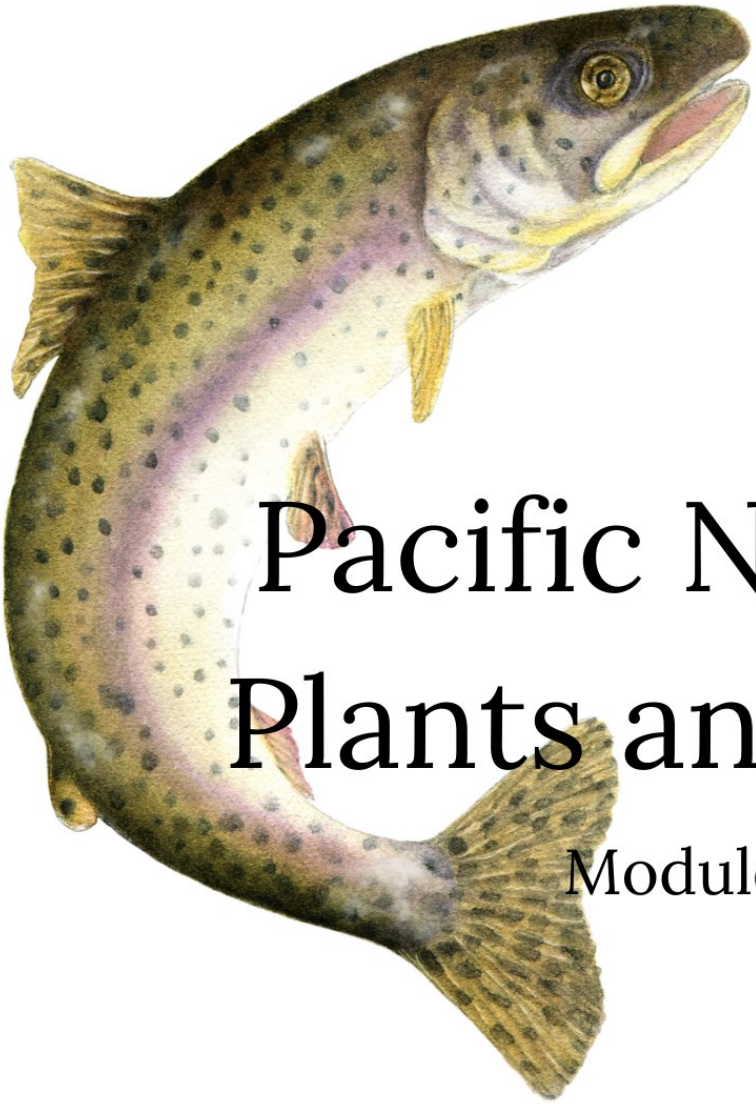


# Pacific Northwest Plants and Animals

## Module 5: FISHES

*Alfred W. Bowers Laboratory of Anthropology*
*Palouse Wildlife Rescue and Rehabilitation*

2022

# Chapter 5: Fishes

A good place to start is when to use "fish" or "fishes". According to the Museum of Paleontology at U.C. Berkeley, the difference is simple. If you are talking about one fish or 2 million, the answer is *"fish"* if they are all the same species. If you are talking about one or more species, the answer is *"fishes"*. But, like all things fishy – there is a catch to that. The word fish is also used as a general term that includes all animals that meet the basic requirements of being a fish. So, what is a fish?

Describing fish is a slippery subject. This is because there are over 30,000 different species around the world! Just imagine all those we haven't identified yet. To get a grip on the topic, let's head back to the Museum of Paleontology at U.C. Berkeley for a quick lesson on what they have in common:

**1.** All fish need a braincase:

The word braincase sounds pretty fancy, but it is just a different way of saying skull. As adults, humans have 22 bones in their skulls – but fish average about 130 in theirs! Whether it is a skull or braincase, the goal is to carefully protect the brain and most other sense organs (sight, smell, taste, and hearing).

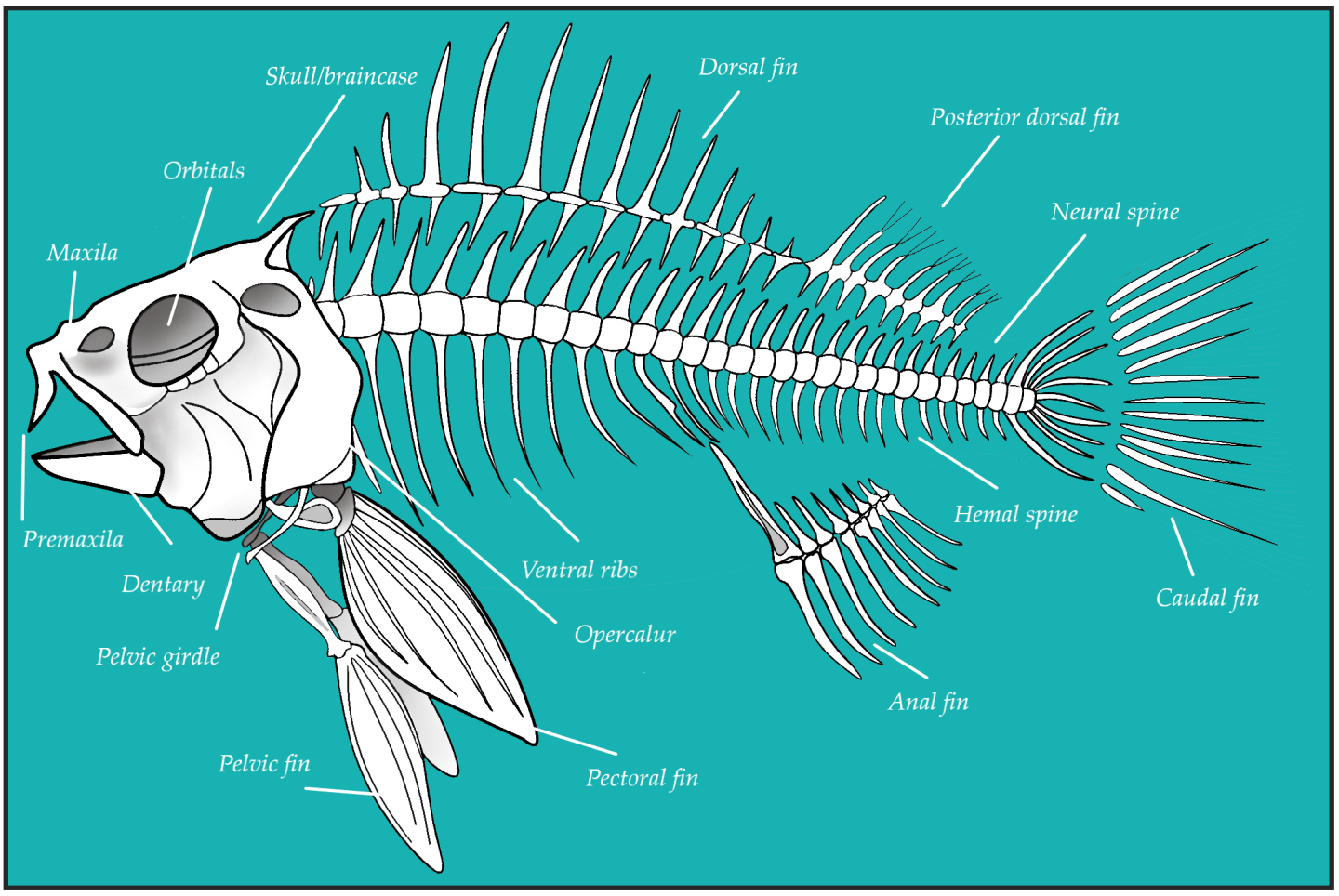



*Figure 1. Basic fish skeleton. Not all fish will have a posterior set of dorsal fins.*

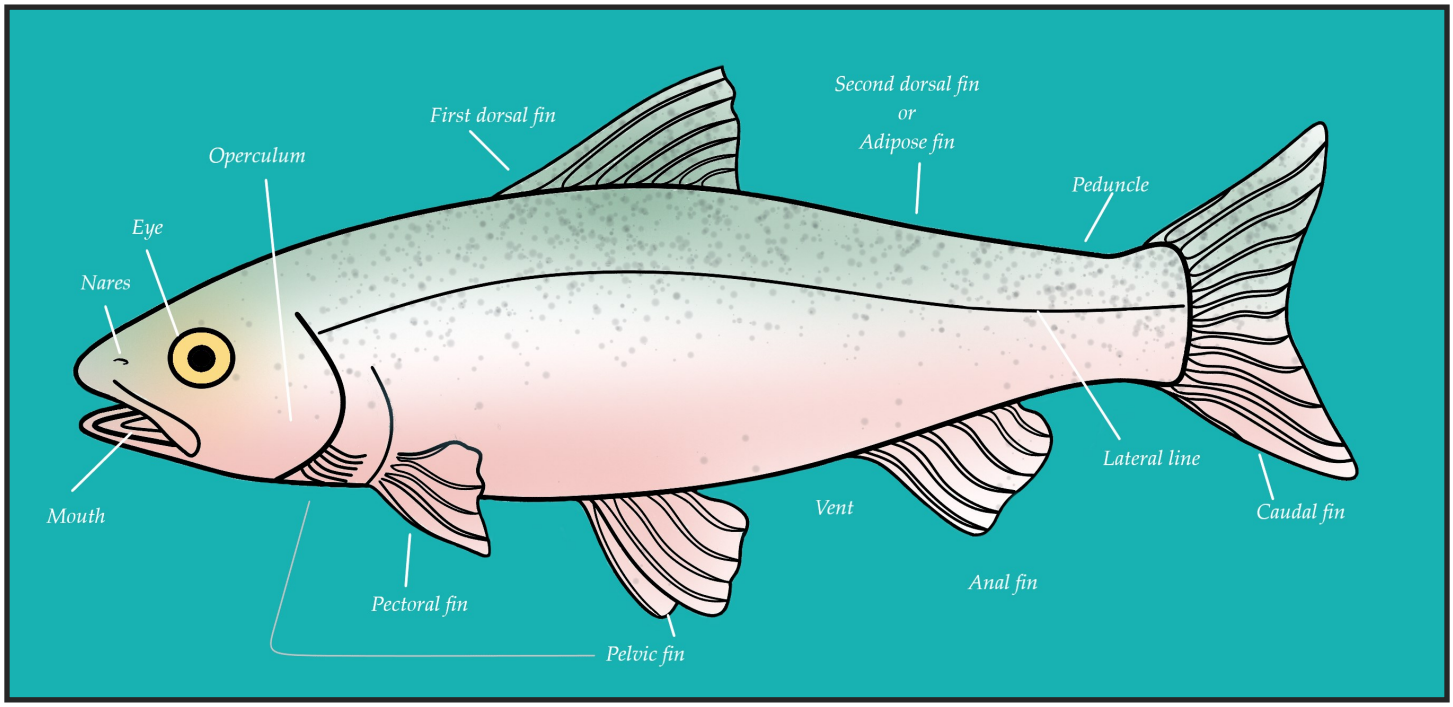



*Figure 2. Most fish will have this shape, or something similar to it. While fish anatomy may change dramatically from species to another, the basic body parts usually remain similar. A fish's pelvis is actually located just behind and a little under their gills. So their pelvic fins can be in different positions on their body. Some might have their pelvic fins up near their pectoral fins, while others might have theirs closer to the belly.*

**2.** <u>*Most*</u> fish are similar and have:

- scales to protect from predators or other harms. Some fish, like sharks, have special scales that help them move through the water faster.
- paired limbs. Just as you and other mammals have the same number of arms or legs on opposite sides of our bodies, most fish have the same number of fins on both sides of their bodies.
- a spinal cord protected by vertebrae – just like you!
- gills instead of lungs. Most fish need water to be able to breathe.
- a series of sensors in their skin called the *lateral line* to help navigate in water.
- a skeleton made up of cartilage or bone, or both. Some fish even have bony plates on the outside of their body. A fish's skeleton, whether it is on the inside or outside, can tell us a lot about its family history.
- no way to maintain their body temperature.

As we go through this module, we will meet a few fish who don't follow these rules. When we do, we will talk about what makes those fish different and why. Stay on the line and let's see what we can learn until then.

***Fish are ancient!***

Fish first appeared in fossil records over 520 million years ago during the Cambrian Period. It wasn't until the late Devonian period (419.2 – 358.9 million years ago) that fish evolved into something we could easily recognize today. In fact, the Devonian is also known as the "Age of Fishes" because so many species showed up in the fossil record from this era. This makes sense—up to 85% of the globe was covered by the ocean back then.

Although there were other fishes before the Devonian, this era saw the rise of a whole new class. Known as Chondrichthyes (kon-drik-th-eez) or the cartilaginous (car-till-aj-a-nuss) fishes, these species would eventually become the sharks, rays, and chimaeras, we know now. While most people are familiar with the idea of sharks, few of us know about rays or chimaeras. These last two members of Chondrichthyes specialize in chomping on molluscs or other hard foods. Chimaeras mostly live in the deep ocean. If you would like to learn more about chimaeras, do an internet search for ratfish or rabbit fish (*Chimaera monstrosa*). Enjoy!

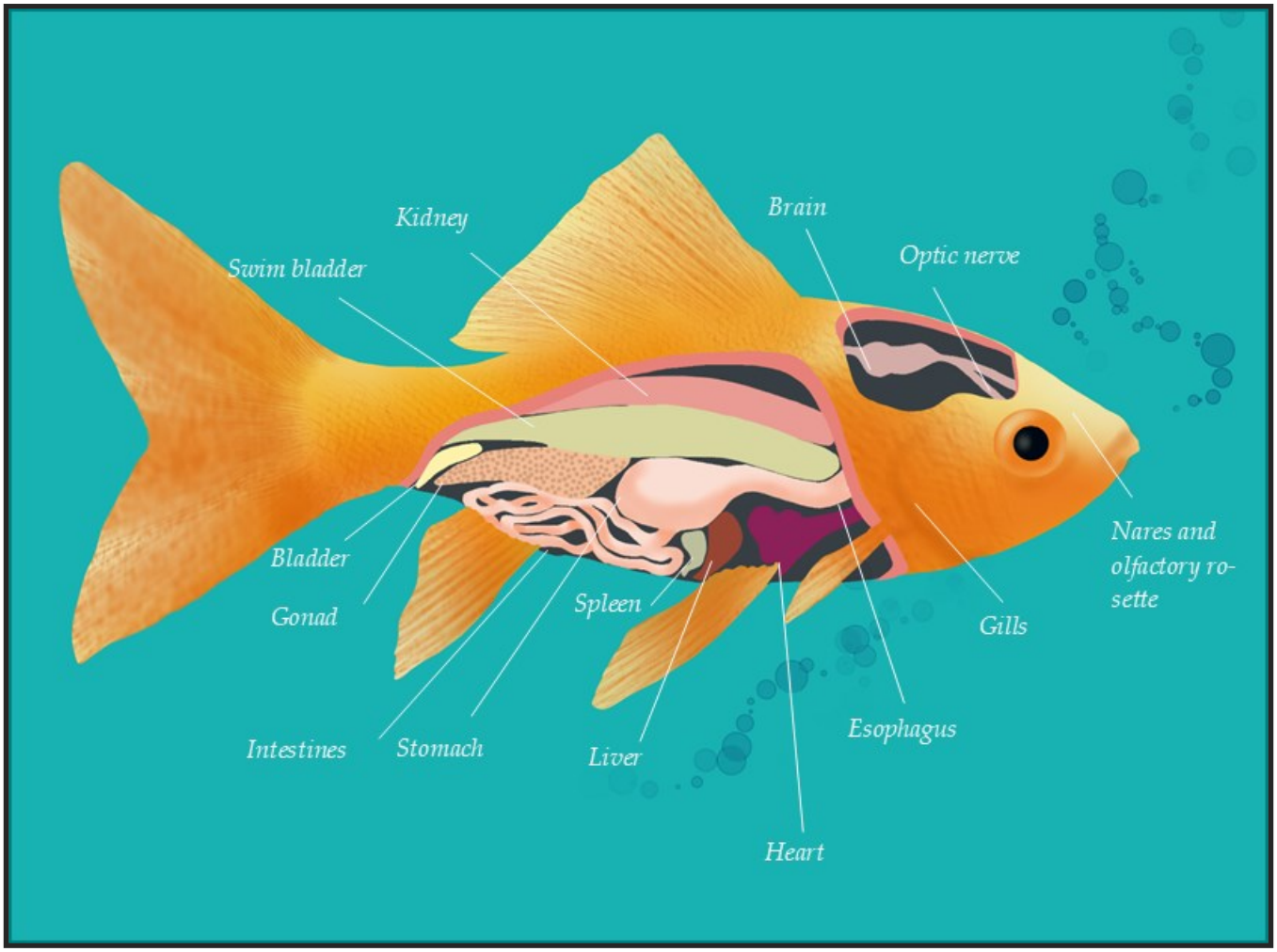



*Figure 4. Fish internal organs will also vary from one species to another, but follow this general plan.*

The next big leap toward modern fish happened at about the same time Chondrichthyes appeared. But this development was a lot bigger and has had longer lasting impacts on the planet. This was the arrival of the superclass Osteichthyes (aww-stee-ick-theez). Even now, our aquatic world is mostly populated by the species that make up Osteichthyes. These animals are known as the bony fishes.

To make this superclass more manageable, it is divided into two main clades (clay-dz) or sub-classes. The first is the Actinopterygians (ack-tin-opt-er-eh-gee-uns) or ray finned fish, and the Sarcopterygians (sar-cop-ter-eh-gee-uns) or fish with bony, lobe shaped fins. Since the Actinopterygians have over 30,000 species of their own and there aren't lobe finned fish in the Pacific Northwest, let's keep our attention focused on the rayfinned fish that swim our waters.

### *Fishes of the Pacific Northwest*

There are at least 24 endangered or at-risk fish discussed in this module, but this number doesn't include all of the fish in trouble in the Pacific Northwest. It is a number that can only go *UP* if we don't change our behaviors! The Pacific Northwest is home to fish that live in ponds, streams, rivers, lakes, and the ocean. By now, we all know about Salmon and other species that need to live in both rivers and the ocean. But, there are others out there that might just surprise you! Despite all the different places these fish call home, they will likely have a similar body shape. Why? Because fish have to solve the problems of water – and that is no simple task.

If you think about how humans struggle to breathe, hear, or see in the water, it gives you an idea of just how complex fish bodies need to be. Although fish and humans have the same senses, we have vastly different ways of collecting information from the worlds around us – because our environments are different. Even among fish, habitats vary widely, so the bodies and abilities of fish must be different too.

***Lured by the bait of learning more about lobe finned fish?***
***Follow these links for two quick lessons!***

*https://www.youtube.com/watch?v=ZDeFBc1rEfI*

*https://www.youtube.com/watch?v=Nyu9RuJNdCo*

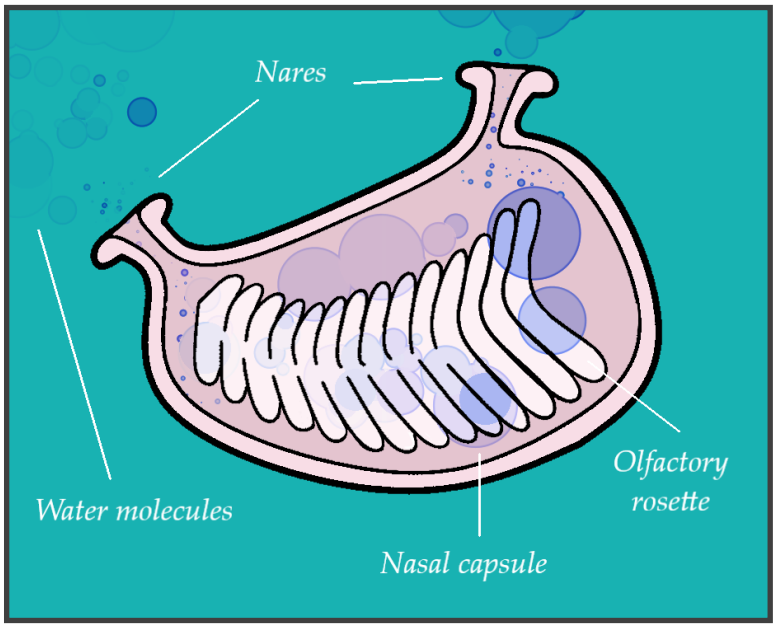
In Pacific Northwest waters, most fish are taller and wider in the front and smaller at the back so they can glide easily through the water with the least amount of wasted energy – or drag. By having paired fins on each side of their body they can easily move in predictable and energy-efficient ways. But there is a lot more to being a fish than being able to move through the water quickly.

***Breathing Underwater***

Let's start with the most important task most of us need to do - breathe. Fish breathe by osmosis (oz-mow-sis). It is a big name for a simple process. It means that molecules in a crowded space want to move to an area that isn't as crowded. Think of it this way - if there are 100 students in a small room trying to play ball, but next door there is a gym with only 10 kids playing ball, where would you want to play? Most people would move to the gym. That is how osmosis works!

Fish need to keep water moving over their gills to help exchange oxygen and carbon dioxide. Inside fish gills, there are networks of tiny blood vessels. As water drifts over the gills, carbon dioxide moves to the water from the gills, where there is less carbon dioxide. At the same time, oxygen is moving into the blood carried by small blood vessels. Why? You guessed it! The oxygen has more room to move around in the blood.

Fish can also exchange oxygen and carbon dioxide through their skin, but most of their breathing is done through their gills. This is how your lungs work too – only without the water!




**Do fish smell?**

Fish can smell water. Well, technically, they smell molecules *in* the water. Above most fish's mouths are nares – which work kind of like your nostrils. Inside each nare, there are sensory pouches that help identify the chemicals in the water. This information goes directly to fish's forebrain where it tells the fish about the world around it.

*Figure 5. It is hard to get a close up look of a nare. All we see are a pair of small dots, but there is much more beneath the surface!*

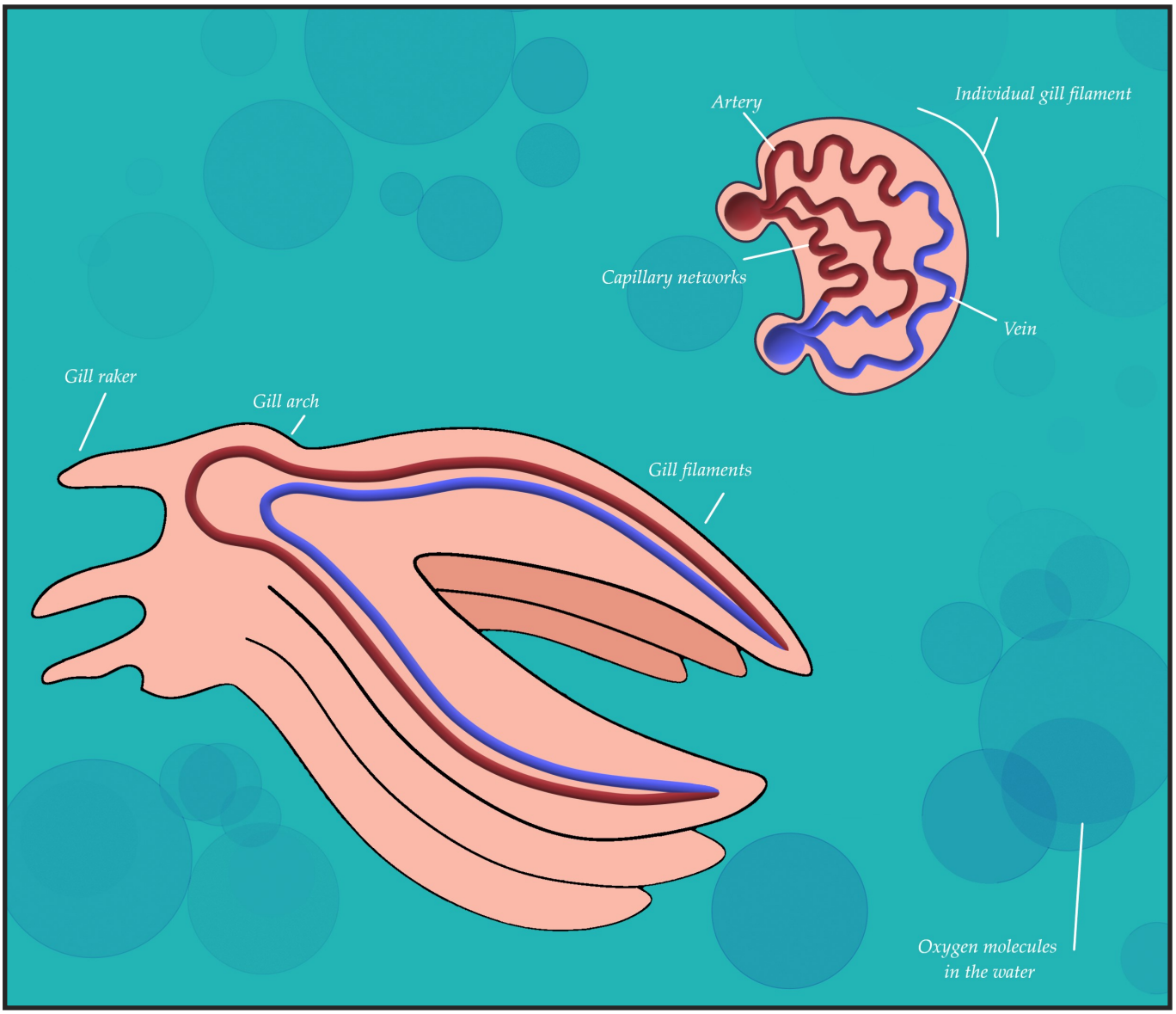



*Figure 6. Most people are used to seeing the bright red part of a gill, or the filaments. Individual filaments are stacked in columns and bathed in water where the oxygen transfers from a high to low concentration.*

The smells can reveal food, danger, or even the way home. Some fish even have sensory patches around their mouths or near their nares that let them "smell" with their skin.

**Wide-angle view!**

You might have a fisheye setting on the camera on your phone. It might give you funny photos, but what does fisheye really mean? Light moves differently through water than it does through air. In the air, light moves FAST. But, when it hits the water, it *slows* down because there are more molecules for it to go through. Water is more dense. Not only does light slow down, it bends a little too. Think of it like waving your arm in the air and then waving it through a sink of water. In the air there is no resistance, so your hand moves easily. If you put your hand underwater and try the same movement, it takes a lot more effort.

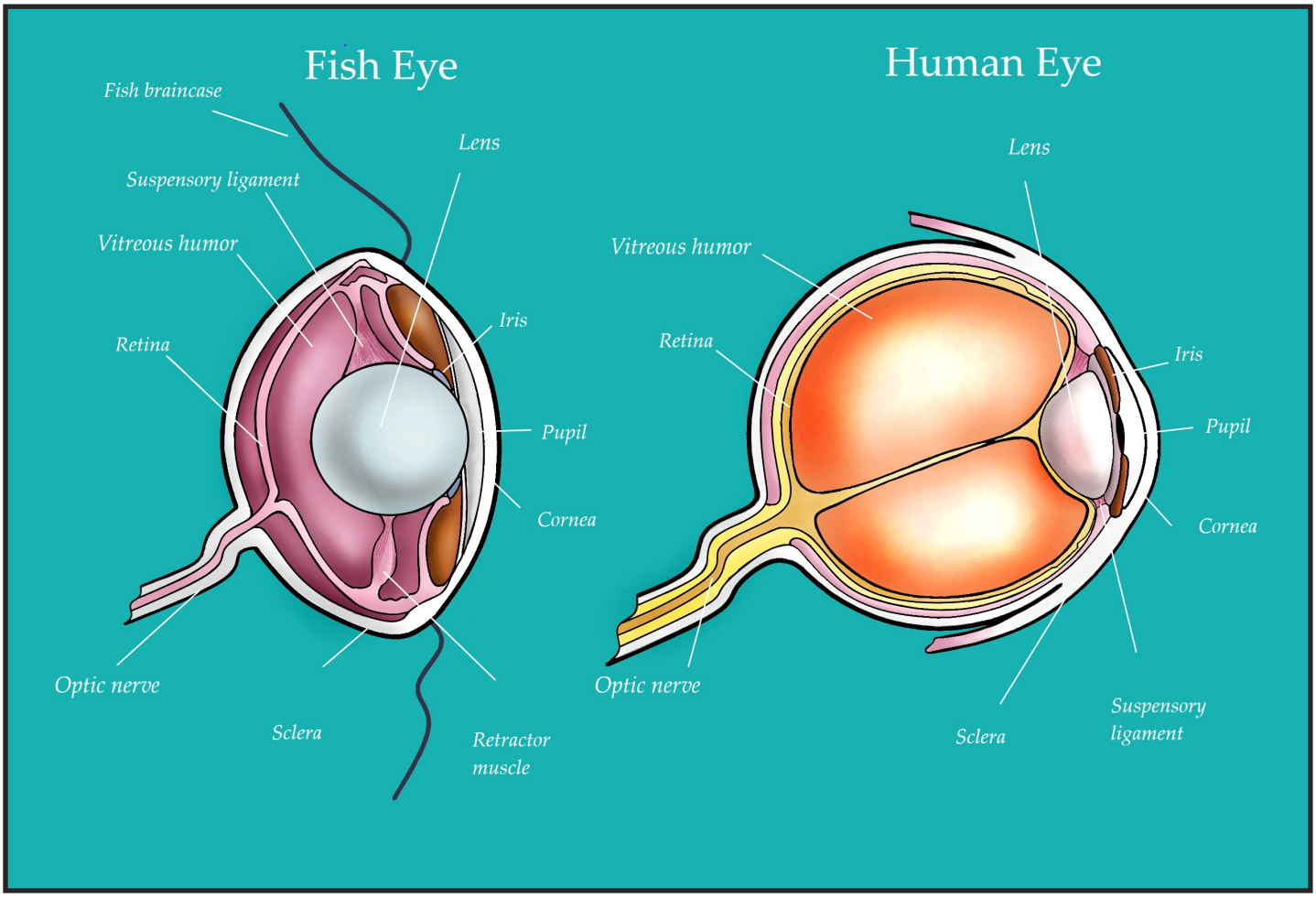



*Figure 7. Comparison of fish eye to human eye. Note the differences in the shape of the eye and lens.*

If you look at your hand while underwater, you might notice that it doesn't look right either. Your hand or arm will look like it bends at a funny angle where it meets the water. That is the light is going slower and bending. This is called refraction.

Even though fish and human eyes have nearly identical parts, the shape can't be the same because fish have to deal with refraction. We often refer to our eyes as eye*balls* because they are actually ball shaped. Fish eyes are shaped like a deflated ball. The front of their eyes, or cornea, is flattened compared to ours and the back of their eyes, or retina, are domed. The curved retina means they have a wide angled view, or fish eyed lens, view of the world.

Inside the eye, there are other minor differences too. Fish *lenses* are round like a ball, while ours look like the deflated ball. The position of the lens between fish and human is different too. Without thought, our eyes adjust to how much light is around us by changing the shape of the lens in our eyes.

Fish can't adjust the shape of their lens because of the refraction problem. So instead, they move their lens in or out to change how much light comes through the pupil. Most fish can see in full color!

**Did you hear that?**

We've already learned it is nearly impossible to sneak up on a fish because they can see really well up close and even far away – depending on how the lens inside their eye moves. But, what if it was really dark and there wasn't much light at all. Could we sneak up on them then? Not easily!

That is because fish hear with their whole bodies – not just their ears! Like light, sound moves through water differently because of the density of the molecules. Only, in this case sound moves over FOUR times *faster* in water than it does in the air. Why? Because sound travels from one molecule to another – so the closer the molecules are, the easier and faster it can move. Think of it like trying to walk across a big area scattered with just a few Lego blocks. In this experiment, you are a soundwave and need to be able to touch two or more Legos to get the sound to move. If the Legos are too far apart, the sound can't travel to the next block. If the Legos are a lot closer, you can touch several blocks at one time. If the Legos are all touching each other and you touch one, the sound will move from you through all of the blocks. Be careful with this experiment though. You don't want to step on a Lego. That is a sure-fire way to make a LOT OF NOISE!

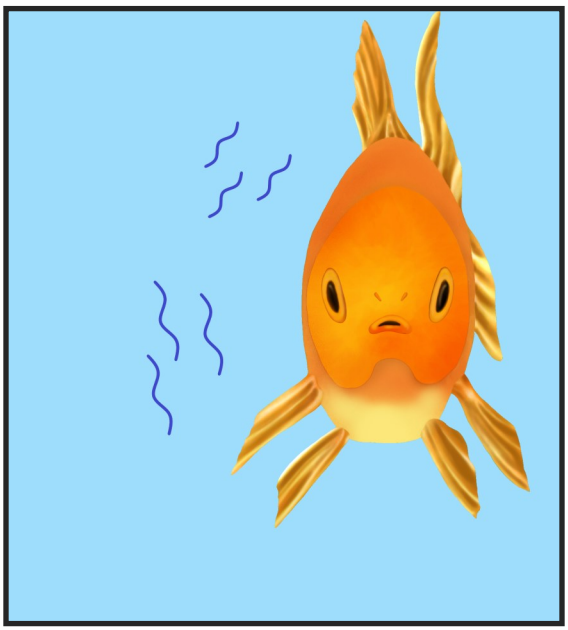


*Figure 8. A fishes lateral line is so sensitive to vibrations, they can even feel their OWN movements in the water!*

***DID YOU KNOW?***

*In 96% of all fish, the lens actually goes through the pupil!*

The density of water can be a bit problematic. It can make things a lot louder, and it can be harder to tell exactly where a sound is coming from. Humans are pretty hopeless when it comes to hearing in water. That is because our ears are built to handle air, not water.

We capture soundwaves from the air and they cause our eardrum to vibrate. As our eardrums shake, three little bones (malles, incus, stapes) connected to the eardrum help control the volume. The last of the three bones, or stapes (stay-pees), touches against another small organ called the cochlea (co-clee-uh). Inside the cochlea are clusters of tiny hairs called cilia that move when tapped by the stapes. As the cilia sway back and forth inside the fluid filled cochlea, electrical signals travel to the brain, where they are understood as sound.

Fish ears work in a similar way, but instead of three tiny bones, they have three pairs of *stones* called otoliths (oh-toe-li-ths) in their ears. Otolith literally means ear (oto) stone (lith).

Their ear stones are even more tightly packed with molecules than water, so they move at a different speed than the rest of the fish's body or surrounding water. The subtle movements of the otoliths are enough information for a fishes brain to understand sound.

To help the otoliths, some fish also get information from their swim bladder. Located above most of the vital organs, the swim bladder is full of gas and helps fish stay upright and float in the water. It can also help sound travel through a fish's body. Since the swim bladder is usually close to a fish's otoliths, it can actually boost noises and make them easier for fish to hear.

If otoliths and a swim bladder weren't enough to help fish hear underwater, there is also the lateral line. Made up of a series of sensors called neuromasts (new-ro-masts), the lateral line runs down the side of a fish's body.

***WANT TO LEARN MORE ABOUT OTOLITHS?***

*Every year, fish otoliths add another ring—just like trees!*

*Watch this video to learn more!*

https://www.youtube.com/watch?v=YEw9UQDsT1I

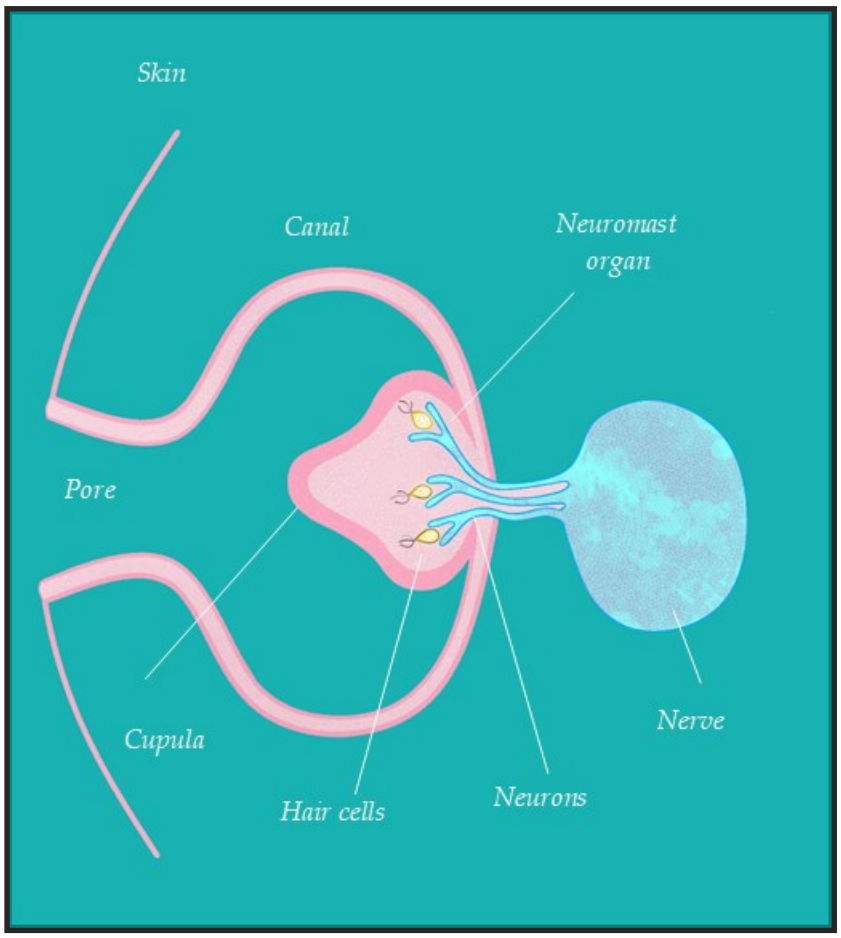



*Figure 9. The lateral line and neuromast organ work like a series of dominoes with one event starting the next. Stimuli moves through the pore opening, moves the gel –like fluid in the cupula, which moves the hair, and that sends the signal to the nerves.*

Neuromasts are inside pores that are just under the skin or in the bones of some fish heads. When sound waves moving through the water touch a fish, fine hairs like those we have in our ears will wiggle a little. That wiggle sends a signal to nerves that travel to the brain. But, the lateral line feeds more information to the brain than just sound. It also helps provide fish with a sense of touch. So, in a way fish can feel sound, or hear motion.

To understand how neuromasts work, try this experiment. Hold a blade of grass or another small thin leaf between your thumb and forefinger. Blow gently on the leaf. Notice that the top of the blade of grass moves a lot with even the slightest breeze. Imagine that those vibrations are traveling down the grass and into the circle made by your thumb and forefinger. That is how individual neuromasts work within the *lateral line* system.

**Love the skin you are in!**

Fish have layered skin – just like we do! Our skins have an outer layer called the epidermis (ep-eh-der-miss) and an inner layer called the dermis. Both layers are packed with the essential things we need to protect our insides from the outside. We need a way to make new skin and shed old skin. We need a barrier that keeps all the water we need on the inside, and all the water we don't on the outside.

In land vertebrates, or those of us with spinal columns, we have hair, feathers, fur, or even scales. But fish need a little something extra to protect them from predators and send messages to others. To do that, they wear scales like armor. Some fish even have special structures in their outer skin that produce light or pigments. Photophores (fo-to-fours)

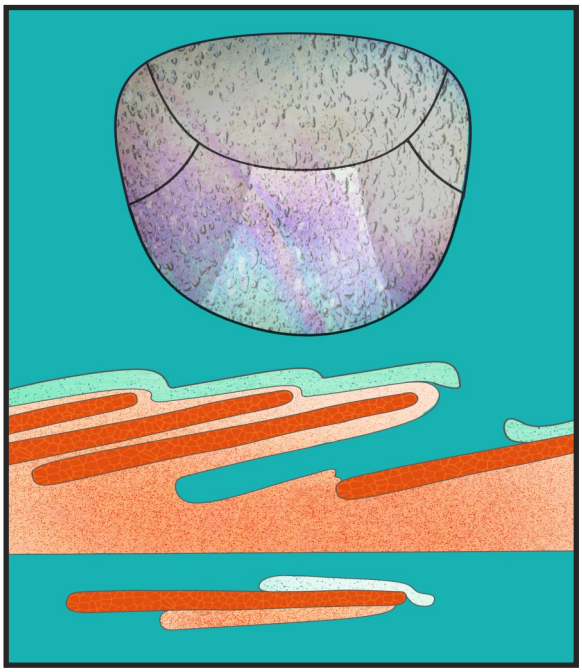


*Figure 10. Fish scales overlap so only a small portion is visible. They are made of the same material as bone and grow below the surface of the skin. Each scale, shown here in dark orange, begins developing in the epidermis, grows through the dermis, and makes it's way to the surface. There, a thin coat of skin covers it. Mucous, shown in light green, covers the whole fish and protects their fragile skin.*

make light called bioluminescence (bye-oh-loom-en-es-ents).

Anyone who has ever touched a fish knows they are slippery, and some are downright slimy! What makes them so hard to hold onto is a thin layer of mucous. This coating is like a protective blanket covering their fragile outer skin. Their epidermis is dangerously thin, only 6-8 cells deep, so any help they can get is necessary!

If the mucous coating is damaged, infections, parasites, or other harms can get to their skins and cause real trouble. This is why it is so important that we never touch fish. Our hands are rough enough to scrape away the mucous and damage their scales or skin.

Like us, a good deal of what goes on in a fish's skin is just under the surface in a layer called the dermis. This layer is where scales actually form and grow. In many species of fish, their scales with stay with them for a lifetime. Like the way trees create a new ring with each season, most fish species add new rings to their scales for each year they have lived.

Because scales are mostly there to protect a fish from an attack, they overlap like armor. Only a small portion of each scale is visible. Most of the scale is still in the dermis or covered by the scales surrounding it. Scales have a base layer that is made of the same material as bone, so they are quite strong.

***WANT TO KNOW MORE?***

*To learn more about bioluminescent fish,*
*check out this video from the Monterey Bay Aquarium*
https://www.youtube.com/watch?v=aPUF40j47-o. s

## *No Bones About it - Fishes and Archaeology*

For decades, archaeologists argued that fish bones were hard to find because they did not preserve well in soil. On the surface, this argument makes a certain amount of sense. Many fish have light and delicate bones. It is also well recognized that fragile organic materials don't preserve well in most soil types. So, recovering only a few fish bones from excavations seemed logical.

Recently, some archaeologists have taken up a different opinion. They think the size of screens used to sift dirt wasn't small enough to catch the fine bones and changing how they do things will recover more bones. There is some truth to this argument also.

Some archaeological sites like Bernard Creek Rockshelter have thousands of fish bones while other sites where fishing undoubtedly took place only have a small number. Is the clue in the name – rockshelter? Organic materials sealed tightly away in the soils of a rockshelter would remain at a more stable moisture level. This means bacteria probably wouldn't eat away at the bones. So, they preserve well naturally. Or, are the fish found there because the people who lived there focused on fishing?

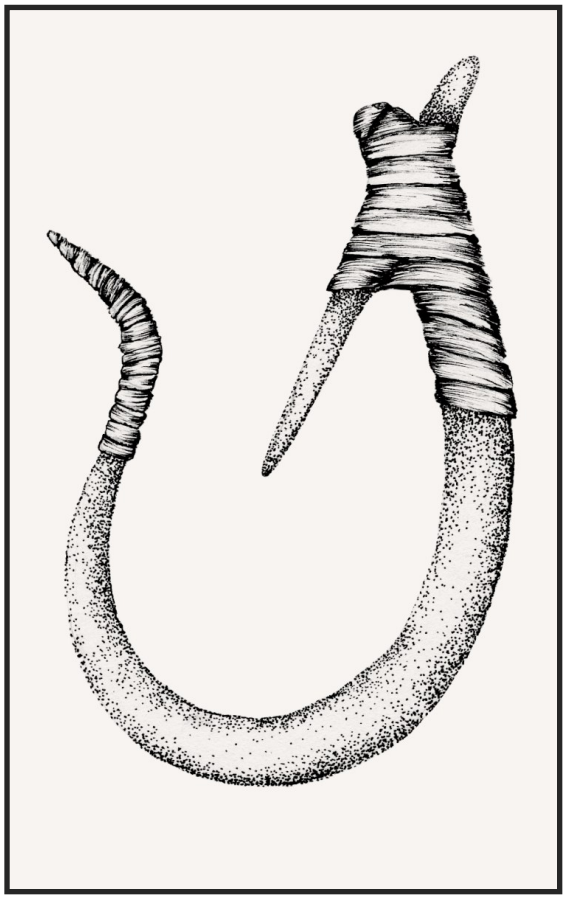


*Figure 11. The **čibu·d** (sounds like chi-bood) is a traditional fish hook used along the northwest coast to catch halibut. The Makah used to make these hooks out of wood, but now they use metal. Here is a video of how they are made:*

*https://www.youtube.com/watch?v=bLjbzgyqseU*

The type of fish caught matters too. Some bones, like those at Bernard Creek, are from large salmon. They are also big enough to be caught in just about every screen. Small fish like daces, or even trout, have smaller bones that would slip through most screens.

### *DID YOU KNOW?*

*The Makah Tribe are studying how their traditional hooks impact fishing? While the **čibu·d** doesn't catch as many fish as modern hooks, the fish they do catch are halibut. That means these hooks are better at reducing harm to other fish and saving at-risk fish.*

https://nwtreatytribes.org/makah-tribe-expands-traditional-halibut-hook-study/

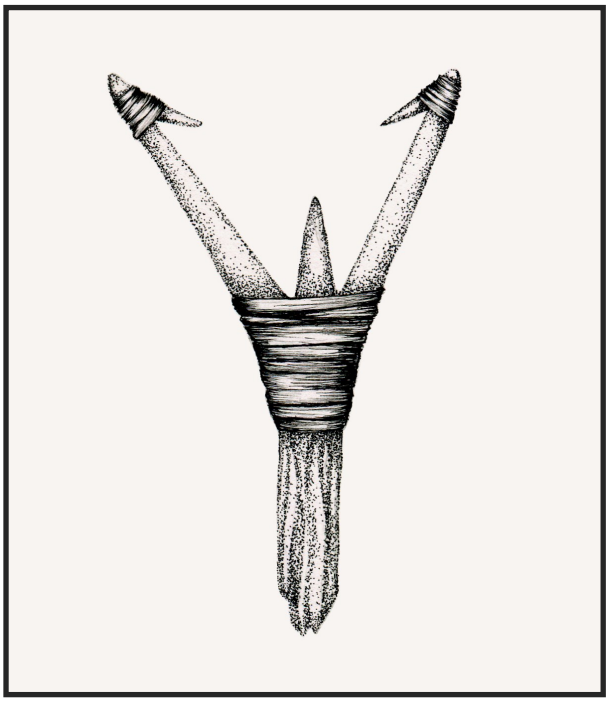


*Figure 12. Barbed spears like this one were used all across the northwest. Typically made of wood, bone, and twine, they are rarely found intact.*

But, screen size or preservation don't seem to give an answer for where most of the fish remains went. There are some other factors that can explain how some of the bones disappeared. Some could have been boiled away in stews, or given to dogs for food, and others eaten by scavengers. In some cultures, the remains are given back to the water to give the next generation of fish a good start.

Until the argument about where the majority of fish bones go is resolved, archaeologists will be working with samples taken using older methods and studying the fish bones they do have. So without a full sample of bones how do archaeologists know which fish are important culturally?

As always, our first step should be to LISTEN. Native American oral traditions are quite accurate. While it is not a good idea to imagine Native or Indigenous peoples as having some kind of magical connection to nature, over time they did learn the patterns and behaviors of the plants and animals that shared their world. Their knowledge of an ecosystem is more reliable than early explorers, settlers, or in some cases even modern researchers.

So, if a culture has an oral tradition about a certain behavior, chances are it is more truthful than written accounts taken by outsiders. Does that mean we should ignore those outside accounts? No, but it does mean we should not rely on them as being more precise than an oral tradition.

***DID YOU KNOW?***

*Before Lamprey stocks were depleted in Idaho, the Nez Perce relied heavily on these fish. In fact, salmon and lamprey were so important, there are specific words in the Nez Language that describe their behaviors. The word Hesu'al means when the salmon start to arrive. Héesu is often translated as eels, but lamprey have long been thought of as eels. To describe the time of year when the lamprey move upstream, the Nez Perce say Ha-soo-ahl.*

*For more information on the Nez Perce language and history, check out this website!*
https://nezperce.org/about/language/

### *Finding Fish*

Despite being somewhat rare, fish bones *are* found in archaeological sites. While there may not be many, they usually provide some insight on what people ate. In the Pacific Northwest, there is a lot of emphasis placed on salmon – and rightly so. It is also important to remember that there are plenty of other fish that people relied on. Species like the longfin smelt or any number of sucker fish were once a reliable food sources between salmon runs or when there weren't many fish returning to spawn.

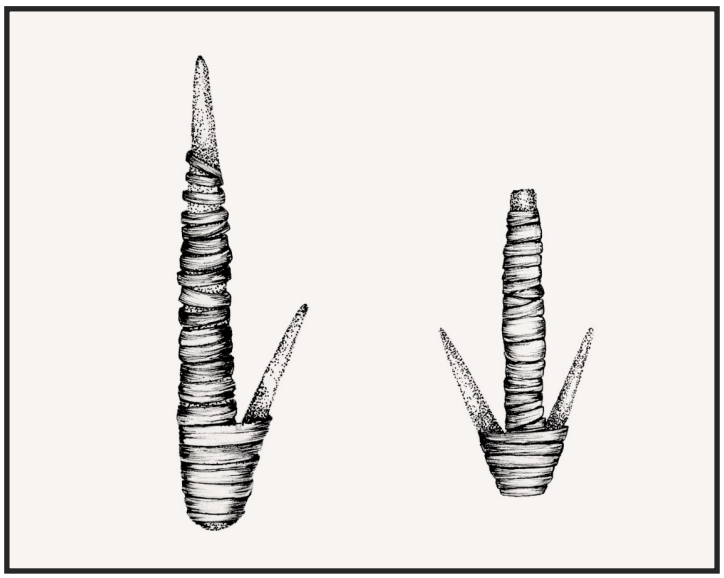


*Figure 13. These hooks are from the Makah village named Ozette, at Neah Bay, Washington, and share a common style with other hooks across the northwest.*

As an example, about 100 fish bones were found at six different archaeological sites in north-central Idaho. Five of the sites were at Pittsburgh Landing in Hell's Canyon. The sixth site is at Kooskia National Fish Hatchery in Kooskia (coos-key), Idaho.

The two locations are separated by about 60 miles and even with modern roads it can take nearly 2 hours to travel between them. At each location we find that the Nez Perce were consistently catching and processing trout, suckers, and minnows – not just salmon.

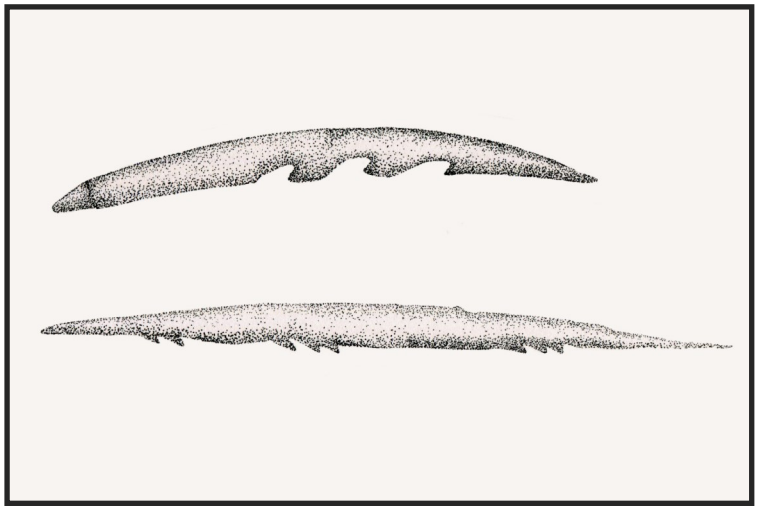


*Figure 14. Bone hooks like these were often mounted on spears with lengths of twine attached to be used as fishing line.*

Native Americans have been fishing in the Northwest and along the Pacific coast for more than 10,000 years, and probably much longer. The exact tools used for fishing are often harder to find than the fish themselves. Organic materials like bone, wood, and twine, don't preserve well in most soils and can degrade when removed.

Each culture has solved the problem of how to catch fish in different ways, but it shouldn't be a surprise that those solutions have a lot in common. Big schools of fish like salmon can be caught with nets, spears, or on hooks. Traps and weirs helped direct fish into holding pens. These technologies were used by cultures across the Northwest for thousands of years. In many places, there are still signs of these structures.

## Fishes with Anadromous Populations

### Salmonids, Lampreys, Sturgeons, and Smelts

In this section, we will discuss fish that have an ocean-going population. Some or all members of the species will be born in fresh waters, move to the ocean, and then return to their home waters to spawn. In some cases, there are land-locked members of the species who never make it to the ocean.

These fish are anadromous (ahh-nad-dro-muss), and they include the most iconic and least known fish in the region. From massive salmon and sturgeon to the tiny stickleback, these fish make epic journeys in their lives.

### Salmon and Steelhead

There are five main species of salmon in the Pacific Northwest: Coho, King, Chum, Chinook, and Sockeye. The rainbow trout or steelhead is a close relative, and the ocean-going populations behave as salmon do. Since they are discussed often in this region, we won't spend a lot of time on them here. Instead, we will focus on some of the lesser-known species.

Before we do move on, there are some things we should discuss about the salmonids – or members of the salmon family. Most ocean-going salmonids are considered at least threatened if not endangered. Some, like the chum are basically considered extinct in most of their home range.

The causes for salmon decline are nearly identical across species and can be solved with a little of that human ingenuity early settlers might have used about 10,000 years ago. While overfishing is the first cause of salmon depletion, it is undeniable that dams, pollution, logging, water diversion, habitat loss, and agriculture, have all played their own parts.

As we will see going forward, many of these causes are why other fish species are facing threat or extinction. If we can all take a little more care, learn about habitats and restoration, and take an active role in cleaning up our waterways, we can all do our part to help *all* the species that rely on water in the region.

***WANT TO KNOW MORE ABOUT WEIRS?***

*In recent years the Cowichan Mustimuhw have worked with other Native tribes and non-native agencies to use traditional fishing methods and it is having a surprisingly good effect on local habitat populations.*

*Check out this website for more information and a glimpse at a reconstructed weir in action!*

https://blogs.uoregon.edu/northwestcoast/2017/02/14/herring-look-back-moving-forwards/

**Lamprey**

In this section we will talk about those that make a run for the sea. We will check back later for those lamprey species that live in freshwater for their whole lives.

Like salmon, there are several species of lamprey in the Pacific Northwest. Some are ocean-goers, and some are resident populations. In fact, there are three kinds of Lamprey. First, there are those that spawn in fresh water, attach to other fish and feeds as a parasite. They will make their way to the sea, return to their home waters to spawn, and die. The second live in fresh water and eat insects and plants so there is no need for parasitic behavior. They will also die after spawning. Lastly, there is the group that lives in freshwater and will survive as a parasite on other fish.

Of the 38 known species of lamprey, only 18 are parasites. While it is tempting to get a bit grossed out by their feeding habits, it is important to know that they only linger on their host long enough to get what nutrition they need.

Lampreys serve critical roles in the environment and cultures of the region. They are known to clean up rivers and streams when they are in their larval form called ammocoetes (am-mow-oh-seats). As they mature, they provide food for numerous other species and serve as a "buffer" for salmonids – meaning they get eaten so that salmon and their relatives don't! As adults, they will either travel to the sea or remain in their home territory. It is thought that they will die after spawning a single time. Here again, their bodies will serve to nourish the waterways.

Culturally they are almost as important as, if not equal to, salmon to many Native American tribes in the region. Being available nearly year-round and being far richer in calories and fat than salmon—makes the lamprey a highly valued food source. Tribes also recognized the medicinal value of these fish long before European settlers did. When European settlers came to the area, it wasn't long before they began unsustainable mass harvests of the eel-like fish. Specifically, the Pacific Lamprey was scooped up for use in animal feed and anticoagulants (an-eye-co-ag-ewe-lents), or drugs to stop blood loss.

Lamprey species in the Pacific Northwest are difficult to tell apart unless you have been trained. In most cases, you need to be able to recognize the color patterns and size differences between variants of the same species. Common identification charts rely on the number and placement of teeth in young fish and adults. That said, it is doubtful many of us will be grabbing lampreys and counting their teeth anytime soon. In general, their slender bodies blend well with the color of river bottoms and range from tans to darker greys across their backs with lighter bellies.

Their ancient lineage means that they don't share a lot in common with other younger fish. They don't have bones, scales, swim bladders, or fins on both sides of their bodies. Instead, they have two long dorsal fins and one well defined fin on their tail. Lampreys don't have gills that work like most of the fish we have talked about either. So, how do they breathe? If you look slightly behind and under their eyes, there are 7 pores that lead to gills.

Where other fish have two nostrils on the front of their faces, lamprey have one and it is on top of their heads. Behind this nostril is a third eye that only works to detect light. Their mouths are different from other fish because they do not have jaws. Instead, they have flat mouths that face downward. As young, they do not have teeth and as adults they do not feed. Lamprey will live most of their lives as juveniles, or ammocoetes.

Lampreys are often referred to as eels because of their long tube-like bodies – but they aren't eels at all. In fact, they are jawless fish and are some of the oldest species on the planet. Their ancestors date back to about 360 million years ago. They are older than trees and even dinosaurs! So far, they have survived four of the world's mass extinction events – can we help them survive this one?

***DID YOU KNOW?***

*That modern day Asotin, Washington, got it's name from the Nez Perce word Hesutiin? To someone who doesn't speak Nez Perce, the Hesutiin sounds like Has-o-tino or Ahs-oh-tin. Near Asotin, there used to be a village where the Nez Perce lived for thousands of years and harvested lamprey. Early settlers called the lamprey eels. In English, Hesutiin is translated as "eel-creek". To learn more about this and another famous Nez Perce village, check out:*

https://www.nps.gov/nepe/learn/historyculture/lenore-and-hasotino-history.htm

**Pacific Lamprey**
*Lampreta tridentata*

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Petromyzontida*
**Order:** *Petromyzontiformes*
**Family:** *Petromyzontidae*
**Genus:** *Entosphenus*

**Length:** 33 inches (84 cm)

After hatching from their eggs, the larval Pacific Lamprey will find their way to gentle waters. Here they will burrow into soft sands with their heads poking out so they can easily feed on algae and other small organisms. They will live this way for several years before reaching their juvenile state. At that age, they come out of the gravels and head for the open ocean. On their journey, their diet shifts and they begin the life of a parasite. This means they use their mouths to cling to the sides of fish. Sometimes, they will even snack on a mammal – like a whale. They use their sharp teeth and tongues to wear through the skin of the host species to drink a small amount of blood. As adults in the ocean, they will continue to cling to various fish and mammals until they return to their home to spawn.

Although there are plenty of animals out there with bite marks on their bodies, so far there isn't any evidence to suggest Lampreys are actually killing off their host species.

**Why are they disappearing?**

After European settlement and into the mid-20$^{th}$ century, this fish was overharvested. Perhaps they might have bounced back if not for land use changes, poor water quality, artificial barriers, degraded habitat, climate change, and getting eaten by other animals – or the SINISTER SIX (Figure 15)!

For those of you who are reading this in north-central Idaho, your chances of seeing Pacific Lamprey are incredibly small. While they used to be common in our main rivers (Snake, Salmon, and Clearwater), they have found it difficult to get around the dams. Another reason they are disappearing is the lack of food. The Pacific Lamprey prefers to eat salmon. With salmon disappearing, so is this lamprey's food source.


*Figure 15. Who are the Sinister Six? From left to right: agriculture, predation by other species, habitat loss/deforestation or degradation, pollution, climate change, and obstructed waterways.*

*When it comes to threats to the survival of a species, there are usually a number of factors at work. It is rare to see a single cause for a species to be in trouble. Around the globe, the **SINISTER SIX** are usually the culprits. All six of these bad actors don't have to work against a species to cause trouble, but they often work together.*

**Western River Lamprey**
*Lampreta ayresii*

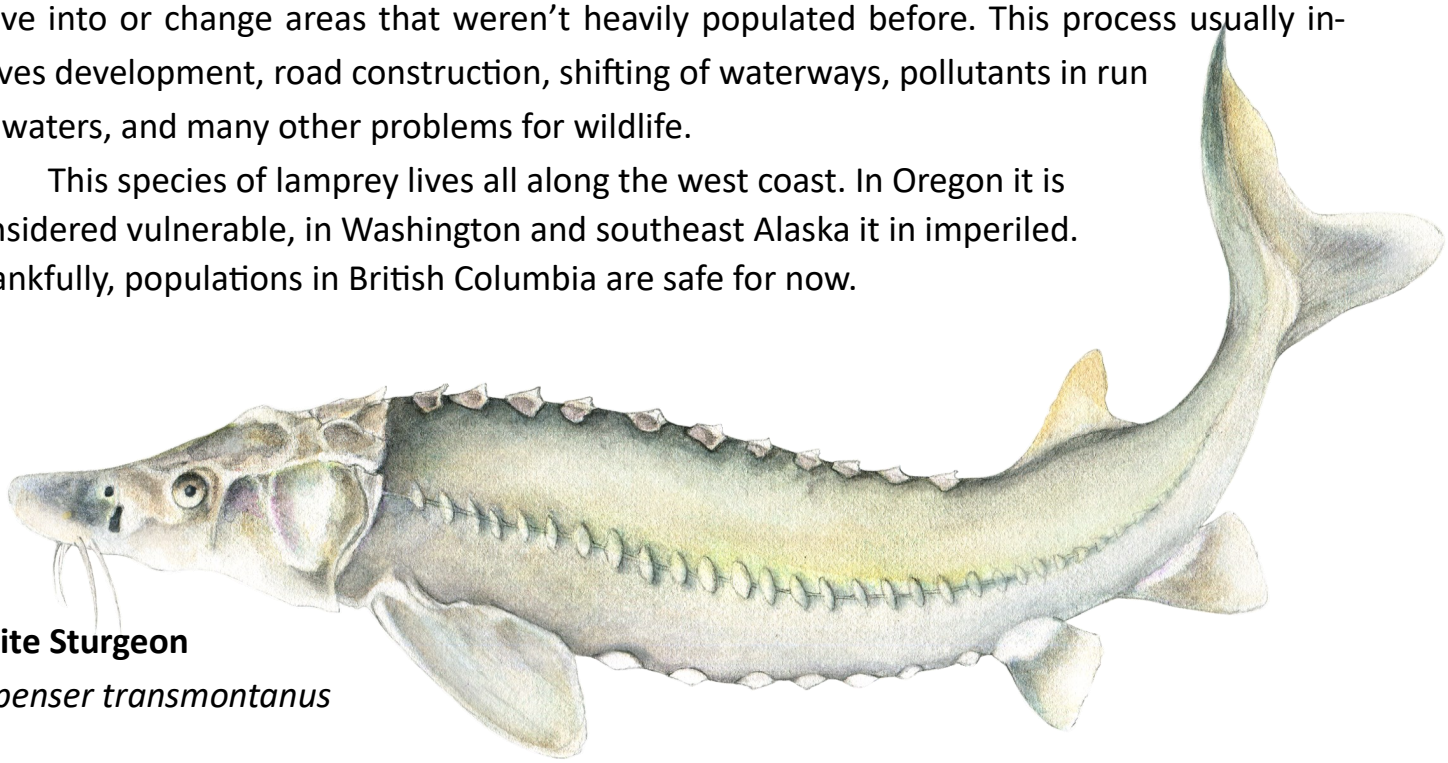
**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Petromyzontida*
**Order:** *Petromyzontiformes*
**Family:** *Petromyzontidae*
**Genus:** *Lampetra*

**Length:** approx. 12 inches (31 cm)

**Why are they disappearing?**

The Sinister Six + urbanization! Urbanization (err-bun-is-ay-shun) is when people move into or change areas that weren't heavily populated before. This process usually involves development, road construction, shifting of waterways, pollutants in run off waters, and many other problems for wildlife.

This species of lamprey lives all along the west coast. In Oregon it is considered vulnerable, in Washington and southeast Alaska it in imperiled. Thankfully, populations in British Columbia are safe for now.



**White Sturgeon**
*Acipenser transmontanus*

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Actinopterygii*
**Order:** *Acipenseriformes*
**Family:** *Acipenseridae*
**Genus:** *Acipenser*

**Length:** approx. 11 – 19 feet (3.4 -6 meters)
**Weight:** approx. 1400 lbs (630 kg)
**Appearance:** It might sound kind of strange, but White Sturgeon are beautiful. Despite their mouths facing the ground, small eyes, and total lack of scales, some are really cool looking. Logically, there is no way a fish that lives at the bottom of deep waters should be an eye catching white. How would it not be seen by others? Well, evidently those things don't matter when you are huge! Even those that aren't bright white are fairly pale. Ranging from a soft, almost pearl white to blue grey or even a tawny-beige, these prehistoric fish are also studded with rows of scutes. That is right. Scutes. Like we see on reptiles and turtles. They have five rows of scutes. One along their back and another on the mid-line of each side of their body. The last two rows run from their head alongside each side of their body to the fins near their stomach. These fish are definitely worth researching!

**Green Sturgeon**

*Acipenser medirostris*

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Actinopterygii*
**Order:** *Acipenseriformes*
**Family:** *Acipenseridae*
**Genus:** *Acipenser*

**Length:** 7 feet (2.1 meters)

**Weight:** approx. 350 lbs

**Appearance:**

Labeled as a "megafauna fish" that has a 200-million-year lineage, the Green Sturgeon looks as ancient as you might imagine. Like the White Sturgeon, it has no scales and feeds on the ocean or riverbed floor. As the name says, this species is green – not white. Their backs are dark olive green. There are also green stripes on the sides and one on the belly between the pectoral fins. Where the White Sturgeon has a bit of a snub nose, the Green has a pointed one. Their scutes are different too. Be careful if you ever get to handle a Green, their scutes are sharp and could cut you!

**Why are they disappearing?**

Traditionally, Green Sturgeon live along the entire west coast. Over time, their range has dwindled to isolated pockets. This makes them particularly vulnerable to disease, climate change, or disaster. If water levels drop, heat up, or suffer pollutants, this species could disappear in entire waterways.

Sometimes the Green Sturgeon will get trapped in nets or on lines as by-catch. That means they were caught on accident.

Logging and other activities have added sediment to the water making it difficult for young to survive.

Sturgeon are slow. They move, age, and reproduce, slowly. It can take decades for a sturgeon to reach maturity and when they do, they don't spawn every year.

***WANT TO KNOW MORE?***

*Check out what the Confederated Tribes of the Umatilla Indian Reservation are doing to help lamprey!*
https://www.youtube.com/watch?v=_tTaWJdOPzk

**Longfin Smelt**
*Spirinchus thaleichthys*

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Actinopterygii*
**Order:** *Osmeriformes*
**Family:** *Osmeridae*
**Genus:** *Spirinchus*

**Length:** approx. 5 inches (4 cm)
**Appearance:**

These little fish shine like small mirrors in the water when they are adults. As young fish fresh out of the egg, or fry, they are translucent with dark spots running down their sides. As adults they are mostly white and silver. During the spawning season, adult males will change colors. While staying mostly silver, their backs will turn an olive green, and they may have stripes along the rays of their fins.

Longfin smelt have been found in any number of habitats. Even though they are mostly freshwater fish, some have been found miles out to sea. Others live close to shore, and some are even in land-locked in lakes. In general, they live near the bottom of the lakes or rivers. As the young develop, they rise up to the surface where the current will push them downstream. There they will join the adults and feed on small fish and insects. When they are fully grown adults, they will travel upstream to spawn and begin the cycle again. Spawning depends on where the populations live. In British Columbia and nearby areas, that is usually around October-November.

**Why are they disappearing?**

Longfin Smelt live all along the Pacific Coast and are doing well in some of their home range. However, in British Columbia, Washington, and California, this fish is facing a scary future. Depending on where you live, this species is listed as vulnerable or of special concern. They are included here because this species is serving as a warning to all of us. We are watching a species fade from existence while there is still plenty we can do to help.

It is well known that the species is in a steady decline, but the threats harming the Longfin Smelt haven't been identified yet. What we do know from the places where the smelt is considered extinct, or heading that way, is that water quality matters. Run off from farming is introducing pesticides.

The smelt are also struggling against low water flows. They are getting hit hard when water is diverted from rivers and streams to feed human needs like agriculture. What this means for populations to the north is a bit confusing - humans in the region use water differently. But, we do know they are disappearing and we have already learned that our actions, for better or worse, can make a difference.

**Eulachon smelt**
***Thaleichthys pacificus***

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Actinopterygii*
**Order:** *Osmeriformes*
**Family:** *Osmeridae*
**Genus:** *Thaleichthys*

**Length:** 8 inches (20 centimeters)
**Appearance:**

The Eulachon (you-lah-con) have an unusual name made up from many different cultures and languages. Coming mostly from Native American languages, Eulachon also includes French and English influences. According to the National Marine Fisheries Service, the name includes:

*Many variants of eulachon, including hoolakan, hooligan, hoolikan, olachan, ollachan, oolachan, oolichan, oulachan, oulachon, ulchen, ulichan, uthlecan; also yshuch, swavie, chucka, juk'wan or za'xwen meaning 'jittery fish' in Haisla language, saak in Tlingit (p. 31).*

Eulachon is an unusual name for a slightly unusual fish. They are slender but have a stretched appearance. Overall, they vaguely resemble the Longfin Smelt. If you get a chance to measure their pectoral fins, you will notice they are quite long – reaching almost to their pelvic fins! Unlike the Longfin Smelt, the Eulachon has a complete lateral line.

Perhaps the easiest time to identify a Eulachon is during spawning season. Both males and females will develop bumps, or tubercules (too-bur-cue-uls), over most of their bodies. The males will have more developed tubercules.

When the Eulachon aren't spawning, they are a more colorful version of the Longfin Smelt with darker pigmentation on their backs. Ranging from dark brown to blue on their backs down to a silver or white tummy, these small fish are sure to catch your eye.

The life cycle of the Eulachon is difficult to figure out. Unlike most fish, their scales and otoliths aren't good ways to determine age. Some studies suggest that depending on where the fish was collected, the otolith can read as being 1-3 years older than the scales.

Even with a difficult time aging a fish, researchers know that some Eulachon will begin spawning at age 2 while others will hold out until 5. Most fish will spawn at age 3 and then die. Some fish will spawn more than once but it is uncommon.

**Why are they disappearing?**

The biggest threat to the Eulachon is overfishing. While they may not be in the intended target, they do often get caught in nets as by-catch. Being in the wrong place at the wrong time is only part of what is causing these fish trouble. Climate change, predation, poor water quality, and water being diverted for other purposes are some of the other causes.

***DID YOU KNOW?***

*Goldfish can drive special cars? To see how they were trained, check out this video!*

https://www.smithsonianmag.com/smart-news/watch-this-fish-out-of-water-drive-a-mini-vehicle-on-land-180979328/

## Non-Anadromous Salmonids

### *Trout*

**Bull Trout**
*Salvenlinus confluentus*

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Actinopterygii*
**Order:** *Salmoniformes*
**Family:** *Salmonidae*
**Genus:** *Salvelinus*

**Length:** approx. 35 inches (90 centimeters)

**Appearance:**

Bull Trout vary in shade from a rich olive-green to a lighter drab olive-grey. They have pale yellow spots along their backs. On their sides, the color shifts to peach or even red. To tell them apart from other fish, the National Resources Conservation Service suggests viewers take a close look at the spots. Bull Trout have *light* spots on a *dark* background – but other fish with a similar appearance will have *dark* spots on a *light* background.

Bull Trout share a lot with other trout species in its territories. Sometimes they look so much like a Dolly Varden fish that it can be difficult to tell them apart. Not only do they share their appearance with other fish, they also spawn at the same time as the Brook Trout and hybridization can occur. This is a problem because it means that the Bull Trout is being bred out of existence. Perhaps it would not be such a bad situation if the hybrids were healthy and could fill the same ecological roles, but that isn't the case. The hybrids tend to have health problems and generally are unable to reproduce.

There are two types of Bull Trout that often live together in the rivers. The local (or resident) population, and the fish who migrate. The resident fish will spawn, hatch, and live in the same river or tributary their entire life. Migratory fish will spawn, hatch, live in a tributary anywhere from 1 to 4 years and then move to the coast, a lake, or a river. Their average lifespan is somewhere around 10 years, but some can go on to live for twice that long.

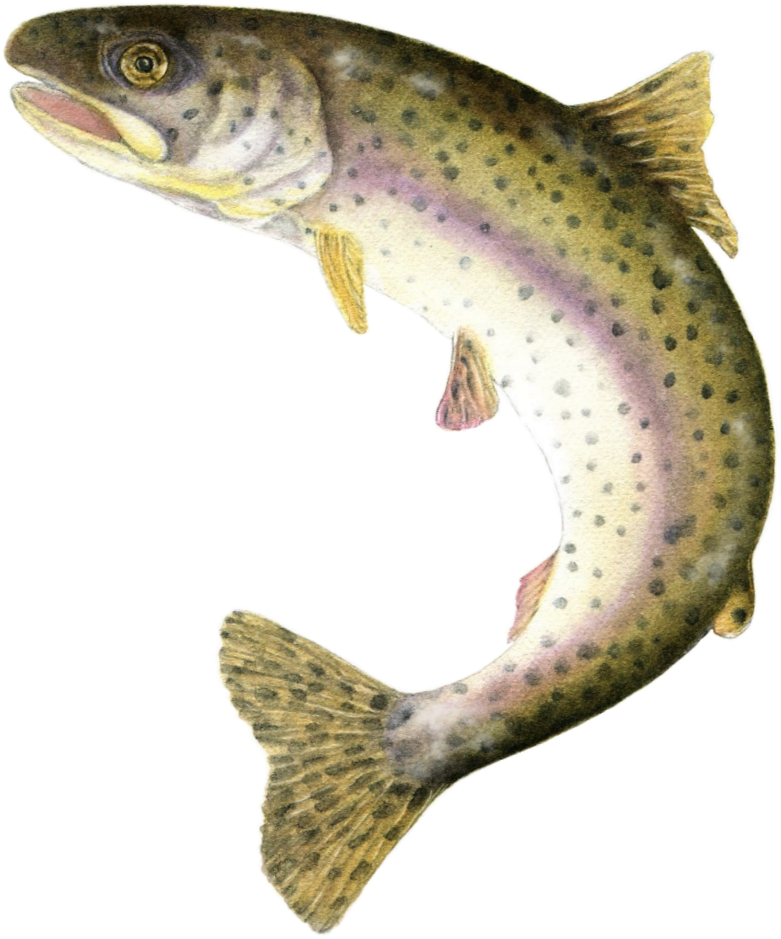
Resident and young migratory fish will eat other fish, insects, and plankton. As adults, the migratory fish tend to be larger. As a result, they will need slightly different food. Depending on where they live, they will forage on different species of other small fish.

**Why are they disappearing?**

These striking fish call the length of the Pacific Coast home. Depending on where you are on the coast, they are already considered extinct, critically imperiled, or vulnerable. One of the reasons they are disappearing is the introduction of Brook and Rainbow Trout into waterways. They also run into conflict for space and food with hatchery stocked Steelhead. As if that isn't enough, Lake Trout often eat young Bull Trout and limit population growth.

While the Bull Trout is traditionally found all along the coast, their habitat requirements are quite finicky. There aren't as many places for them to live as we might think. For starters, they need cool water – nothing over 54 degrees Fahrenheit will do. Although in rare cases some individual fish have been found in warmer rivers.

They also need a good deal more, like clean free flowing rivers that meander through deep pools with overhangs and other great places to hide or hunt. They do like some logs and other organic debris for hunting and hiding. Lastly, they need the places where they spawn to connect to the places where they can hide in deep water over the winter, eat, and grow. Often, that location is a deep pool downstream of where they were hatched.



**Coastal Cutthroat Trout**

*Oncorhynchus clarkii clarkii spp*

**Kingdom:** *Animalia*

**Phylum:** *Craniata*

**Class:** *Actinopterygii*

**Order:** *Salmoniformes*

**Family:** *Salmonidae*

**Genus:** *Oncorhynchus*

**Length:** 15 inches, but 7-9 is an acceptable average (38 centimeters)

**Appearance:**

The Coastal Cutthroat lives in a variety of environments and like the Bull Trout, different members of the species may migrate to a number of locations. Overall, Coastal Cutthroats are various shades of green, but their backs are dark enough that they have earned the nickname "blue-back trout". As expected, the dark color fades out along their sides, and they have silvery undersides. Coastal Cutthroat are hard to tell apart from a typical Rainbow Trout – especially when they are young. Most Coastals have red slashes under their jaw and spots over their whole body – even below the lateral line.

Unlike the Bull Trout which has fish that stay local or venture to nearby lakes or tributaries, the Coastals will spread into the ocean, move between the river and sea, or move up rivers. So, this species technically has anadromous, sea-run, and resident populations. The ocean-going, or anadromous, fish will go about 100 miles offshore and live for a few months before returning to spawn. Sea-run fish move easily between the sea and fresh water. These fish do not make long journeys upriver like salmon and their relatives. The farthest they will travel inland is roughly 100 miles.

While all Coastal Cutthroats appear similar, the sea-run fish do have a different body shape. Sea-run fish have a slightly longer nose, more tubelike body shape, and lighter coloration.

Coastals have a trout-typical diet. The young feed on insects, small shelled animals like shrimp and snails and when possible smaller fish. As adults, their diet changes little.

**Why are they disappearing?**

There are a variety of reasons the Coastal Cutthroat is vanishing. They are losing habitat to human development. Other activities like logging introduce silt and other matter into the water. For those fish that must migrate to or from the sea, dams can prove a deadly obstacle. They also face overfishing. In some cases, native stock is being replaced by hatchery grown fish.

We are also losing this species because of what we *don't* know. Since this fish is so hard to tell apart from the Rainbow Trout or Steelhead, it is hard to say how many are actually out there.

***WANT TO KNOW MORE ABOUT FOREST HABITATS?***

Check this site out!

https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5038987.html

## Non-Anadromous or Resident Species

**Western Brook Lamprey**
*Lampetra richardsoni*

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Petromyzontida*
**Order:** *Petromyzontiformes*
**Family:** *Petromyzontidae*
**Genus:** *Lampetra*

**Length:** approx. 6 inches (15 cms)

The Western Brook Lamprey lives along most of the west coast. For this species, there is some good news. It is secure in most of its home range. However, in Washington state and the northern part of British Columbia they are vulnerable or even imperiled.

This lamprey has anadromous parasitic, freshwater parasitic, and freshwater non-parasitic populations. The freshwater non-parasitic kind eats insects and plants. They need cool streams that are clear and clean. Juveniles choose to live in deep pools or stream eddies because settling silt from the river brings food. Adult lampreys need clean gravel riffles.

The Sinister Six are hard at work on this species. They are particularly sensitive to habitat changes like pollution and changes to their streams and waterflows.

**Vancouver Lamprey**
*Entosphenus macrostomus*

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Petromyzontida*
**Order:** *Petromyzontiformes*
**Family:** *Ptromyzontidae*
**Genus:** *Entosphenus*

**Length:** 7- 10 inches (18-27 cm)

Like many other of the native lampreys that live along the west coast, these imperiled fish have a small home range. In fact, they only occupy three small lakes in the south of Vancouver Island. Estimates given by local experts suggest there might only be 1,000-2,000 of these fish left. The Vancouver Lamprey is a parasitic fish.

As land locked lampreys, you'd think their life cycles would be different from the oceangoing fish. Remarkably, their lives are quite similar. These fish will likely live to about age 7-8. They start as the undeveloped larvae who burrow into gravels and remain there. Like the other lampreys noted here, they don't have real eyes yet and their mouths aren't fully formed. They will stay in this stage for 5-6 years, then they will mature into juveniles.

As juveniles, their eyes fully develop and their teeth change. As larvae their teeth are great for snatching passing meals from the water. As juveniles, their teeth need to be able to chew through scales and tough flesh so they can feed on other fish or even mammals. It is surprising to think that those vicious looking teeth are really only there for the lamprey to get access to a fish's blood!

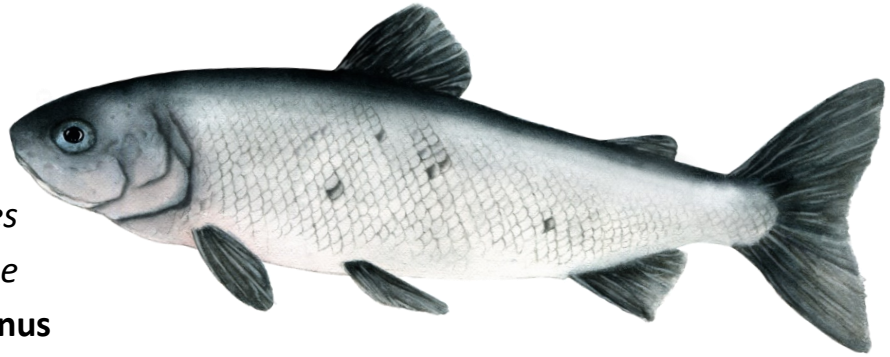
In their final stage, they are adults who no longer eat. They will spawn near the lakeshore and possibly some river tributaries before dying.

**Why are they disappearing?**

For this fish, the Sinister Six are definitely a problem but they are taking some serious hits from nearby housing developments and getting netted as by-catch too.

**Broad Whitefish**
*Coregonus nasus*

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Actinopterygii*
**Order:** *Salmoniformes*
**Family:** ***S****almonidae*
**Genus: Coregonus**



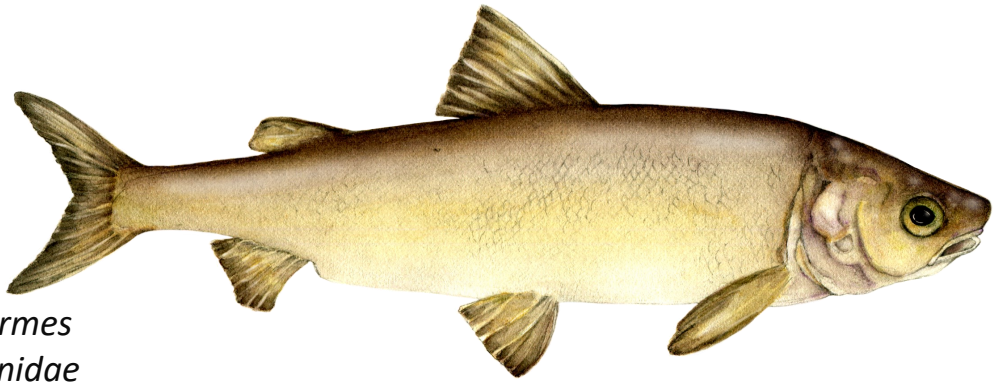
**Length:** approx. 18 inches (46 cm)

The Broad Whitefish isn't actually white. It displays the usual pattern of dark on top with silvery white sides and belly. They may have a slightly yellow look to their bellies. Otherwise, this whitefish is grey. It might not be the nicest thing to say, but these fish look like they have been squashed a bit. Imagine taking a fish like a trout and pressing on its nose and tail until is just a little shorter. This kind of compressed appearance gives them a blunt head and a tall body.

Broad Whitefish call Alaska, British Columbia, and portions of the sub-arctic, home. Outside of B.C. this species is doing well and is stable. These fish have resident and anadromous populations in some areas, but most prefer rivers. Their annual spawning migration begins in July-August and ends in November. The fish look for fast moving, clear, clean streams that have sandy bottoms. To get that, some will even lay their eggs under layers of ice! Unlike most of the other species we have studied here, these fish don't die after spawning. Instead, they move downstream to deep pools of water to spend the winter where it is safe.

These fish live in many types of river systems. They feed from the bottom of the rivers and eat insect larvae, small crustaceans, mollusks, and snails.

**Arctic Cisco**
***Coregonus autumnalis***



**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Actinopterygii*
**Order:** *Salmoniformes*
**Family:** *Salmonidae*
**Genus:** *Coregonus*

**Length:** 20 inches (approx. 51 cm)

**Appearance:**

The Arctic Cisco shines icy silver in the water. With nearly see-though fins and dark brown or green backs, these northern fish can easily disappear. Unlike other fish we have studied so far, this fish doesn't have teeth in their jaws. Instead, they have a tooth like patch on their tongue that they use to feed.

Arctic Cisco are anadromous fish, but they are lucky enough to spawn several times before they die. They won't start spawning until they are about 8-9 years old. They can easily live into their early 20s. As young, the fish are washed out of the MacKenzie River, Canada, into the Colville River Delta, Alaska. Here they will grow to maturity and make the more than 100 mile journey back to their birthplace to spawn. As adults, the

Artic Cisco will dine on krill, crab, shrimp, and smaller fish like sculpin, smelt, and other whitefish. It is uncertain what these eat fish as young.

**Why are they disappearing?**

Despite there being little known about the Arctic Cisco in British Columbia, they are listed as a critically imperiled species. Perhaps this is because they are a "low-resilience" species. That means it could take up to 14 years for this population to double.

Also working against these fish are Alaskan commercial fishers who take 80,000 fish per year. It is likely that the fish harvest is taking fish from the Canadian stock that spawn in the MacKenzie River. According to the Alaskan Fish and Wildlife Service, this number is sustainable but Canadian officials list potential over-harvesting as a threat. Sometimes it is easy to forget that ocean creatures travel long distances and can call more than one place home.

Unknown effects from our changing climate could mean widespread challenges. Some concerns include more aggressive storms, unpredictable weather patterns, and the die-off or migration of other species the Arctic Cisco rely on for food.

The Artic Cisco are also facing trouble from gas pipelines that travel near, through, or even under, their native waterways. Big construction projects like pipelines disrupt natural habitats for long periods of time – maybe even permanently.

## The Cyprinids: Small and Large

***Daces***

Daces are generally small and light colored. Curiously, they are described as being slender bodied *and* nearly round in cross section. Maybe it is helpful to think of them as narrow tubes. They are members of the carp or *Cyprinidae* (sigh-prin-in-a-day) family. They are also known as true minnows.

As a genus, the *Rhinichthys* appear seem to want to stay close to home, few travelling more than .5 of a mile or 1 km from their birthplace. As young fish, they might get swept downstream before they are strong swimmers. Adults tend to swim back upstream.

Their specific environment or food of choice might change from one subspecies to another, but all of their mouths face downward. This means that their upper lip hangs over their bottom lip. The location of a fish's mouth is usually a good indicator of where and what it eats. Most fish with downward facing mouths are going to feed near the bottom of wherever they live.

Some daces have slightly humped backs, and others have thicker caudal sections. But, at first glance they might be easy to confuse with other subspecies. If you can't remember what the caudal section is, return to Figure 2 for a quick refresher!

## Nooksack Dace

*Rhinichthys cataractae - Chehalis lineage*

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Actinopterygii*
**Order:** *Cypriniformes*
**Family:** *Cyprinidae*
**Genus:** *Rhinichthys*

**Length:** approx. 4.5 inches (12 centimeters)

### Appearance:

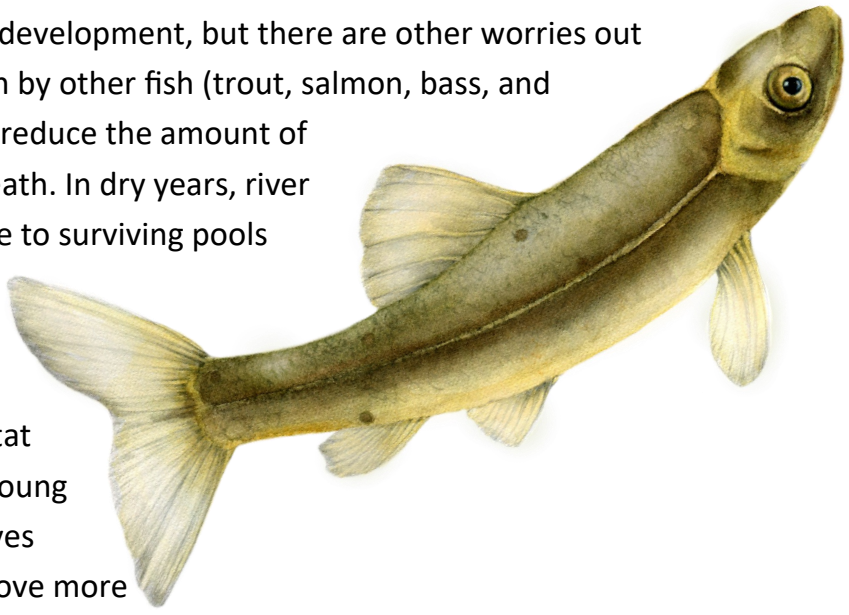
The Nooksack Dace is dark across the back and lighter color, or white, on the belly. This dace is olive green on top with a dull band of off-yellow travelling down their sides. They might have a dark band in front of their eyes that goes down their sides– juveniles usually do. If you look at them from the top, there should be a light area around the dorsal fin. The Nooksack is a subspecies of the Longnose Dace so they share some things in common. It is difficult to tell them apart as young fish.

The Nooksack Dace feeds on small invertebrates. Specifically, they like to eat worms, crustaceans, caddis or mayfly larvae, midges, or beetles.

### Why are they disappearing?

Critically imperiled in British Columbia and vulnerable in the state of Washington, these little fish need shallow water that flows over rocks in features called riffles. Dace and other fish need oxygenated water for food and for their eggs to breathe. Most fish need clean water and a place to lay their eggs without a lot of dirt particles. Fine soils that wash in can settle over eggs and then they are unable to get oxygen from the water.

They are mostly losing their habitat to development, but there are other worries out there too. In some cases, they are being eaten by other fish (trout, salmon, bass, and others). Low or polluted water flows can also reduce the amount of oxygen available, leading to poor health or death. In dry years, river levels fall, and riffles dry up. The fish will move to surviving pools if they are able, but they will not reproduce.



It is no surprise then that the Nooksack Dace is in trouble. These fish and others in their family are losing habitat and what is left isn't healthy enough for the young to reach adulthood. Worse, this subspecies lives close to home it's entire life. They may not move more than 50 yards throughout their lives – so once that habitat is lost, it is really gone!

**Umatilla Dace**
*Rhinichthys Umatilla*

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Actinopterygii*
**Order**: *Cypriniformes*
**Family:** *Cyprinidae*
**Genus:** *Rhinichthys*

**Length:** 4.7 inches (119 millimeters)

**Appearance:**

The Umatilla Dace is mostly cream colored. They do have a slightly darker back and head and may have spots over their bodies. Since they are a hybrid of the Leopard and Speckled Dace species, they share characteristics of both. Depending on where they are from, their appearance may differ slightly, but they do tend to resemble their Leopard Dace relatives. On close inspection, there are also markers that link them to their Speckled Dace family members. To find these traits, you need to look at the mouth and pelvic fins for barbels.

As the shape of their mouths suggest, they live and feed near the bottom of rivers and streams. There seems to be a good amount of debate on where the Umatilla Dace prefers to call home. Some argue that they prefer warmer water with gentle, sloping banks. Others argue that they prefer colder streams. The answer is probably somewhere in between. The fish seem to be able to thrive in a variety of habitats if the summertime water temperatures are around 64 degrees (18 Celsius). Much colder and they will seek places to hide and conserve their energy.

The adults need silt free waters and gravel beds with different sized rocks to hide in and under. This means they need water that can move fast enough to keep silt from building up. This becomes more important as they mature. Younger fish can easily live in shallow waters, but as they get older, they need to move to water that moves faster and is about 3 feet deep.

***WANT TO KNOW MORE ABOUT RIFFLES?***

https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5042807.html

**Why are they disappearing?**

These little fish are found over most of the western half of Idaho, eastern half of Oregon and Washington, and southern parts of British Columbia, and even into Alberta. Sadly, these once free flowing rivers have all mostly been dammed for hydroelectric power. The biggest threat to the Umatilla Dace is dams.

By now, we have all heard about dams and the trouble they cause fish. Although humans have tried to solve these problems, there are some issues that remain. Dams change the way water moves. By stopping, or slowing down water, it means that silt can build up and water quality suffers.

***Chubs***

**Hutton Tui Chub**
*Gila bicolor ssp*

**Kingdom:** *Animalia*
**Phylum:** *Chordata*
**Class:** *Actinopterygii*
**Order:** *Cypriniformes*
**Family:** *Cyprinidae*
**Genus:** *Gila*

**Length:** 4.7-6 inches (12-15 cm)
**Appearance:**

These little chubs are mostly silver with a bit of grey-green across their backs. Compared to other chubs, they have slightly bigger heads and eyes. Their dorsal fins tend to be a little smaller too. They have an impressive row of teeth for a small fish so mind your fingers!

**Why are they disappearing?**

Technically the Hutton tui chub isn't disappearing just yet – but that doesn't mean that the population is safe either. The problem for these chubs is their location. Right now, they are divided between two springs that have created small ponds. Hutton springs is the larger of the two. In this case when we are talking about small ponds – we mean small!

The *big* pool only measures 40 feet across at its widest point. In total, the pond measures 120 square yards of water.

A count from 2007 recorded 959 chub in Hutton spring while the other spring only had 87. These fish are at risk of losing their water during the summer, grazing cattle, and even toxic pollution. Toxic herbicides were improperly dumped about 2 miles from the spring. Federal agencies stepped in to try and stop the flow of chemicals into the groundwater. They are still watching the situation to protect the region from groundwater contamination. If those chemicals get into the ground water, the Hutton chubs won't stand much of a chance.

Hopefully, these 1200 or so fish will continue to thrive in their local springs. Wouldn't it be great to go see them in person one day? Good luck finding them though! They like to swim among the grasses and plants at the edge of the pond or on the bottom where they feed on insects, snails, and microscopic crustaceans.

**Alvord Lake Chub**
*Gila alvordensis*

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Actinopterygii*
**Order:** *Cypriniformes*
**Family:** *Cyprinidae*
**Genus:** *Siphateles*

**Length:** 3-5.5 inches (<14 cm)
**Appearance:**

The Alvord chub is a small off-white fish. Even though it may be slightly darker on the top and lighter on the bottom, overall, it is light in color. They usually have a light band of darker grey running down their sides. Their eyes are nearly the same color as the rest of their bodies.

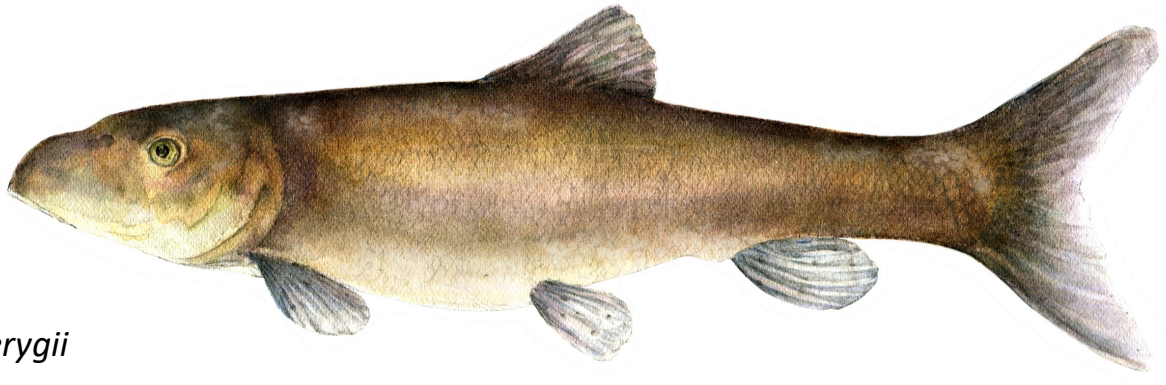
Though small, the Alvord chub is a fighter. They eat opportunistically. That is a big word that means they eat whatever they have the "opportunity" to eat. They live in similar environments to other chubs and daces so they will eat similar things. They eat midge larvae, insects, microscopic crustaceans, worms, and other small things we can barely see!

**Why are they disappearing?**

Like the Hutton Tui Chub, the Alvord lives in only a few places and faces the same concerns as a result. If the water temperature rises above 80 degrees (F) it could harm this little chub. Similar threats come from other fish entering the pools, intentionally or by accident. If the ground water dries up or is pumped out, the water level in the ponds could drop – and then the fish would have nowhere to live. Of these, the water level might be the most significant in our modern era. This is because we are all looking for alternatives to fossil fuels and geothermal development is a promise of good, clean, energy. But in dry areas like the eastern half of Oregon, geothermal development could pull water from already straining aquifers and drop pool levels.

## *Sucker Fish*

In our modern times, sucker fish have a bad reputation. Many anglers think sucker fish taste bad and they so are considered "trash fish". But, even the most committed angler knows that certain suckers are quite tasty and are valued. For many Tribes, sucker fish have been a desirable food and oil source for thousands of years.



**Lost River Sucker**
*Deltistes luxatus*

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Actinopterygii*
**Order:** *Cypriniformes*
**Family:** *Catostomidae*
**Genus:** *Deltistes*

**Length:** approx. 31 inches (80 cms)
**Appearance:**

As the *only* member of the genus *Deltistes*, the Lost River Sucker does show subtle signs of being different than other fish in the sucker family. However, most of these differences are in places most of would never to think to look. On the outside, they are described as pale with some speckles. Yet, Google searches show dark fish with a barely visible band of dark yellow near their lateral line. This all makes them look a bit like the Shortnose Sucker. But, if we look at the nose, we can start to see some of those hard to

spot differences. The Lost River Sucker has a long nose – and it has a slight bump to it. Plan to take time counting the scales along their lateral too. It can vary anywhere from 76-113.

To get at the other differences, you really have to look on the inside. Fish are weirdly inconsistent about the number of bones they have in their spinal column so this number can and will change. Their gill rakers are a bit odd too. These numbers can vary between 27-33. The number might increase with age. The shape of the raker is also different. They are widely spaced, smooth, triangular, and short.

Lost River Suckers are slow to mature, reaching adulthood at about age 9, but they may live until age 45. Between March and May they travel short distances to good spawning grounds and lay their eggs.

**Why are they disappearing?**

This is another species that lives at the edge of the Pacific Northwest. Once native to the Klamath Basin, it bridged the border between Oregon and California. Now, the Lost River Sucker lives only in the Upper Klamath Lake, Oregon, and Lost Lake, in California. They also make use of the seeps and tributaries surrounding the lakes.

In the 1920s, waterways in the Klamath and Tule basins were permanently altered when they were drained. This was the first major decline in this fishes' population. Today, most of their habitat is gone and what remains is in bad shape.

With few choices on where to live and the Sinister Six after them, the Lost River Sucker could surely use a break! Fertilizer runoff from nearby fields causes algae to bloom. The algae sucks up all the oxygen in the water and the fish can't breathe. Dams and diversions along their waterways mean that there is little water available to support their population. What water is available is heating up from unprecedented heat and droughts.

***DID YOU KNOW?***

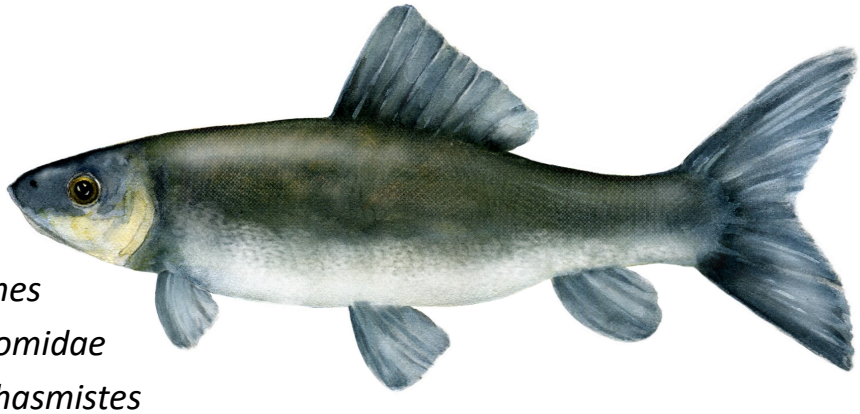
*Native American tribes and federal agencies are partnering with others to save the Lost River and Shortnose Suckers.*

*Check out this video on the work they are doing to try and save these species.*

https://www.youtube.com/watch?v=HYzRXtkWeSs

**Shortnose Sucker**
*Chasmistes brevirostris*

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Actinopterygii*
**Order:** *Cypriniformes*
**Family:** *Catostomidae*
**Genus:** *Chasmistes*



**Length:** approx. 18 inches (45 cms)
**Appearance:**

The Shortnose Sucker shares the same range, body style, and lifestyle, as the Lost River Sucker. They also vaguely resemble one another. Both fish share the golden color, but the shortnose is much darker along their backs making the whites of their bellies seem extra bright. They are shorter both in size and lifespan. While still long-lived, they generally pass-on in their early 30s.

**Why are they disappearing?**

Since they share habitat and most of the behaviors of the Lost River Sucker, all the same causes affect this fish population as well. Although steps are being taken to help these species, conservationists are worried. They argue that within the next 20 years or so, several die-offs will happen and that will drop the populations significantly. What can YOU do to help these species today?

## ***Sticklebacks***

These *tiny* fish are light in color, have see-through fins, and oval bodies. Sticklebacks earn their name from a series of spines on their back and pelvis that can be raised and then locked into place to prevent being eaten. Another defense strategy these freshwater dynamos probably got from their ocean-going ancestors is body armor. They have bony plates that line the sides of their bodies to prevent damage or injury.

Their name may sound like it came straight out of “How to Train Your Dragon” but sticklebacks are actually aquatic geniuses. They are highly valued by scientists because they easily and rapidly adapt to new environments and help us understand how species evolve.

Sticklebacks can be found over most of the globe and are seemingly secure in most of their habitats. Where are they are most at risk is in B.C., Canada. Here, ancient sea-going sticklebacks were isolated as water levels fell. As a result, several subspecies have become genetically distinct in a series of lakes.

While there may be many populations of the three-spined stickleback at risk, we will only discuss one of them because they are so similar. However, do keep in mind that there are plenty more fish to learn about. Consider taking the time to study the Charlotte Unarmoured Threespine Stickleback, Little Quarry Lake Benthic Threespine Stickleback, Vananda Creek Threespine Stickleback Pair, or the Enos Lake Limnetic Threespine stickleback.
Since they are all related and have yet to be given names for each subspecies, they all share the same place on the phylogenetic tree. Here is how to find them:

**Kingdom:** *Animalia*
**Phylum:** *Craniata*
**Class:** *Actinopterygii*
**Order:** *Gasterosteiformes*
**Family:** *Gasterosteidae*
**Genus:** *Gasterosteus*

**Why are they disappearing?**

The Sinister Six are at it again! But, these little fighters are facing more than just the usual human causes, some subspecies are also fighting off beavers. That's right, beavers. These mammalian earth movers and dam builders are so efficient that they can change the water levels in the areas surrounding their homes. Unpredictable water levels can definitely harm a small fish like a stickleback.

Sticklebacks can also lose their genetic distinction by interbreeding with other subspecies, or within their own paired subpopulations. Scientists have already seen it happen in the Enos Lake population. Once there were two types of sticklebacks that lived in Enos Lake, but now that system has broken down and given way to hybridization.

The Misty Lake population is avoiding hybridization for now but is facing threats to run off from nearby parking lots and loss of water quality because of logging. Humans are having some big impacts in other areas too. Usually, we focus on the Sinister Six, but here we need to add basic bad behavior to the list. Some people have been misbehaving at Misty Lake and not using the waterway responsibly. Remember to respect signs posted at lakes, streams, and rivers. You might just be saving a species!

**Paxton Lake Limnetic and Benthic Threespine Stickleback Pair**
**Length:** 2 ½ -3 inches (65-75 mm)

Three spined sticklebacks in Paxton Lake can be silver, green, or brown. During the mating season, the males will get big red patches on their throats.

This little stickleback is a critically imperiled Canadian native and lives only in Paxton Lake. What is super cool about this species is that it comes in two varieties – in the same lake! The names benthic and limnetic actually refer to where these fish live in the water.

The limnetic area of a lake is usually the part where we humans want to be. It is the section of open water away from the shore. Us humans like this zone because it receives the most sunlight and is the warmest part of a lake. Most fish will live in this zone too because it has the most oxygen and plants. Benthic species live deep in the water – basically on the lake bottom. It is where all the dead animals, plants, and silt fall.

Since the fish live in different parts of Paxton Lake, it makes sense that they would have different dietary needs. In this lake, the benthic fish eat invertebrates while the limnetics have learned to survive on zooplankton and other small organisms. Though a good part of their lives may be spent apart doing different things, springtime spawning brings the benthic and limentic groups together in the littoral zone. This zone is limited to the near shore and shoreline. It includes the reeds and other plants that surround most lakes. Paxton sticklebacks will spawn in this zone and hide their young in the reeds and other plants that grow at the edge of the water. As young, they will feed and grow in the littoral zone before moving into open water. Over winter, they will have to go to deeper waters to avoid freezing.

The limnetic stickleback will mature in about one year. It is thought they do not live much past their first and only breeding season. Benthic fish may live up to five years and won't start spawning until their second year or so.

Changes to their habitat like water quality, temperature, and pollution, are huge threats. Since they only live in one lake, habitat loss will effectively remove their population forever. Other major impacts include mining and logging that cause silt and other impurities to wash into the lake. Without maintaining good water quality, the lake won't be able to produce plankton and sticklebacks will run out of food. Other threats include invasive species like crayfish that can eat the Sticklebacks or their young.

**Why are they disappearing?**

The biggest threat to these isolated sticklebacks is the introduction of a non-native species. Scientists often use the Enos Lake and Hadley varieties as examples of what has gone on when new species arrive or the habitat changes too much. These species are considered lost or changed forever.

All the sticklebacks listed here are facing the Sinister Six and other threats too. Aside from the work beavers are doing, the threats facing these fish are caused by humans. The good news is that there are new plans in place to protect them. But, without our help these fish will disappear.

***Fun fact! Even though their name is the threespine stickleback, the number three is an average. Some fish will have less than three while others will have more.***

***WANT TO KNOW MORE?***

*To learn more about sticklebacks and why these tiny fish are helpful to scientists trying understand genetic changes in species, check out this video!*

https://www.youtube.com/watch?v=Pv4Ca-f4W9Q&t=62s

***A special thank you to Allison Fashing and Tim Mace, Alfred W. Bowers Laboratory of Anthropology***

***SCBWI writers group of Moscow, Ariana Burns of Palouse Anthropology,***

***and Marco Sieferle-Valencia of the University of Idaho Library.***

## Bibliography


"12.11: Fish Evolution and Ecology." *Biology LibreTexts*, 6 Oct. 2016, https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_Introductory_Biology_(CK-12)/12%3A_Vertebrates/12.11%3A_Fish_Evolution_and_Ecology.

*Alvord Chub – Oregon Conservation Strategy*. https://www.oregonconservationstrategy.org/strategy-species/alvord-lake-chub/. Accessed 13 June 2022.

*Basking Sharks and Lampreys | JONATHAN BIRD'S BLUE WORLD*. *www.youtube.com*, https://www.youtube.com/watch?v=-KfoGaoH1XY. Accessed 12 July 2022.

Beacham, Walton, et al., editors. ""Hutton Spring Tui Chub (Gila Bicolor Ssp.)." *Beacham's Guide to the Endangered Species of North America, Edited by Walton Beacham, et Al.,* Gale Group, 2012, link.gale.com/apps/doc/CV2644400243/GRNR?u=mosc00780&sid=bookmark-GRNR&xid=dba0e0e5.

*Bioluminescence in the Deep Sea: How and Why Do Animals Create Their Own Light? www.youtube.com*, https://www.youtube.com/watch?v=aPUF40j47-o. Accessed 12 July 2022.

British Columbia Ministry of Environment, Lands and Parks. *Stickleback Species Pairs*. Ministry of Fisheries, 1999.

Canada, Environment and Climate Change. *Nooksack Dace (Rhinichthys Cataractae): COSEWIC Assessment and Status Report 2018*. 9 Oct. 2019, https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/nooksack-dace-2018.html.

---. *Vancouver Lamprey (Entosphenus Macrostomus): Status Reports 2017*. 15 Oct. 2018, https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry/cosewic-assessments-status-reports/vancouver-lamprey-2017.html.

Clemens, Benjamin, et al. *FINAL Coastal, Columbia, and Snake Conservation Plan for Lampreys in Oregon*. Oregon Department of Fish and Wildlife , Feb. 2020, https://www.dfw.state.or.us/fish/CRP/docs/coastal_columbia_snake_lamprey/CPL%20-%20Final%202-14-20.pdf.

"Coastal Cutthroat Trout (Resident)." *Washington Department of Fish & Wildlife*, https://wdfw.wa.gov/species-habitats/species/oncorhynchus-clarkii-clarkii. Accessed 13 July 2022.

*Coregonus Autumnalis | NWT Species Search*. https://www.enr.gov.nt.ca/species-search/coregonus-autumnalis. Accessed 18 Aug. 2022.

*Coregonus Autumnalis (Pallas, 1776)*. https://www.gbif.org/species/2351006. Accessed 16 Aug. 2022.
*Coregonus Nasus, Broad Whitefish : Fisheries, Gamefish*. https://www.fishbase.se/summary/Coregonus-nasus.html. Accessed 9 Aug. 2022.

COSEWIC. *COSEWIC Assessment and Status Report on the Paxton Lake Benthic and Limnetic Threespine Stickleback Species Pair Gasterosteus Aculeatus in Canada.* 2010, p. xiv + 22 pp., www.sararegistry.gc.ca/status/status_e.cfm.

COSEWIC. *COSEWIC Assessment and Status Report on the Vananda Creel Benthic and Limnetic Threespine Stickleback Species Pair in Canada*. Committee on the Status of Endangered Wildlife in Canada., 2010, p. xiv + 25 pp.

---. *COSEWIC Assessment and Status Report on the Western Brook Lamprey Lampreta Richardsoni, Morrison Creek Populatio, in Canada.* 2010, p. x + 27 pp., (www.sararegistry.gc.ca/status/status/_e.cfm).

COSEWIC. *COSEWIC Assessment and Status Report on the White Sturgeon (Acipenser Transmontanus) in Canada.* 2012. Committee on the Status of Endangered Wildlife in Canada.

COSEWIC. *COSEWIC Assessment and Update Status Report on the Enos Lake Stickleback Species Pair Gasterosteus Spp. in Canada.* Committee on the Status of Endangered Wildlife in Canada.

---. *COSEWIC Assessment and Update Status Report on the Nooksack Dace (Rhinichthys Cataractae) Ssp. in Canada*. Committee on the Status of Endangered Wildlife in Canada, 2007, p. vii + 27 pp.

dfg.webmaster@alaska.gov. *Arctic Cisco Species Profile, Alaska Department of Fish and Game*. https://www.adfg.alaska.gov/index.cfm?adfg=arcticcisco.main. Accessed 18 Aug. 2022.

"Discovering the Mysterious Spawning Habits of the Threatened Cowichan Lake Lamprey." *Frontiers for Young Minds*, https://kids.frontiersin.org/articles/10.3389/frym.2019.00125. Accessed 24 July 2022.
*E-Fauna BC Atlas Page (Src: AtlasAccordian July 29, 2021)*. https://linnet.geog.ubc.ca/efauna/Atlas/Atlas.aspx?sciname=Coregonus%20autumnalis. Accessed 18 Aug. 2022.

*Extremely Endangered Nooksack Dace!!! www.youtube.com*, https://www.youtube.com/watch?v=iniKNqjgF8A. Accessed 6 June 2022.

Fisheries and Oceans Canada. *Report on the Progress of Recovery Strategy Implementation for the Paxton Lake and Vananda Creek Stickleback Species Pairs (Gasterosteus Aculeatus) in Canada for the Period 2016 to 2021.* Fisheries and Oceans Canada, 2022.

Government of Canada, Public Services and Procurement Canada. *Information archivée dans le Web*. https://publications.gc.ca/site/archivee-archived.html?url=https://publications.gc.ca/collections/collection_2014/mpo-dfo/Fs97-6-2193-eng.pdf. Accessed 9 Aug. 2022.

"How Many Species Of Fish Are There?" *WorldAtlas*, 10 Jan. 2019, https://www.worldatlas.com/articles/how-many-species-of-fish-are-there.html.

kazilek. *Fish Out of Water*. 8 Jan. 2012, https://askabiologist.asu.edu/plosable/fish-out-water.

"Lake Stratification." *WorldAtlas*, 2 Aug. 2021, https://www.worldatlas.com/lakes/lake-stratification.html.
*Lamprey - The Forgotten Fish*. *www.youtube.com*, https://www.youtube.com/watch?v=_tTaWJdOPzk. Accessed 14 Sept. 2022.

*Lenore and Hasotino History - Nez Perce National Historical Park (U.S. National Park Service)*. https://www.nps.gov/nepe/learn/historyculture/lenore-and-hasotino-history.htm. Accessed 9 Sept. 2022.

*Lost River Sucker (Deltistes Luxatus) - KFFS | U.S. Geological Survey*. https://www.usgs.gov/labs/klamath-falls-field-station-%28kffs%29/science/lost-river-sucker-deltistes-luxatus-kffs?qt-science_center_objects=0. Accessed 18 Aug. 2022.

Magazine, Smithsonian, and Elizabeth Gamillo. "Watch This Goldfish Drive an Aquarium on Wheels." *Smithsonian Magazine*, https://www.smithsonianmag.com/smart-news/watch-this-fish-out-of-water-drive-a-mini-vehicle-on-land-180979328/. Accessed 6 June 2022.

*Makah Halibut Hook*. *www.youtube.com*, https://www.youtube.com/watch?v=bLjbzgygseU. Accessed 14 Sept. 2022.

*Making of the Fittest: Evolution of the Stickleback Fish — HHMI BioInteractive Video*. *www.youtube.com*, https://www.youtube.com/watch?v=Pv4Ca-f4W9Q. Accessed 9 Aug. 2022.

*Marine Animals and Their Senses: Hearing! www.youtube.com*, https://www.youtube.com/watch?v=QxXUcYVuZ88. Accessed 6 June 2022.

---. *www.youtube.com*, https://www.youtube.com/watch?v=QxXUcYVuZ88. Accessed 12 July 2022.

National Marine Fisheries Service. *Recovery Plan for the Southern Distinct Population Segment of Eulachon (Thaleichthys Pacificus).* National Marine Fisheries Service, West Coast Region, Protected Resources Division, Portland, OR, 97232., Sept. 2017, https://repository.library.noaa.gov/view/noaa/15989.

---. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.100935/Thaleichthys_pacificus. Accessed 23 July 2022.

---. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.102975/Entosphenus_tridentatus. Accessed 24 July 2022.

---. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.101157/Coregonus_nasus. Accessed 9 Aug. 2022.

---. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.1098982/Lampetra_richardsoni. Accessed 9 Aug. 2022.

---. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.100046/Entosphenus_macrostomus. Accessed 9 Aug. 2022.

---. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.103723/Coregonus_autumnalis. Accessed 18 Aug. 2022.

---. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.104933/Coregonus_artedi. Accessed 18 Aug. 2022.

---. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.104933/Coregonus_artedi. Accessed 18 Aug. 2022.

---. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.102932/Deltistes_luxatus. Accessed 18 Aug. 2022.

---. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.106479/Chasmistes_brevirostris. Accessed 18 Aug. 2022.

*Niimiipuu Language Program | Nez Perce Tribe*. https://nezperce.org/about/language/. Accessed 14 Sept. 2022.

"Nooksack Dace." *South Coast Conservation Program*, http://www.sccp.ca/species-habitat/nooksack-dace. Accessed 6 June 2022.

*Northwest Coast: Archaeology as Deep History | Herring: Look Back, Moving Forwards*. https://blogs.uoregon.edu/northwestcoast/2017/02/14/herring-look-back-moving-forwards/. Accessed 9 Sept. 2022.

*Pacific Lamprey*. Volume III, Chapter 3, Northwest Power and Conservation Council, May 2004, https://nwcouncil.org/media/filer_public/17/07/170759cb-1ee5-4674-890e-d9aa3aa03f40/Vol._III_Ch._3__Lamprey.pdf.

*PL1: ACTINOPTERYGIAN VS. SARCOPTERYGIAN FISH*. *www.youtube.com*, https://www.youtube.com/watch?v=Nyu9RuJNdCo. Accessed 6 June 2022.

*Reading Bones The Fish Skeleton*. *www.youtube.com*, https://www.youtube.com/watch?v=beMu54KfRJc. Accessed 12 July 2022.

*Restoring Historical Fish Passages in Southern Oregon*. *www.youtube.com*, https://www.youtube.com/watch?v=OjZIKI7TVjs. Accessed 13 June 2022.

*Riffles*. https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5042807.html. Accessed 13 June 2022.
"Salvelinus Confluentus | U.S. Fish & Wildlife Service." *FWS.Gov*, https://www.fws.gov/species/bull-trout-salvelinus-confluentus. Accessed 12 July 2022.

*Saving the Klamath Basin's Endangered Suckers*. *www.youtube.com*, https://www.youtube.com/watch?v=HYzRXtkWeSs. Accessed 14 Sept. 2022.

Scheerer, Paul D., et al. "DISTRIBUTION AND ABUNDANCE OF ALVORD CHUB IN OREGON AND NEVADA." *Northwestern Naturalist*, vol. 96, no. 2, 2015, pp. 118–32. *JSTOR*, https://www.jstor.org/stable/26454351.

Scheerer, Paul, and Steven Jacobs, . *Hutton Spring Tui Chub and Foskett Spring Speckled Dace Investigations*. Oregon Department of Fish and Wildlife, 2005, p. 16 pp.

Sep 25, and 2017 | News. "Makah Tribe Expands Traditional Halibut Hook Study." *Northwest Treaty Tribes*, 25 Sept. 2017, https://nwtreatytribes.org/makah-tribe-expands-traditional-halibut-hook-study/.

*The Difference Between FISHEYE and Wide Angle Lenses*. *www.youtube.com*, https://www.youtube.com/watch?v=6toiNmZ_e4I. Accessed 6 June 2022.

*The Pacific Lamprey: Your Ancient Neighbor*. *www.youtube.com*, https://www.youtube.com/watch?v=ptTqf81SFNY. Accessed 9 Aug. 2022.

---. *www.youtube.com*, https://www.youtube.com/watch?v=ptTqf81SFNY. Accessed 14 Sept. 2022.

*Threatened and Endangered Species: Bull Trout | NRCS Montana*. https://www.nrcs.usda.gov/wps/portal/nrcs/mt/newsroom/factsheets/nrcs144p2_057914/. Accessed 13 July 2022.

*Trout in the Classroom | Idaho State University*. https://www.isu.edu/imnh/imnh-education-outreach/trout-in-the-classroom/. Accessed 9 Aug. 2022.

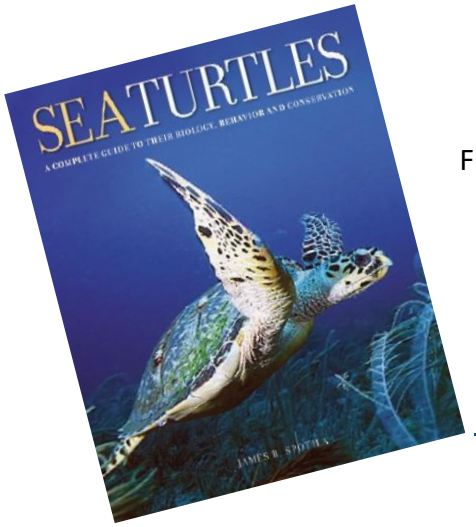
U.S. Fish and Wildlife Service. *Lost River (Deltistes Luxatus) and Shortnose (Chasmistes Brevirostris) Sucker Plan Recovery. Portland, Oregon.* 1993, p. 108 pp.

---. *Revised Recovery Plan for the Lost River Sucker (Deltistes Luxatus) and Shortnose Sucker (Chasmistes Brevirostris).* 2012, p. xviii + 122 pp.

U.S. Fish and Wildlife Servie. *Recovery Plan for the Coterminous United States Population of Bull Trout (Salvelinus Confluentus).* 2015.

Walker, Deward E. *Indians of Idaho*. University Press of Idaho, 1978.

*Western Native Trout Status Report: Coastal Cutthroat Trout.* Jan. 2021, p. xviii.

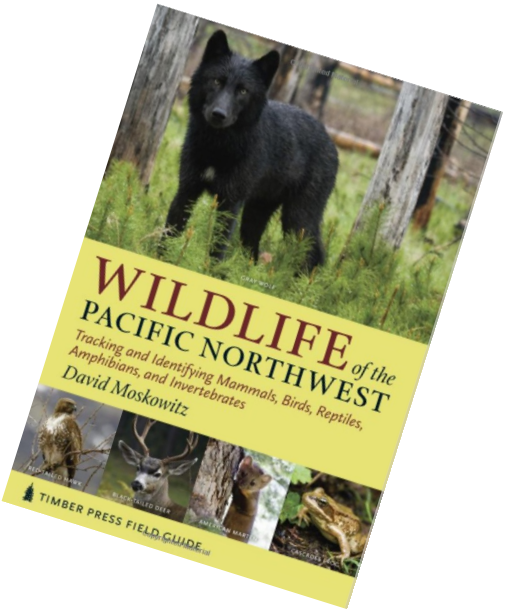



## Want to Know More?

Try these books!

Full of information about our local plants and animals. These books are suitable for most family members.

Or, you can search the species of British Columbia through this website: https://ibis.geog.ubc.ca/biodiversity/efauna/




***This Module was brought to you by:***

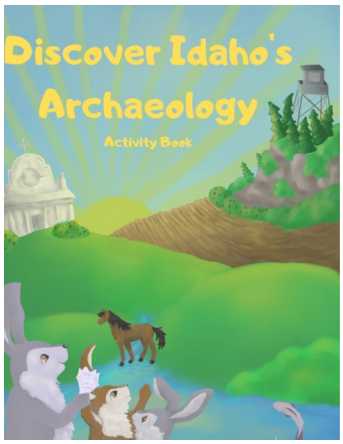
***Alfred W. Bowers Laboratory of Anthropology***

***&***

***Palouse Wildlife Rescue & Rehabilitation***

*The Laboratory of Anthropology was founded in 1949 by Alfred W. Bowers to give students the opportunity to practice anthropology and archaeology in a safe environment before entering the professional community.*

*The laboratory is committed to serving the public through interactive educational programs, interpretive displays, public volunteering programs, lab tours and many other options.*




*Need classroom content? Homeschooling? Find information and activities here:*

*https://www.uidaho.edu/class/anthrolab/k-12-resources*


*Palouse Wildlife Rescue & Rehabilitation began in 2006, founded by Idaho resident, Ryan Law. Palouse Wildlife serves animals in the greater Palouse region of north Idaho, in conjunction with veterinary partners at Washington State University and PAWS veterinary clinic.*

*Like all wildlife rehabilitators, Palouse Wildlife does not receive any state or federal funding—we are purely a result of the volunteered love, time, and gifts given by our kind-hearted community! To learn more about how you can assist local wildlife, click the "Get Involved" link at the top of the page. Thank you for your wonder-*

*https://palousewildlife.wixsite.com/palousewildlife*