

Engraulidae — Anchovy

The pizza parlor was quiet that Saturday evening. This was a good thing for a young teenager who had never crossed the threshold of one before; restaurants of any kind were a once-a-year experience in my family. I was somewhat damp and cold from a day of skiing, but an offer to stop and give the local establishment the benefit of four enthusiastic, if wet, customers was inviting. We entered, took possession of a table, and chatted about the menu. Ignorant of the taste of additions to a basic cheese pizza, I perused the offerings. My friends remained tactfully silent. All but one, that is.

I should have noticed the twinkle in his eye. “Anchovies,” he said. “Nothing better.” The others nodded in approval, stifling embarrassing ignorance, and so the pizza order was placed.

Delivered to our table, the pizza was hot, appealing, inviting. But the taste? It was like inhaling the contents of a saltshaker flavored with intensely fishy oil, and a few scales added for texture.

I have not knowingly eaten an anchovy since that evening. A friend tells me that anchovy prepared by a knowledgeable chef is delicious. I have no reason to doubt what he says. Nevertheless, I think that anchovies will continue to be safe from me.

Most abundant from San Francisco south to Magdalena Bay near the tip of Baja California, the Northern Anchovy (*Engraulis mordax*) is typically associated with warm coastal waters. Thus, although less numerous in cold water, this little fish is present as far north as Haida Gwaii on the eastern Pacific coast. It is established in the Salish Sea, including the Strait of Juan de Fuca, where it gathers in schools large enough to support a bait fishery. And as waters warm in response to climate change, the far-ranging anchovy may be poised to expand in both range and numbers.

The Northern Anchovy is a member of the Engraulidae family; *Engraulis* is Greek for “small fish”, a reference to the size of most species, although there are exceptions. The family consists of 17 genera and 155 species, nearly all inhabiting shallow coastal waters. Some are also present in temperate and tropical estuaries, and a few are freshwater species. They are found in the Atlantic, Indian, and Pacific oceans. Maximum size for an Engraulidae species is about 20 inches (50 cm), but most are small, 6 inches (15 cm), or less, including the Northern Anchovy. Nevertheless, in spite of its petite form, anchovies have been fished for thousands of years and are currently commercially sought for both their oily flesh and as bait and fish meal.

The Engraulidae is a member of the Clupeiformes order, a large collection that includes the closely related Pacific Herring (*Clupeus pallasii*). Origins of the Clupeiformes date back at least 50 million years. Although anchovies have been considered one of the younger families, at least one related fossil dates to nearly the beginning of the order. The anchovy genus — *Engraulis* — originated about 5.3 million years ago.

Clupeiformes species include some with an anadromous lifestyle, that, like the better-known salmon, travel from freshwater to saltwater and back to spawn and die. At least one genus in the Engraulidae family — the *Coilia*, or the so-called “Grenadier anchovies” — includes anadromous species up to 16 inches in length and is native to the western Pacific from Japan to Southeast Asia.

The Northern Anchovy genus consists of nine species, distributed worldwide, most in warm ocean habitats, although at least one other species is known to inhabit cooler waters, much like the Northern Anchovy. All *Engraulis* species are small and short-lived. The Northern Anchovy is a typical genus member, with a maximum length of 7 inches (17.8 cm) and a lifespan of 7 years. Maturity is reached within 2-3 years.

Engraulidae — Anchovy

While the genus name refers to the small size, the Northern Anchovy species name, *mordax*, means “to bite,” a reputation that may have originated from the observation that this little fish has a very big mouth, which it opens to expose its tiny teeth, and plows through the water, scooping plankton as it goes, often in company with a thousand others. This habit is also believed to help with ventilation; anchovies are known to be tolerant of low oxygen conditions.



Northern Anchovy (*Engraulis mordax*)

The Northern

Anchovy’s big mouth underlays a short, blunt snout and a large head. The eye is large as well, and the cylindrical body tapers to a deeply forked caudal fin; a single dorsal fin and a substantial anal fin also contribute to a classic fish look. Dark bluish-green on the back, the anchovy’s belly is silvery and the body translucent; there is no lateral line. This is a shallow inshore species where it often gathers in tightly packed schools. However, the versatile little fish is known to range as deep as 720 feet (219 m).

Spawning in winter and early spring, Northern Anchovy females deposit their eggs in the water column, typically in several batches timed about 7-10 days apart. The eggs hatch in two to four days. Spawning often takes place in shallow, warm waters, but can also occur far offshore, with eggs and larvae observed as far as 300 miles (483 km) from the coast. During the winter, anchovies typically move offshore to deeper waters. They are known to migrate considerable distances north-and-south and sometimes travel with other schooling species such as eulachon, sardine, and juvenile herring. Northern Anchovy can tolerate a wide range of temperatures, from as low as 47° F (8.5 °C), to a much warmer 77° F (25° C).

Almost exclusively plankton eaters, anchovies occasionally are known to feast on algae as well as fish eggs and snails. Rich in oil, Northern Anchovy is important prey for many marine species, including other fish, birds, mammals, and invertebrates. They are a vital part of the marine food chain and in some places may take pressure off species at risk, such as salmon, by providing prey for other fish consumers.

Anchovies in the Salish Sea — Past and Present

Northern Anchovy bones do not dominate Paleoindian sites in the Pacific Northwest, but they are present, an indication of use long before the 20th century when observations of population fluctuations

Engraulidae — Anchovy

began to be documented. At a site on Decatur Island, located in the eastern part of the San Juan archipelago, anchovy bones have been found in a shell midden, dating to 2,600 to 2,400 BP.

Between 2014-2016 the Northern Anchovy population increased dramatically in Washington, particularly off the mouth of the Columbia River, but also in the more northerly waters of the Salish Sea. Such increases are of interest because in the past anchovies were not considered to play an important role in the local ecosystem; forage fish here are dominated by Pacific Herring, Pacific Sand Lance, and Smelt. However, it is known that the anchovy does spawn in the Salish Sea, and observations of its presence, particularly in the Strait of Georgia, date to as early as 1941. By 1981 the anchovy had been recorded as spawning off the mouth of the Fraser River, and the fish was known to serve as a prey item for Chinook Salmon in Canadian waters.

The Northern Anchovy population is relatively small in the Strait of Juan de Fuca, but as with other regions of the Salish Sea, probably increasing, at least intermittently. This is a species whose numbers are difficult to measure or predict, as natural fluctuations are not uncommon. Larvae have been observed in the Strait although eggs are not recorded. Surveys which include anchovies as bycatch indicated the presence of over 3,500 fish in the eastern Strait in 2002. However, forage fish surveys along the shores of the Strait have not typically included Northern Anchovy.

Off the coast, the anchovy is commercially fished, with numbers taken reflecting the both the market demand and the variability in population. Regulations permit fishing in the Columbia River, Willapa Bay, and Grays Harbor. In 2010 an annual catch target of 1,500 metric tons (mt) was established. Acknowledged in the setting of restrictive quotas is the lack of assessment of the status of the Northern Anchovy stock. Collected as bycatch, surveys are minimal, catch logbooks not required (these give more specifics as to populations locations), and fish of the so-called “northern subpopulation” which includes the Washington coast, subject to minimal assessment.

Fishery

The Northern Anchovy ocean fishery is regulated by the Pacific Fishery Management Council (PFMC), one of eight regional councils established in response to the directive of the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSA). This act is the regulatory authority for marine fisheries in the United States. The PFMC is responsible for regulating fishing, both commercial and recreational, in the EEZ (Economic Exclusion Zone) which includes waters between 3 and 200 miles off the coast.

Following the enactment of the MSA, in 1978 the newly created PFMC produced the Northern Anchovy Fishery Management Plan, which at that time included anchovy only. Subject to approval by the National Marine Fisheries Service (NMFS) the plan was later modified to include eight species — Pacific Herring, Pacific Sardine, Pacific Mackerel, Northern Anchovy, Jack Mackerel, market squid, and krill. The plan was renamed the Coastal Pelagic Species Fishery Management Plan (CPS FMP) and was implemented in 1999. Changes in the years following the plan’s enactment have added 19 amendments. This is the definitive federal management tool for coastal pelagic species in the EEZ.

State jurisdiction extends from the shore to the three-mile boundary of the federally managed EEZ. Regulations for commercial fishing offshore within these state waters follow federal rules, with additional provisions set by the Washington Department of Fish and Wildlife (WDFW.)

As defined by the management plan, Northern Anchovy is a “monitored” stock as opposed to an “active” stock or a “prohibited” stock. This status implies less intensive harvest management, as

Engraulidae — Anchovy

opposed to an “active” stock which is considered to require more intense scrutiny. Monitored stock status implies tracking landing trends but does not require stock assessments on a regular basis. Other restrictions may apply, while another important parameter, the Harvest guideline (HG), defined by the plan, is not included.

What is most important to the regulating of Northern Anchovy off the Washington coast (the northern subpopulation) is the concept of Maximum Sustainable Yield (MSY). This parameter is defined as the maximum catch in numbers or mass that can be taken over an indefinite period of time that ensures sustainability of the stock at maximum growth rate. This concept has been part of fisheries management since the 1930s, although its use is not without controversy.

The determination of the use of the MSY parameter in estimating the northern subpopulation of Northern Anchovy is specified in Amendment 14 to the CMS FMP, approved in 2015; this amendment sets a catch limit of 0.3, meaning that 30 percent of the Maximum Sustainable Yield can be fished. Thus, permitted take of anchovy off the Washington coast ultimately depends on the estimation of the MSY. The amendment also implies that northern anchovy population is not necessarily regulated similarly to others, such as those of the central and southern California coastal waters.

Set at 130,000 mt, the MSY value for the northern subpopulation is derived as an average across surveys and research undertaken during the 1970s and in 2008. Multiplying the MSY by .3 defines an OFL (overfishing limit); thus the allowable catch is 39,000 mt. However, due to uncertainties in estimating Northern Anchovy biomass, the number is further reduced by 75 percent and so the annual catch limit is 9,750 mt.

What this conservative number implies is that the estimation of fish biomass is of utmost importance to the management of fish species. For many, the combination of fishery-dependent data, modeling, surveys, and independent estimates are among the factors that must be considered, and ultimately, are necessary for understanding the status of a particular fish species. Understanding a species’ lifecycle, applying models, studying predation and food availability, attempting to ascertain the impact of climate change — all these efforts and more contribute to successful management of species such as the Northern Anchovy.

Although catch limits in coastal waters are derived from both federal and state jurisdictions from the shore to 200 miles off the coast, within the Strait and throughout the Salish Sea, the federal plan does not apply, although its specifications are considered in state regulations. Instead, fishing is regulated by the state with rules (although they often are similar numbers) under the directive of the WDFW for defined Marine Areas east of the mouth of the Strait which is defined as a channel with a western boundary Bonilla-Tatoosh line.” The Strait extends east about 96 miles, is bounded on the south by the Olympic Peninsula, on the north by Vancouver Island, and on the east by the San Juan and Whidbey Islands. Within the Strait, three state Marine Areas — 4, 5, and 6 — are part of a total of 13 areas that comprise all state salt waters.

In 1998, the state adopted the Forage Fish Management Plan for “forage fish” in state waters; this plan was intended to take an ecosystem approach rather than a catch emphasis. As far as anchovies are concerned, the plan calls for interstate efforts and an annual review of stock status. The plan also lists priority species; however, this does not include the Northern Anchovy. The document acknowledges that anchovy, among other forage species, tend to fluctuate widely from year to year, and that “catchability” (the probability of catching a fish given the fishing effort) remains constant. *The implications of a set catchability for a forage fish such as anchovy is that a severe decline could occur long before it is perceived by fishery managers.*

Engraulidae — Anchovy

That said, in the Washington Forage Fish management plan, little is indicated concerning the status of Northern Anchovy.

Thus, it can be concluded that management of forage fish stocks, such as anchovy, requires direct measurement of stock size by surveying abundance during spawning or conducting acoustic surveys. Without such efforts predicting declines is impossible.

Commercial fishing of Northern Anchovy does not occur in the Salish Sea, but as with other forage fish they are taken by recreational anglers. Gear specifications, restrictions on vessel movement, and some other specific rules apply to this fishery, often depending on which marine area is being fished. The rules state that “two daily limits” may be taken fresh, others in frozen or processed form. The fishery is open year-round, except for a six-month closure for Pacific Herring in a small region. The daily limit in the western Strait is 25 pounds; however, this total must include other forage fish; in the western Strait this is usually sardines. There is no minimum size to the catch. In the central Strait, Anchovy is grouped with four other forage fish and the daily limit is 10 pounds.

Given the mixture of state and federal jurisdiction in coastal waters, and the state regulations within the Salish Sea, the offshore commercial fishing take seems quite separated from the recreational fishery in the Strait. The difference in anchovy population numbers alone and the small Salish Sea catch compared to the catch off the coast would seem to imply little connection, at least in regulatory terms, at all. Yet what transpires offshore is arguably always related to the waters of the Strait and the rest of the inland sea.

However, by comparison to Oregon and particularly California fisheries, the Washington state commercial fishery is quite small. Calculated to represent only about five percent of the take and one percent of the revenues, a large catch inside the Columbia River in 2016 was undoubtedly a direct result of the noted increase in anchovy numbers between 2016 and 2017. Since that time value of the catch and the tonnage has decreased along the entire coast.

Fluctuations in population are not fully understood, although surveys, such as those of zooplankton abundance, offer clues to forage fish dynamics. Response to climate change is probable, but related factors such as the effect of surface water temperature, including its influence on fish species other than anchovies, is also not understood. Data from fixed locations, such as lighthouses on the British Columbia coast, serve as “proxies” for the entire Salish Sea; these and other measurements sometimes have a long history while other data may be more recent. Fish surveys provide some insight into possible changes, locations, and abundance. New models, both qualitative and quantitative, hopefully contribute to understanding of constancy and change.

Unfortunately, sufficient funds and personnel are always in demand, contributing to uncertainties about knowledge of the present and prediction of the future. These ups-and-downs of human institutions clearly affect the ability to ascertain the status of any marine species, including the dynamics of forage fish distribution. And given the imperiled status of so many fish species, a population crash of a species as seemingly abundant as the Northern Anchovy can never be discounted.

Thus, the current conservative approach to Northern Anchovy regulation seems most advisable, both today and in the years to come. This institutional caution as well as involvement and contribution of knowledge by those who fish, and those who observe, seems the best approach for a small fish that may come and go at will, but whose future, as with its companions, is in human hands.

Engraulidae — Anchovy

Eating the Anchovies

Human use of anchovies for food dates back thousands of years. On the west coast of North America, anchovy bones in middens indicate that the little fish was caught and eaten by indigenous people. In Europe and Asia, anchovies constitute a dietary addition for many cultures, including the ancient Romans who made a sauce from them. This was called “garum,” a liquid typically produced by slaves who tossed fish guts and other pieces into amphorae (stone tanks or clay pots), fermented them for up to a year, producing a thick dark liquid; apparently thinner garum was the most expensive. It is said that garum played a role in Roman cuisine similar to ketchup so popular with Americans today.

The method for producing garum is followed in the 21st century by some companies and individuals, although the tanks and pots are more often (although not always) replaced by modern containers. “Garum” is now a rather broad term for a clear, savory fish sauce, but experts insist it should be prepared following traditional methods, including using the entire fish, fermented for several weeks.

Today, anchovies, whether aged for sauces, preserved in vinegar or olive oil, fried, or used as a paste, continue to be a very popular food choice in European cuisine. The species most commonly used is the European Anchovy (*Engraulis encrasicolus*), and Morocco is the largest marketer of canned anchovies in the world. The market is large; the fish are consumed by individuals, offered in a variety of preparations by restaurants, processed according to traditional recipes, and popular abroad as well as locally. Check the Internet: canned anchovies are readily available, most of them imported.

Thus, with a diversified use borne of history, anchovies are much more than a pizza topping. They are very popular — yet there are a few concerns for their consumption. In recent years, considerable research has investigated the safety of anchovy products, whether as fresh or processed fish. Not surprisingly, the results of these studies reveals a variability, most often dependent on preservation methods, but also on where they have been caught.

To begin with, it is not wise to eat anchovies raw. They are quite appealing uncooked, with a mild, not too salty taste. Unfortunately, the little fish is a host for a parasitic nematode worm, named *Anisakis*, of which there are probably several species, although only a few have been studied. This is a worm with a life cycle that includes residency in whales; in this host females release their eggs, which in time, as small larvae, exit the whale, move to inhabit an intermediate host, and then reside as adults in fish. Undesirable for any species to consume, the worm can be passed to the human gut in raw fish.

That said, many studies have provided guidance in the preparation of anchovies (and other hosts as well), testing which methods successfully eliminate any possible *Anisakis* presence. Freezing for a period of time will destroy the worm, but consumers are often dissatisfied with the negative effect on flavor and texture in frozen fish. Thus, there are procedures that may negate the requirement for freezing. And much can depend on the substance used for marinating canned and fresh anchovies.

Traditionally, marinating anchovies involved placing them in vinegar for up to a day. Unfortunately, this method has proven to be unsuccessful in killing *Anisakis*. Studies have shown that adding acetic acid in various concentrations will kill the worms in acceptable processing times, with only a day required at highest concentrations. Unfortunately, this adds to the cost of processing the fish.

Flavored olive oil has also been shown to be effective, particularly those infused with lemon juice or various additives.

Besides the most common canning method, anchovies can also be eaten fried, although preparation requires gutting and sometimes (depending on preference) deboning them. This method is

Engraulidae — Anchovy

certainly time consuming, but the fish, fried like a trout, are considered by many to be delicious, bones and all. And frying will most certainly kill any parasites.

As for the anchovy of the west coast of America — *Engraulis mordax* — the *Anisakis* worm is present, as it is in many fish species. However, canned anchovies consumed in American restaurants and by individuals alike are most often imported for consumption. Today the worldwide market is large, and the anchovy, particularly the native European Anchovy, widely available.

Continued study and regulatory processes share the goal of ensuring anchovy safety for consumption. History indicates that as long as managed carefully, with particular attention paid to sustainable numbers in the sea, and safety in the market, the anchovy will persist in its appeal to humans, served up in a variety of ways, both modern and historical. Advocates love them and, hopefully, the anchovy is here to stay.

For a non-anchovy consumer, the research into the widespread use of this tiny fish has been informative. In the eastern Pacific, in modern times the Northern Anchovy serves humanity primarily as bait for other species, but in Europe, its close relative is a chosen food item prepared in ways that vary from tasty sauces to marinated whole fish to an important ingredient in countless recipes.

*As for me, I suppose it is possible that an anchovy or two might find its way to my dinner plate. But I think the setting should involve a European restaurant, **located in Europe** — Italy will do. There I might ponder the history of anchovies while an experienced chef, eager to reacquaint me with this nutritious fish, prepares a meal.*