basis GAPP assists companies in the development of new markets for various fish products. Grants are available through the so-called "Partnership Program" participants. Since its inception five years ago the program has allocated funds exceeding $7.8 million for product promotion. The goal is simple – sell Alaska Pollock. And GAPP advertising propounds the idea that any protein other than the pollock's is vastly inferior — the organization unabashedly labels Alaska Pollock as the "perfect protein."

But it isn't all words: this is a serious organization with nevertheless rather simple goals. It is instructive to understand the reach of GAPP by perusing the list of speakers and attendees at the meeting. From the politicians (whose presence one might expect), among others, speakers represent organizations that are as diverse as the market for the pollock itself — representatives of universities, the Port of Seattle, the Seattle Mariners, and the Climate Pledge Arena, located on the site of the 1962 Seattle World's Fair. The inclusion of the Arena seems symbolic and, indeed, the promoter's goal for the pollock appears to encompass as many worldwide consumers as possible. From schools to sports arenas, grocery stores to eateries — all are perceived as potential customers as well as beneficiaries of this small but plentiful fish of the northern seas.

Pollock Products in Many Forms

The marketing of pollock goes beyond offering filet sandwiches at fast-food eateries and fish sticks in school lunch menus. With their long history of consumption, Pollock roe and surimi are an important part of the market today. Roe has been popular in Japan and Korea for centuries and is often eaten as a salted delicacy: many consider it to be as delicious as caviar. Roe is marketed for its high nutritional content and its versatility in preparation. Raw or cooked, it is used in sandwiches, toppings, pasta dishes, rice bowls and spaghetti, to name just a few. And for marketing purposes, Pollock roe carries the "sustainably" label, a much-touted designation in the pollock fishery.

In 2020, Alaska Pollock roe was estimated at a dollar value of $114 million. Shipped as frozen "skeins" (the membrane surrounding the cluster of eggs) to Seattle and South Korea where the roe is auctioned, processing is mostly done in Japan. Although widely consumed in Asia, much of the roe is also shipped back across the Pacific where it is sold to eager consumers. A quick search of the Web reveals its availability.

As with roe, a paste made from deboned pollock has a long history of human consumption. Dating back to at least the 12th century and commonly called "surimi," this is an intermediate product derived from thawed deboned fish, and subsequently refrozen. It is used in a variety of forms (called Surimi-based products or "SBP") that include such well-known products as imitation crab meat. Current production methods developed in Japan and dating to the 1960s marked the beginning of a rapidly expanding market for the versatile paste. Originally made from Alaska Pollock, depletion in pollock populations has resulted in the use of other whitefish in surimi; at least one study identified 16 species used. Fish of tropical waters are also the basis for surimi— in fact, the use of these fish in surimi exceeds Alaska pollock by a factor of four. Today, the United States alone consumes more than 130 million pounds of surimi annually. In Asia, the production has exceeded 694,000 tons and the value worldwide was 2.5 billion United states dollars. The growth is expected to continue.

Much of the surimi is produced in Asia, although there are American companies in the market as well. Referred to as a "reprocessing" method, Asian surimi made from Alaska Pollock follows a route that includes two ocean crossings, one to the west from the pollock's icy water northerly home, and the other back to its ultimate destination — the dinner plate.

Fish caught in the Bering Sea are most often handled in "catcher processors," huge factory ships up to 376 feet in length: these are designed primarily for pollock and other whitefish hauls. The largest of the ships can process as much as 248 tons of gutted, frozen fish product daily. The fish are shipped throughout the world, with approximately 58% transported to Asia. There it is processed and shipped again; China occupies the largest role in the export market. Although declines occurred in part due to the Covid pandemic and resulting shipping rate increases, exports from Alaska to China in 2022 were over 385,800 tons, a number expected to climb once again to pre-pandemic numbers. And more.

In 2021 Aquamar, a surimi producing company located in southern California, purchased the Seattle-based Shining Ocean: this transaction makes Aquamar the second largest surimi source on the continent. Founded in 1981, the company farms tilapia and shrimp locally, while frozen surimi is shipped from Viet Nam and processed into the several surimi end products. These vary from crab flakes to fish sticks.

South of the Alaskan waters where the pollock is caught, in the Ports of Seattle and Tacoma frozen Alaska Pollock is one of the top 10 seafood exports. Its importance to the shipping business is apparent from large murals of the fish, such as the mural at Pier 91, in Seattle. Created by a local artist, the cost of the mural was in part subsidized by the Association of Genuine Alaska Pollock Producers — GAPP. The importance of pollock to local business is not lost on the Port of Seattle and this organization's website features a page devoted to the species.

Advertising and promotions are a necessary part of a billion-dollar business, one dependent on wise management of an ultimately limited resource. The pressure to extract more from this finite number is always there, at least in a perceived expanding market. Expansion is the goal.

For example, the market value for surimi alone is expected to increase from $6.1 billion US dollars to $11 billion over the next ten years. This ambitious expectation implies bountiful years in Alaska. But can the Walleye Pollock support such a growth in the industry?

Size of the Resource

The contrast between the schools of pollock numbering in the thousands in the Bering Sea, and the barren waters of Puget Sound could not be more dramatic.

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In 2020, the Alaska fishing fleet landed 3.23 billion pounds of Alaska Pollock from the Bering Sea and Gulf of Alaska. The estimated value was $420 million dollars.

Meanwhile, in 2021, a paper published by the National Oceanic and Atmospheric Administration (NOAA) estimated the Southeastern Bering Sea Alaska Pollock biomass at 3.3 million tons, a number indicating a decline from previous years. The pandemic may have influenced estimates, but the drop was nevertheless notable. However, an increase was expected in 2022, followed by another decrease in 2023. These numbers are derived from modeling various parameters such as predator impact and climate variables as well as fisheries data and surveys.

It is estimated that in 2024 the Eastern Bering Sea pollock fishery will be allowed to take 1.44 million tons, an increase over the previous year when the total was 1.43 tons: in 2022 the number was 1.22 tons. These numbers represent an increase of approximately 18 percent in two years. The limit is set by the North Pacific Fishery Management Council (NPFMC) and is based upon a predicted increase in pollock biomass. An increase in the take will also be permitted in the Gulf of Alaska.

The Blue Label of Sustainability

From the local Walmart to the frozen food isle at Trader Joe's, the Marine Stewardship Council's blue label assures the customer that their purchase supports a "sustainable" fishery.

On July 2, 1992, the Canadian government shut down the Atlantic Cod (*Gadus morhua*) fishery. Within days thousands of commercial fishermen lost their jobs in a once-thriving industry. It was an unprecedented extreme measure for a fishery that dated back hundreds of years. Yet the decline in harvest had been dramatic over the latter part of the 20th century, with the highest number in the early 1980s at over 66,000 tons. Estimates at the time of closure put the Atlantic Cod population at one percent of its former abundance. Perhaps the numbers remaining were a bit higher than this dismal estimate, but the reality behind this extraordinary closure was a species possibly on its way to extinction.

Five years later, in part as a response to the Atlantic Cod crash, the non-profit Marine Stewardship Council (MSC) was incorporated in London. A vision borne from a discussion held in a popular bar, the purpose of the company was to address the decline in oceanic species throughout the world. The fundamental idea was to certify so-called "sustainable" fisheries — those harvesting their target at a rate that ensured a constant population. It was an innovative idea, but the question, particularly in the early years, was how to encourage participation. Fisheries may have been concerned about declining numbers, but motivation was lacking in the acceptance of what many perceived as new restrictive measures.

Three laudable principles guided the MSC from its earliest days — stock sustainability, ecosystem impacts, and effective management. The objective of ensuring long-term species' viability was lofty, while the reality of implementation was proceeding on uncharted ground. The necessity of flexibility was acknowledged, then as now, but what became increasingly apparent was the role that business "buy in" would play. And, ultimately, the consumer.

In 2000, Whole Foods Markets became the first company in the United States to stock an MSC-labeled product; in 2005, Walmart followed. By 2004, the Alaska Pollock fishery sought MSC certification. Yet progress continued at a slow rate, with only 10 fisheries certified by 2007. It was a small start, one recognized and addressed with reorganization and inclusion of a broader spectrum of interests.

Members began to acknowledge that seeking MSC certification would in large part be driven by customer demand. And that is what ultimately happened. From restaurants to mammoth grocery chains to small independent markets, the MSC label would be advertised or displayed on packages of sustainably caught fish. Today, 20,000 products carry the blue label, representing more than 400 fisheries.

MSC certification is granted for five years with annual assessments as part of the process; these reports are provided by an independent company. Decertification does occur (17 had been suspended by 2016), typically following a "suspension" period during which the fishery may enact measures to improve their practices. Certification can be legally challenged: such was the case with the Orange Roughy (*Hoplostethus atlanticus)* fishery, a controversial industry based in New Zealand and Australia. A new MSC standard, issued in 2022, addresses issues while causing concerns. Amongst the new requirements is full implementation of a "harvest strategy" by certified fisheries, imposing a tightening of regulations that is designed to prevent overfishing. Yet many conservationists, scientists, and other concerned individuals believe that the MSC has failed to meet its objectives of "oceans teeming with life."

Nevertheless, the number of certified fisheries has risen dramatically in the last 15 years. Today customer demand for MSC-certified (the "blue label" of sustainability) encourages and promotes fishery buy-in to the concept. It is not without cost, for not only is the fishery held accountable for their practices, but, except for certain non-profits, each pays annual fees for its certification, as do businesses that carry or use MSC products. Over 87% of the MSC income is derived from these sources. In recent years, countries with significant fisheries, such as China and Japan, have increased their MSC-labeled products from a few to hundreds. As the leading certification company in the world, MSC's "business" has grown consistently. From the beginning, it has seemed like a very good idea.

But the discerning consumer might ask — upon what standards does the concept of "sustainable" depend? How rigorous are the requirements? From the beginning, global (which MSC labeling has become) implementation of an idea borne in the stunning loss of the Atlantic Cod, the company's practice has been to employ scientific principles in the evaluation of an individual fishery.

Fishing to Maximum Sustainable Yield

The maximum sustainable yield (MSY) concept in fisheries management has been employed for nearly a century. It is defined as the catch that can be extracted from a species indefinitely, with a permitted fishing rate that will produce a maximum rate of production. An MSY approach assumes that populations will replace themselves – they are renewable. It is based on the concept of surplus numbers that can be fished, depleting the population below its carrying capacity. This is a theoretical concept that assumes a species' dynamics follows a logistic curve (an exponential curve). Ultimately limited by its environment, the species would increase to the carrying capacity in the absence of fishing. It is a surplus production model approach that assumes a population will grow to a certain maximum size that the environment can support; beyond that number is "surplus" and it is this that can be harvested.

However, it is not the goal in the MSY approach to enable a stock to reach carrying capacity. Rather, fishing will be permitted on the "surplus" based upon a maximum production rate. This is the point at which the equation reaches a maximum rate (the steepest part of the curve) and is theoretically one-half of the carrying capacity.

Since carrying capacity is not known, the MSY value is determined from fisheries data. The maximum rate of production is calculated from the catch per unit effort (CPUE) and the fish numbers

caught. The CPUE is in theory calculated independently of the fishery, while actual catch is available from reported take. These numbers form a linear curve — the longer you fish the more you catch. However, there will be a maximum biomass caught as a function of the CPUE. This is the MSY. It is the apex of a dome-shaped curve based upon the idea that a maximum rate of production occurs when the population is fished at a level equal to half of the BMSY (Biomass at Maximum Sustainable Yield).

In practice, this theoretical maximum growth rate tends to occur at about 30% of the unexploited (non-fished) population size.

Coupled with the MSY, is the "BMSY" (biomass maximum sustainable yield) — the biomass that ensures MSY is achieved. The maximum fishing mortality rate (FMSY) is that rate that can be applied over a long period to guarantee the BMSY.

The MSY concept assumes a close relationship between adult abundance and productivity. This dynamic depends upon the species and is subject to many variables, such as size of the habitat, water temperature, and food availability. Also important is the life expectancy of the species itself.

There are two main components to estimating the MSY: these are data, both observational (survey) and fishing take rate, and modeling of the population itself which may extend beyond a logistic approach by incorporating other considerations, such as including other species in the model. Yet whereas fish stock dynamics are stochastic processes, subject to such variation as environmental conditions, many models treat various parameters as constants, sometimes specified from experience rather than measurement. Estimates of recruitment, fishery age composition, weight, size, predation, and other factors can be inputs to population models. The output of modeling is estimated biomass and recommended exploitation rate. Much of the accuracy depends on knowledge of the "spawner-recruitment" relationship, meaning the number of spawners and those returning fish that survive their growth to adulthood, evading predators, fisheries, and other hazards. Thus, for non-anadromous fish such as the pollock, recruitments are those that return before spawning. Unfortunately, the relationship between the two is subject to many variables that are difficult to quantify.

In part to compensate for incomplete data, Alaska Pollock stocks are designated with "tier" levels, meaning that the reliability of the MSY concept varies depending on that assignment. For example, the Southeastern Bering Sea pollock stock is categorized as Tier 1a, meaning the BMSY is considered dependable. By contrast, the dependability of the BMSY is considered less reliable for the Gulf of Alaska stock, which is given a Tier 3 rating.

The reality of the ocean is that nothing is constant. That has never been more apparent than today. Yet modeling will always include the assignment of constants to variable parameters, in part because so much is unknown, and data is always incomplete. Quantitatively, sustainability will always be a moving, variable target. Some would argue that the designation of "surplus fish," meaning those fish remaining after harvesting to the maximum fishing mortality rate, should not be used at all.

It is difficult to model a fish population, particularly a pelagic one such as the Alaska Pollock. Whether the MSY approach will retain its long-term value as the measure for fishing quotas is uncertain. It is a combination of theory and data, yet always limited by incomplete knowledge and modeling assumptions. The unknowns associated with climate change and its impact on fish populations are certainly a worrisome factor in predicting long term viability. But what remains a constant for present fishery managements is that estimates will be made of stock biomass, and fishing quotas will be regulated. Economic impacts are always considered, and concerns such as fishing methods, particularly for ocean-going species such as the pollock, will continue to be addressed, argued, and sometimes find their way into the courts.

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Trawl Fishing in the Courts

The beginning of trawl fishing in the northwestern Atlantic Ocean in the 1950s has been implicated in the demise of the Atlantic Cod. In a sense this method compressed a relatively small annual historical take to one estimated in the millions each year. Within 25 years the yearly Atlantic Cod catch had peaked at 800,000 tons and by 1992 the fishery was essentially gone. Such a huge fishing industry was ultimately unsustainable. The Atlantic Cod has not recovered.

Less noticed was the impact on other species as well. These constituted the "bycatch," a word that has come to plague the Alaska Pollock trawling fishery.

Bycatch refers to the unintended catch of species other than the designated target. In the case of the Alaska Pollock, bycatch in the trawl fishery includes salmon numbering in the thousands. Many of these are Asian hatchery fish, but not all. And it is the continuous taking of salmon, which are subsequently discarded, that has provoked a reaction.

In autumn, 2023, two large tribal groups, representing about 100 tribes, sued the federal government for alleged mismanagement of the pollock and cod fisheries. The lawsuit represents the culmination of frustration over the continuing bycatch numbers and recent directives limiting native fishing of salmon, a subsistence resource for many Alaska tribes.

It didn't help the pollock fishery that nine killer whales (Orcas) died in trawling-based fisheries in the Bering Sea and Aleutians. Some critics speculate that Orcas are attracted to the trawlers by discarded bycatch, an easy meal for the hungry whales. This point may be argued, but politically, it is damaging to the fishing industry. And in October 2023, the Center for Biological Diversity filed a notice stating its intent to sue the National Marine Fisheries Service for failing to protect marine mammals. Noted in the filing is that marine mammals are protected under the Marine Mammal Protection Act.

There is a limit of Chinook Salmon bycatch permitted for the trawling fishery; however, attempts to limit Chum Salmon take have not been implemented. And trawling is considered damaging to other ecosystems; much of this impact may depend on how often the large nets range over the ocean floor.

The Alaska pollock fishery is the nation's largest, a source of great wealth for a few and a good living for many. It is considered sustainable. Yet the impact of trawling on ecosystems, the lack of knowledge of what climate change means to the resource itself, and the bycatch level are, for many, resulting in frustration and the ultimate turn to the courts.

Meanwhile, in the Salish Sea

During the summer, Walleye Pollock is commercially fished by Canadian boats in the Strait of Juan de Fuca. In Washington state, recreational fishing is permitted with a limit of two fish per day. The pollock is not the most sought-after species; that status is more typically reserved for salmon and halibut. The Strait, however, is one of the few places where this pollock, present in every sub-basin in the region, may be fished. The walleye is nearly absent in Puget Sound, but in the Strait, the population is considered stable and is often numerous in trawl surveys. Less sought after than many other species, the Walleye Pollock undoubtably benefits from the lack of attention.

Gadus chalcogrammus — Walleye Pollock

With the reality of climate change upon us, it seems imperative to increase our understanding of the effects on the ocean's ecosystems. Factors such as species' interactions, food availability, predation – all will be of an importance never before considered. Attempting to model these changes is a huge challenge, yet nevertheless a necessity. Without increased knowledge, whether it takes the form of developing better models, interviewing fishers, collecting data – the concept of sustainability may have little real meaning.

Ocean fishing is an extractive industry. It always has been. Fishing does not directly replace what is caught and, at times, our species has taken much more than could be provided. It can be hoped that better assessment of population numbers, modeling improvements, agreements between fisheries and nations, improved certifications, and, ultimately cooperation, amongst the millions of people involved, including the consumer, will promote a future for the extracted and the species that depend on them on as well.