# NatureMapping for Fish and Streams

*A citizen's guide to stream monitoring and restoration*

*Washington Department of*
***FISH AND WILDLIFE***
*Outreach and Education*


**Federal Aid Project**
funded by your purchase
of fishing equipment
and motor boat fuels

January 1997
Produced by the Washington Department of Fish and Wildlife, Outreach and Education

Funded by the Shewmaker Bequest Scholarship
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# Introduction

## *NatureMapping*

...is a joint outreach program (developed by the Washington Department of Fish and Wildlife and the University of Washington Gap Analysis Project) to promote biodiversity studies through citizen and school-based data collection. The objective is to empower citizens to plan and manage resources for a community within a watershed.

... enlists citizens in WDFW's mission to preserve and protect fish and wildlife in Washington. The expected outcome of NatureMapping is to involve the public in WDFW's mission by educating and developing stewardship for fish and wildlife.

... complements all watershed, water quality and stream field study environmental education programs by providing students an opportunity to perform field studies that contribute to the state's biological data base.

... enables citizens to collect data at schools, in backyards, and on community sites, establishing a baseline for species and habitats in their area. Data goes into the state biological survey, and may be used for local watershed planning and resource management.

...creates a user-friendly way for fish, wildlife, stream and habitat data gathered by NatureMappers to be digitally entered into a public data layer established by the UW Gap Analysis Project.

## How to Use This Manual

The purpose of this manual is to provide Washington State citizens with the information necessary to conduct fish and/or fish habitat surveys, and to evaluate the health of their stream. To accomplish this the manual is separated into several sections: Introduction, Fish and Their Needs (basic information about fish found in the Pacific Northwest), Data Collection (survey instructions and a data collection form), and Appendices.

Before surveying, you should read through the manual and decide what you want to accomplish by surveying your stream. If you only wish to see salmon in a stream, then one or two trips to an appropriate survey site in the fall will suffice. However, if you wish to assess the impacts of local land use practices on the stream, then more frequent surveying is recommended.

### *NATUREMAPPING* for STREAMS
### Stream Safety and Etiquette

1. Always ask permission to enter private property. Your ability to monitor and enhance fish habitat depends on the goodwill of the landowner.

2. Watch for redds (salmon egg nests), particularly from September through January. Redds can be hard to see, and eggs are easily killed by a poorly placed foot. In some streams, trout redds persist until late July. (See Redd Identification on page 12.)

3. While working around the stream, limit the impacts of your activities. Avoid creating unnecessary erosion and disturbing fish and wildlife.

4. If spawned fish carcasses are removed from the stream for close observation, return them to the stream. Carcasses are an integral part of the food web, providing nutrition to salmon fry and other animals.

5. Stream surveying is not a dangerous activity, but streams are natural, uncontrolled environments. A few simple precautions will help ensure your safety.
   a. Never survey alone.
   b. Always inform a responsible friend or family member about where you will be surveying and when you plan to return.
   c. Plan your surveys to end well before dusk.
   d. Fast-moving water can be dangerous. Know what depth and velocity of water is safe to work in. When crossing a stream use one or more of the following precautions: cross with a partner, use a walking stick, or use felt-soled footgear.
   e. Be prepared for the unexpected. Have a plan of action prepared in the event of an accident or injury. If possible, carry a cellular phone and a first aid kit.
   f. The best defense against hypothermia, a potential lethal condition, is education and preparation.
      * Take a Red Cross first aid class. Learn how to recognize and treat hypothermia.
      * Wear clothing that will keep you warm and dry. Carry a rain coat and matches, even on "good weather" days.
      * Avoid fatigue. Know when to call it a day.
   g. NEVER DRINK THE WATER

# Fish and Their Needs

Freshwater fish have five basic needs for survival:

- **clean water**
- **proper water chemistry (dissolved oxygen, pH, temperature)**
- **food**
- **shelter**
- **spawning areas**

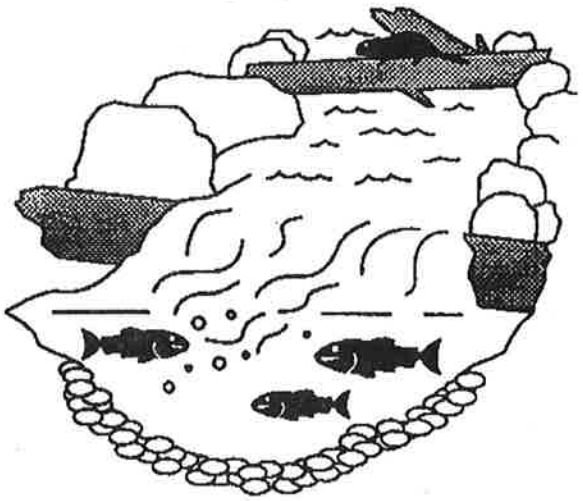
• **Fish need clean water**. A fish's entire body is in water, and it uses water for drinking and breathing. Even small amounts of pollutants like motor oil, paint, slug bait, or other poisonous chemicals will kill fish. Dirty water is also caused by *silt*, fine particles of sand and debris floating in the water. Silt is often the result of erosion; sand and soil particles are washed into the stream and make it difficult for fish to breathe by clogging their gills. Silt smothers fish eggs incubating in gravel nests, and it can smother the stream bugs that juvenile fish need for food.

• **Fish need proper water chemistry.** Like land animals, fish "breathe" oxygen, but with gills instead of lungs. The amount of oxygen in water can be decreased by pollutants like sewage or lawn fertilizer. When these chemicals wash into a stream they absorb oxygen from the water, leaving less for fish. Some fish species also have a limited range of pH and temperatures they can live in. Chemical pollutants or acid rain can change the pH balance. And water temperatures increase when the trees around a stream are cut down, either for lumber or to make room for houses, roads, or pasture. The water heats up because the trees no longer shade the stream. (Removing stream-side trees also lowers the amount of dissolved oxygen. On a chemical level, warm water holds less oxygen than cold water.)

• **Fish need food.** Most fish eat plankton, insects, or other fish. Recent studies show that carcasses of spawned salmon are an important food source for all stream residents in the Pacific Northwest. After salmon die, their carcasses enter a nutrition cycle which feeds most of the wildlife in and around a stream, including birds, mammals, fish and insects. Streams without salmon carcasses have a less productive food web.

• **Fish need shelter to hide from predators.** This is particularly important for small fish, because there are more potential predators. Depending on the species, shelter can be between rocks, within aquatic vegetation, under logs or tree limbs, or at the bottom of a deep pool. In the Pacific Northwest the most important structures for fish shelter are logs and the rootballs of trees. In a natural setting, large, old-growth trees die and fall across the stream, providing shelter and creating deep pools. Such

**Pools under logs provide fish shelter**



large trees can remain in place for hundreds of years before rotting away, providing shelter to many generations of fish.

• **Fish need a place to spawn.** Spawning is the way fish reproduce, and if they can't reproduce they become extint. Some fish spawn in the same environment in which they live, while other fish migrate to spawning areas from elsewhere. Salmon are the best known example of the latter behavior; they live as adults in the ocean, then migrate back into freshwater streams to spawn. (Fish that live in saltwater and spawn in freshwater are called *anadromous fish*.)

Anything that prevents anadromous fish from returning to the stream in which they were hatched, such as a dam, a waterfall, or a failed culvert, prevents them from reproducing. Man-made barriers are a far too common problem on many small northwest streams, particularly in urban and suburban areas.

If cool, clean water with proper chemistry, food, shelter, and spawning areas are all available, nature will provide the fish.

## Salmon

In Washington, 82 species of fish may be found in freshwater at some point in their lives; 49 are native species and 33 were introduced. Of these, none are more recognizable or easier to observe than the seven native species in the genus *Oncorhynchus*, or Pacific salmon.

People who live in the Pacific Northwest are often accused of being 'salmon-crazy' because of the amount of time, energy, and money we expended to study, fish for, and raise salmon. The fact is, salmon are an important part of Pacific Northwest culture, both the Native American culture and the later European culture. No other group of fish species, or for that matter animal species, impacts the natural environment of the Northwest quite like salmon.

The huge spawning runs of salmon in the fall and winter are quite literally the fuel which powers the ecosystem in the Northwest. The nutrition these millions of salmon carcasses provide to the riparian community allows many animals to survive the harshness of winter. In areas where salmon runs have declined, the populations of many other animal species have also declined. To study the natural ecosystems of the Pacific Northwest requires an understanding of salmon and their behaviors.

## The Salmon Life Cycle

Salmon have seven different life stages.

1. egg
2. alevin
3. fry
4. parr or fingerling
5. smolt
6. sub-adult
7. mature adult

Salmon begin their lives as fertilized **eggs**. Adult salmon lay and fertilize their eggs in gravel nests known as *redds*. The egg goes through several changes over the next few months, the most obvious being the *eyed stage*, when the eye can be seen as a black dot on the egg. Eventually the egg becomes an **alevin**, which looks like a tiny fish with a pot belly. This "belly" is the remaining egg yolk, which provides nutrients to the immature fish.

**Seven Native Washington Salmon (genus *Oncorhynchus*)**

| Name | Nickname | Scientific name |
|---|---|---|
| chinook | king | *O. tshawytscha* |
| coho | silver | *O. kisutch* |
| chum | dog | *O. keta* |
| sockeye | red | *O. nerka* |
| pink | humpback | *O. gorbuscha* |
| steelhead & rainbow trout | | *O. mykiss* |
| cutthroat trout | | *O. clarki* |

Alevin remain in the gravel stream bottom for several weeks to avoid being eaten by predators.

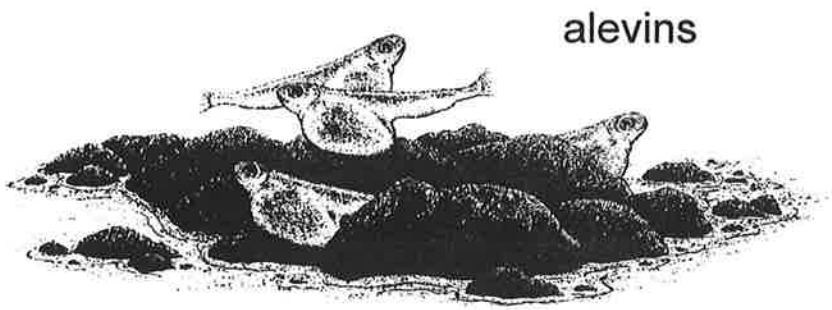
When the yolk sac has been used up, the fish no longer has a pot belly. It is now called a **fry**, and without the yolk sac it must leave the protection of the gravel stream bottom to find food. This is a very dangerous time in the life of a salmon.

At this point there are two different things salmon do, depending on the species. Some salmon stay in the stream for months or even years, feeding and growing in the stream. Other fry go directly to the ocean to feed and grow in the estuaries and bays.

In both cases salmon fry that reach a few inches in length are called **fingerlings**. Fingerlings are also called **parr**, a name which refers to the camouflage markings on those fingerlings that stay in freshwater. These marks help young salmon blend into the shadows of the stream environment.

When a parr is ready to enter the ocean, it goes through a process known as *smoltification*, and is now called a **smolt**. The fish now lose their stream camouflage and take on the characteristic silver color of ocean-run fish.

Depending on the species, salmon spend from one to eight years in the ocean, with the average being three years. For most of



this time they are considered **sub-adults**. Then, when they reach sexual maturity, and begin their return to their natal stream to spawn, they are called **mature adults**. Since salmon die after they spawn, this is the last life stage.

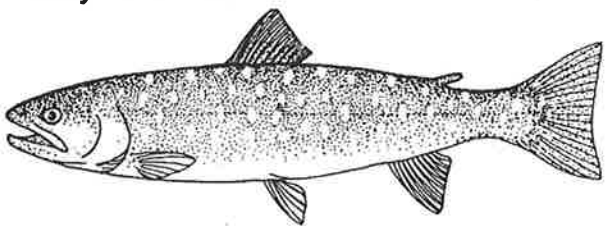
The two sea-run trout species, steelhead and cutthroat, may survive spawning and return to the sea. Fish that survive spawning are called **kelts**. The following year these fish will migrate upstream to spawn again, and may comprise up to 15 percent of runs.

## Other Fish

At least 75 species of fish other than salmon inhabit Washington streams and rivers. These fish range in length from an inch (Olympic mudminnow) to 20 feet (white sturgeon). Data on these other species is just as important but less frequently collected than data on salmon.

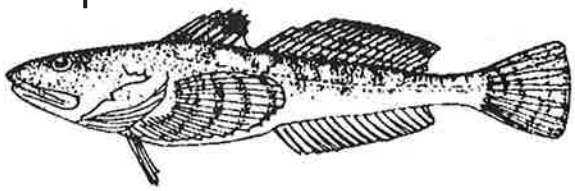
The fishes of the char genus, *Salvelinus*, are very closely related to salmon and trout. Fortunately there is a simple way to tell them apart. Salmon and trout have dark spots on a light background, and char have light spots on a dark background. There are four char in Washington State, two native species (**Dolly Varden** and **bull trout**), and two introduced species (**lake trout** and **brook trout**).

Dolly Varden



Dolly Varden and bull trout look so similar to one another that for many years they were thought of as simply two different forms of Dolly Varden. Only recently have fish biologists decided that they are different species. Some evidence suggests that Dolly Varden are anadromous while bull trout are a freshwater fish, but this is still uncertain. What is certain is that these two species require very cold water. A recent study showed that spawning bull trout only used the two coldest tributary streams out of eight choices; the other six streams, with warmer water, were ignored. Such cold water is becoming harder to find as development, agriculture, and logging activities (among other things), cause higher temperatures in many of our state's streams. As a result, Dolly Varden and bull trout are becoming rare except in northern and mountain streams.

sculpin



Some of the more common non-salmonid species found in northwest streams are sculpins, minnows, lampreys, smelt, and suckers. **Sculpins** are a common fish genus with 11 Washington species. These odd-looking fish have large heads and large pectoral fins, and are sometimes called "bullheads" by locals. (The term bullhead also refers to several species of catfish, some of which have been introduced to Washington.) Ten of Washington's sculpins are freshwater fish, and none measure greater than five inches at maturity.

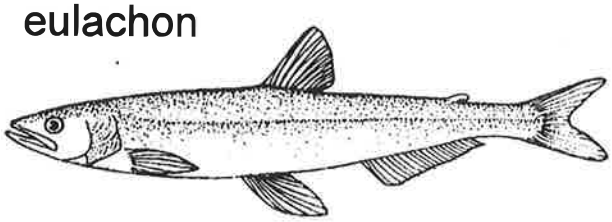
Twelve species of **minnow** are found in our state, nine native and three introduced. The term "minnow" usually refers to a very small fish, but in biological terms it refers to members of the Cyprinidae family of fishes. Some minnow species can grow to over a foot long. Well-known minnow species include **carp** (an introduced fish), **goldfish** (another introduced species from household aquariums), and the **northern squawfish**, a major predator of juvenile salmon. All of these "minnows" commonly grow to a foot and a half long! More typically-sized minnows include the three daces; the **longnose dace**, the **leopard dace**, and the **speckled dace**. These fish grow to only four inches at maturity. The **redside shiner** is another native minnow about six or seven inches long. These fish are sometimes caught in streams when fishing for trout or salmon.

**Lamprey** are an ancient fish that evolved before the "bony fish." They are closely related to sharks; both groups lack hard bones, and have skeletons made entirely of cartilage.

Lamprey are long, slender fish with small fins, resembling an eel, and are sometimes mistakenly

called eels. Lamprey are usually parasitic; they attach to another fish with their sucker-like mouths, then absorb nutrients from the host like a leech sucking blood. There are three species of lamprey in Washington, all native: the **western brook lamprey** (freshwater, less than seven inches long), the **river lamprey** (anadromous, up to 12 inches long), and the **Pacific lamprey** (anadromous, up to 30 inches long).

eulachon



**Smelt** are small fish, generally less than nine inches long, with both marine and anadromous species. At least four smelt species are found in Washington, two of which are found in freshwater. The **eulachon** can be found in large late-winter spawning runs in big coastal rivers, such as the Columbia, Cowlitz, Lewis, and Nooksack. During their spawning runs, which occur in the late winter, they are fished by commercial and sport fishers. The **longfin smelt** is known to use the Swinomish Channel in LaConner for spawning, and another population has adapted to a freshwater lifestyle in Lake Washington.

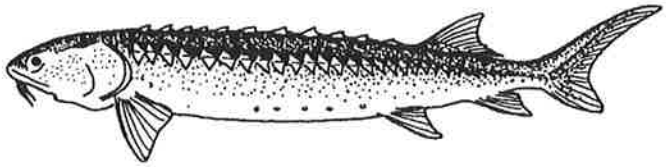
Smelt are sometimes called "candlefish" by local anglers, and candlefish lures are a commonly used salmon jig in Washington waters. The name candlefish comes from a Native American custom of drying a particularly oily species of smelt, called eulachon, then igniting the dried fish to provide light. The dried fish is so oily it burns like a candle.

Washington is home to four **sucker** species. These fish range in size from eight to 17 inches at maturity, and are found mainly in the Columbia River system. The **largescale sucker** is the only one that can be found in streams throughout the state. Most fish rely on insects and other fish for food, but a large part of a sucker's diet consists of plants and algae. Some suckers have mouths adapted to scraping algae off of rocks, which may be why they received the name "sucker."

The **three-spine stickleback** is a fish with both freshwater and anadromous forms. They rarely grow over three inches long, and are easily identified by the three separated spines of the dorsal fin. Large groups of sticklebacks are usually associated with aquatic vegetation.

**White sturgeon** and the closely related **green sturgeon** are the largest fish found in Washington's freshwater. Even though sturgeon have been fished for centuries for their eggs, which become caviar, relatively little is known about their life-histories. We do known that sturgeon can live for many years; the oldest known white sturgeon was 82 when caught.

white sturgeon



The **Olympic mudminnow** is a tiny fish that lives only on the Olympic Peninsula of Washington. These small fish live in swamp, bogs, and very slow-moving parts of streams, and rarely grow longer than two and a half inches.

In addition to these native fishes, observers may find **catfish** in Washington streams. Seven species of catfish have been introduced to Washington, mainly east of the Cascades.

Refer to Appendix 2 in the back of this manual for a list of all 82 species of fish known to use freshwater habitats in Washington.

For more information on freshwater fish species, refer to "Inland Fishes of Washington" by Wydowski and Whitney, University of Washington Press, Seattle, 1979. This excellent reference includes photos of 76 different fish species to help with identification.

# Data Collection

Data collection is simply gathering information by conducting surveys. A survey is an activity in which the subject being studied is either observed or measured, or both, and the observations and/or measurements are recorded for future reference.

On the following pages, two types of surveys are described; fish surveys and habitat surveys. Citizens are encouraged to conduct surveys in their local communities and record their findings on the data sheet provided. *Each survey requires a fresh data sheet, so copying the form will be necessary for multiple surveys.*

**Location, location, location!**
Knowing where you are is as important as knowing what you see. A good map is important when finding your township/section/range, or latitude and longitude. Without a location your observations are less useful.
Before conducting surveys, you must obtain permission to be on private property.

## Fish Surveys

**Purpose** - Fish surveys conducted by volunteers are useful in determining the presence or absence of fish species.

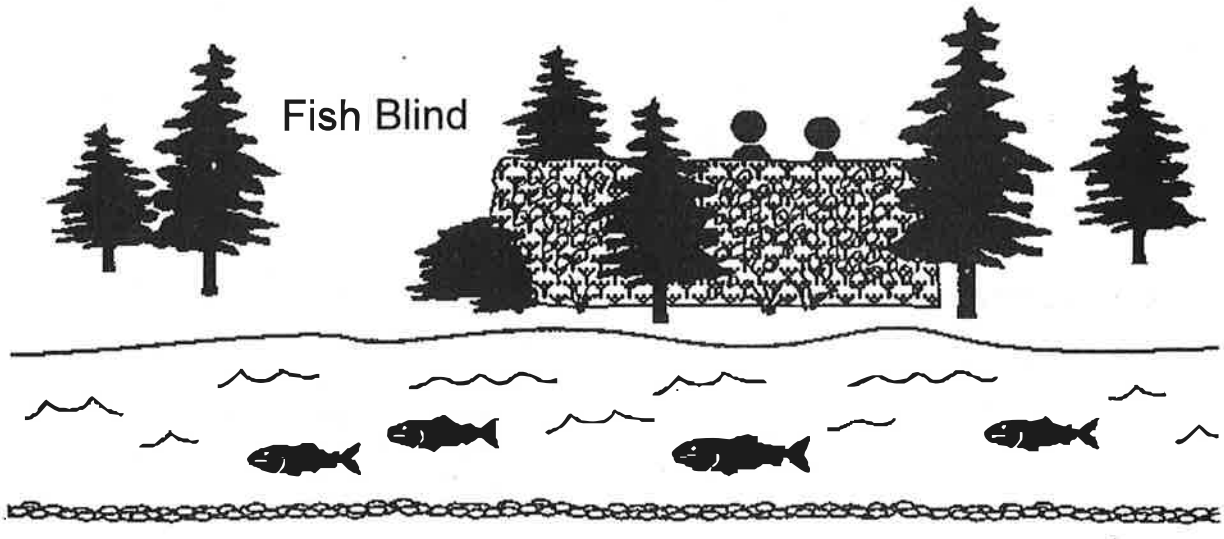
**How** - Fish surveys are conducted by observing fish and their behaviors in a natural environment. Fish are not handled or collected.

All fish, regardless of age or size, are wary of predators. To improve viewing opportunities and prevent stressing the fish, you should conceal your presence and limit your movements. Wear clothing that blends into the surroundings, move slowly and deliberately, and do not crowd the fish. Remember that fish can "hear" vibrations in the water, so throwing rocks in the water or splashing through the stream are surefire ways to scare off fish. One way observers can conceal themselves is to use a **fish blind**, like those used for duck hunting. A fish blind is a natural or artificial camouflage structure observers can hide behind to avoid being seen by fish. It can be as simple as a strategically placed bush, or as complex as a plywood lean-to covered with camouflage netting. A sturdy blind that can be left in place from year to year would be very effective at a point of known activity, such as a favorite spawning area.

An important tool for all fish observers is a pair of **polarized sunglasses**. These specially tinted glasses block some of the light rays from reaching your eyes, cutting down on surface glare and improving vision into the water. Polarized sunglasses cost about the same as ordinary sunglasses and can be purchased at most sporting goods stores. Fish surveys should not be conducted without them.

Before beginning your survey, check Appendix 3, Critical Salmon and Steelhead Stocks in Washington State. Surveys should not be conducted on streams containing critical runs.

Keep in mind that even professional fish biologists sometimes have difficulty identifying fish



from the streambank. There are times when spawning salmon can be right in front of a surveyor but are nearly impossible to see. Seeing fish in a stream is a hard-earned skill which usually improves with practice.

If at first you do not find any fish, don't be discouraged. You may simply be a few days early, or you may be observing at the wrong time of day. Make sure there are no obstructions downstream which may prevent fish from getting to your survey area, like a waterfall or a man-made barrier. Although not finding fish is disappointing, you can still gather good data. You may discover a previously unknown problem which needs correcting. Above all, don't give up, persistence and patience may produce better results than knowledge, skill, or luck.

## Spawning Adult Salmon

Most anadromous fish spawn in the fall and winter months, although some species and some runs spawn in the spring. These concentrated fall spawning runs provide an excellent opportunity to see fish. The main purpose of these surveys is to count the number of each species of fish using the stream. Data on the sex, behavior, and lifestage of the fish observed can also be collected.

**Where** - The best places to see adult migrating salmon are large pools, such as the plunge pools below small jumps. The fish will use these pools as resting areas to gather strength for the jump ahead. Salmon also like to rest in pools with overhead cover. These hiding places provide protection from predators. Look for structures such as undercut banks, overhanging vegetation, rootwads hanging over the stream, or logs in the stream.

To see salmon spawning behaviors, you should survey riffles and other highly oxygenated areas. Spawning areas are often used year after year, so once a good location is found it may provide annual viewing opportunities. Mass spawning species like chum and sockeye will be easier to observe than coho or chinook, which spawn in dispersed pairs.

**When** - Migrating adult salmon move primarily at night, although they can be seen at dusk and in the early morning. Observers will have better luck seeing fish in shaded areas or on cloudy days.

As a general rule most adult salmon migrate upstream in the fall and winter months. Most spawning surveys are conducted from September through December. Specific run timing depends on species, location, and environmental factors such as weather and precipitation. Chum, which are the easiest species to observe, can often be seen in streams for several weeks each fall. But coho respond to stream flows, and are usually in streams for only a week or two after a heavy rain.

**How Often** - This is an extremely difficult question to answer. Each stream is unique, and the time fish enter streams often varies from year to year. Fish biologists conduct formal spawning surveys every 10 days, but such frequent surveys would be difficult for most volunteer observers. Until you become knowledgeable about your stream and it's rhythms, spawning surveys can be conducted once a month from September to December. More frequent surveying may be disruptive to wildlife living around the stream.

### Tools

The following tools will make stream surveys easier and more enjoyable.

**Polarized sunglasses** - a useful tool that reduces glare and allows the wearer to see into the water.

A **fish identification guide**, such as Inland Fishes of Washington; Wydoski and Whitney, University of Washington Press, 1979, for accurate species identification.

An **insect identification guide** for those unfamiliar with EPT insects.

A **thermometer** to measure water temperature, preferably a heavy-duty or non-mercury design.

Other recommended equipment includes a USGS topographic **map** of the area, **boots** for instream work, a **pen or pencil**, and **clipboard**.

## Juvenile Salmon

Some salmonid species require rearing time in freshwater before migrating to sea. Although these small fish are often more difficult to see than spawning adults, knowing when and where to look will improve your chances for success. The species most likely encountered as juveniles are coho and cutthroat, and in eastern Washington chinook. Steelhead fry and parr are commonly found in fast moving streams, but are very difficult to observe from the streambank. Chum, pink, and fall chinook fry emerge from the gravel and migrate to salt water in the spring, when flows are high and streambank observation is difficult.

**When** - The spring and summer months are often the best time to collect data on juvenile salmon for several reasons. Fall and winter are generally set aside for observing spawning adults, and with all that activity fry can be hard to find. In early spring, fairly large pre-smolts (up to six inches long) can be found in small coastal streams before they head out to sea. And summer flows are usually the lowest of the year, making it easier to see fry. ( Look for chum, pink, or fall chinook fry from March to May.)

**Where** - This is a two part question. First, "What kind of salmon are likely to use this stream or reach?" And second, "What kind of habitat structures are juvenile salmon most likely to use?"

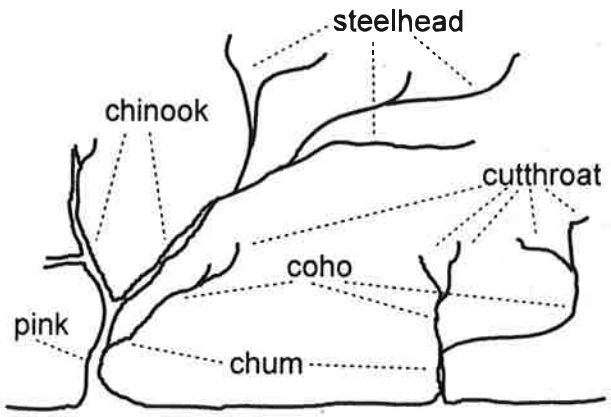
The first part can be answered by knowing what type of salmon spawn in the stream, either by conducting spawning surveys or by researching the stream history. If spawning information is unavailable, volunteers can assess the stream using the guidelines in Table 1.

The second part of the question is easier. Like spawning adult salmon, juvenile salmon prefer areas of undercut banks or overhanging vegetation. They will also use deep pools, especially pools with logs or rootballs in them. The problem with trying to observe fish, and particularly juvenile fish, is they don't want to be seen. If there is a deep, dark pool that is hard to see into, you can be sure that is where the fish are.

**How** - When surveying for juvenile salmon, you should look for movement. Salmon fry are camouflaged extremely well, and motionless fry are virtually impossible to detect. When they move, they do so quickly and immediately become motionless again. Observers who come upon a pool with moving fry will see what appears to be shadows darting from one end of the pool to the other. Novices may mistake what they see as insect shadows moving over the water. Again, persistence and patience can be the deciding factors.

Smolts and fingerlings may be even harder to see than fry. They are older and wiser, and are generally only seen if they school up. Occasionally they gather in pools during periods of low water.

### Stream Reach Usage by Species




## Table 1

| Habitat Type | Species |
|---|---|
| Small streams and tributaries | chum - near the mouth<br>coho - mid and upper reaches<br>cutthroat - the very uppermost reaches |
| Large streams and rivers | pinks - mainstem near mouth<br>chum, coho, cutthroat - in tributaries<br>chinook - mainstem and large tributaries<br>steelhead - high-gradient reaches |

Note: These are general guidelines only.

## Habitat Surveys

Habitat surveys are conducted by measuring or estimating the physical characteristics of a stream. The term habitat refers to the area or type of environment an organism or population lives in. For a habitat to support a species, it must provide all of its survival needs. We know from Chapter 1, "Fish and Their Needs," that fish have five basic needs:

- **clean water**
- **proper water chemistry**
  **(dissolved oxygen, pH, temperature)**
- **food**
- **shelter**
- **access to spawning areas**

**Why** - The main reason to conduct habitat surveys is to see if a stream has these five basic needs. Is the water clean? Is the temperature low enough? Can fish access their spawning areas? A stream with all five basic needs will have a healthy fish population; a stream without one or more of these needs is a candidate for restoration activities.

If you are fortunate enough to have a healthy stream, you may choose to monitor it to make sure it stays that way. Activities like development and logging along a stream can affect its health and its fish population. For other streams the damage has already been done. In these cases, collecting habitat data is the first step in deciding how to restore the stream and return fish to it. Protecting and restoring habitat is a better way to increase fish populations than planting fry or eggs into a stream.

**Where** - Habitat surveys can be conducted at any point along a stream. Ideally, you should have access to 200' of stream, and measurements should be the average condition within the 200' section.

**What** - You can easily monitor four of the five basic fish needs with very little equipment:

- **clean water**
- **temperature (part of water chemistry)**
- **shelter**
- **spawning areas**

(The other requirements for fish are more difficult to measure or are not part of habitat.)

- **Water chemistry** is measured by several volunteer groups (G.R.E.E.N., EPA Stream Team, local conservation districts, etc.) and is in the *NatureMapping* **Water** Module. Some measurements require chemical testing kits or other equipment that these groups can provide.

- **Food** is discussed in the next section on stream bugs.

**How and When** - Refer to Table 2 on pages 10 and 11 for detailed information on how and when to measure habitat. In general, plan to do a quarterly survey each season (spring, summer, fall, winter), one of which can be your annual survey. Try to do the annual survey during the same season each year.

## Stream Bugs

**What** - Stream bugs are also called benthic macro-invertebrates, a term that refers to all the creatures in a stream that don't have spines, like insects, worms, snails, etc. The three best kinds of stream bugs to find in a salmon stream are mayflies (order Ephemeroptera), stoneflies (order Plecoptera), and caddisflies (order Trichoptera), which are known as the **EPT** bugs. A healthy population of EPT bugs is a sign of a healthy stream.

**Why** - Stream bugs are an important food source for many freshwater species, as any fly-fisher can tell you. In the Pacific Northwest they are very important to resident trout species and to juvenile salmon as they rear in freshwater.

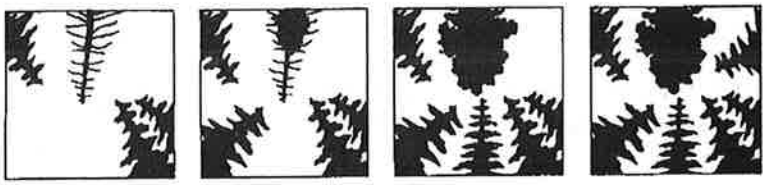
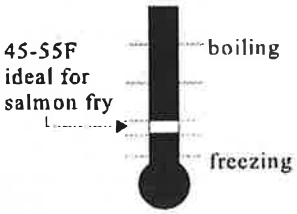
In addition, finding EPT insects in a stream is useful because they can tell us if the stream is polluted or low in dissolved oxygen. Like salmon, these insects need cool, clean, highly-oxygenated water. Finding these insects in a stream is a good sign that the stream is clean enough to support fish.

**When** - Spring and summer are the best time to look for stream bugs. In the fall, spawning salmon will be in the stream, and in the winter the water is often too high to work in safely.

**Where** - These insects are usually found under rocks in highly oxygenated water, such as riffles.

**How** - In-depth stream bug sampling is conducted by the same groups that measure water quality. For this survey, record any EPT bugs you see by turning over a few rocks, or any you may accidently find while doing other surveys.

# Table 2 - Habitat Surveys

| | What to Measure | How to Measure |
|---|---|---|
| **clean water** | garbage | Look for garbage in the stream, on banks, and within the riparian zone. |
| | silt (also called "turbidity") | Determine visibility in the water by measuring or estimating the deepest place the stream bottom can still be seen. This measurement should be combined with a description, such as "high turbidity," "medium turbidity," "low turbidity," or "clear." |
| **shelter** | canopy (trees and shrubs shading stream) | Estimate the percentage of overhead canopy by standing on the streambank and looking up. (Average for 200' length of stream.)<br>0-25% 25-50% 50-75% 75-100%<br>  |
| | Large Woody Debris (LWD = logs ≥4" at thin end and ≥6' long; must be in water. Also includes rootballs.) | Count the pieces of LWD in the 200' survey area. It may be helpful to distinguish between fixed pieces and floating pieces, and between conifer logs and deciduous logs. Track changes from year to year. |
| | pools and undercut banks | Estimate the percent of pool and undercut bank area in the 200' survey area, including pools associated with LWD. Track changes from year to year. |
| **access to spawning areas** | spawning gravels | Estimate percent of gravel in each size category.<br>bedrock (solid rock)<br>boulders (>12")<br>rubble (3"-12")<br>spawning gravel (.25"-3")<br>sand / silt (<.25") |
| | barriers | Look for natural or man-made jumps (waterfalls, dams, failed culverts) higher than two feet, or any area where fish are observed trying and failing to negotiate an obstruction. |
| **temperature** | temperature | Measure water temperature with thermometer.<br>  |

# Table 2 - Habitat Surveys

| Frequency | Problem | Solution Suggestions |
|---|---|---|
| As needed | Garbage visible | 1. Community clean-up<br>2. Anti-litter campaign |
| Quarterly or seasonally (4x / year) | Very silted or highly turbid water | 1. Find source of siltation and correct problem<br>2. Construct in-stream sediment pond* |
| Quarterly | (Western WA) less than 50% canopy in spring or summer months | Replant native trees and shrubs along stream to provide shade. |
| Annually (1x / year) | Decreasing pieces of LWD over three or more years, or no LWD in 200' survey area | 1. Construct in-stream structures*<br>2. Replant native conifers along stream for future LWD recruitment. |
| Annually | Decreasing percent of pool area over three or more years, or no pools in 200' survey area | 1. Construct in-stream structures*<br>2. Replant native shrubs along stream bank to stabilize banks. |
| Annually | Less than 50% spawning gravel | Create spawning pads by putting spawning gravel in stream* |
| Annually | Presence of any fish barrier | 1. Notify landowner.<br>2. Assist private landowner with passage (fish ladder, replace culvert, dam removal, etc.)* |
| Quarterly | Summer temperature over 55F. | Replant native trees and shrubs along stream to provide shade. |

*** Requires HPA permit (Hydraulic Project Approval)**

## Redd Identification

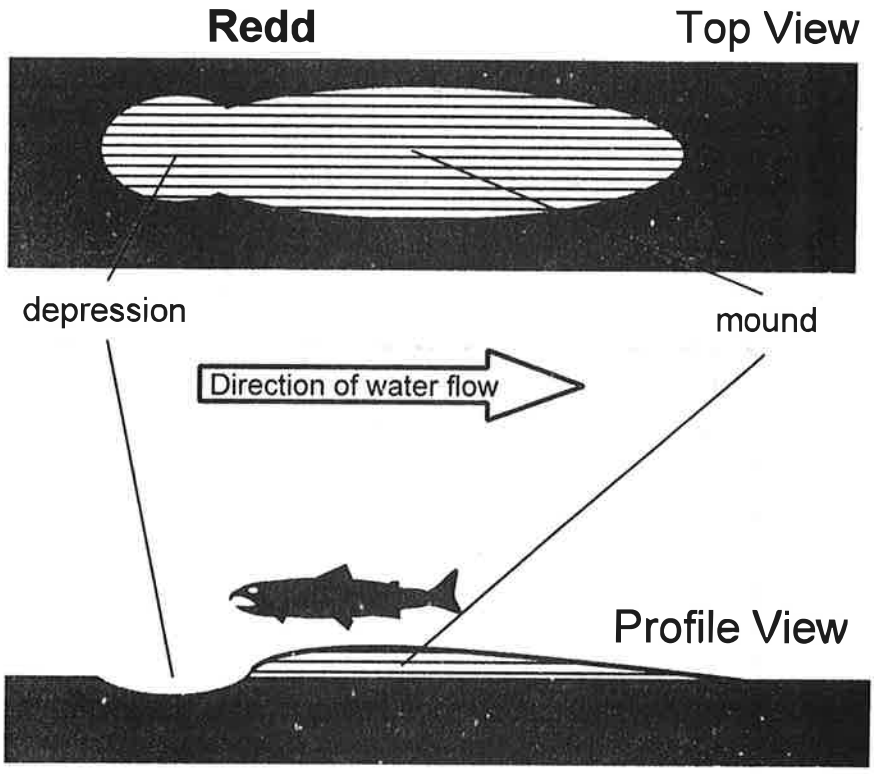
A valuable skill for anyone walking or working in Pacific Northwest streams and rivers is the ability to identify redds. Redds are salmon and trout egg nests; a female salmon or trout digs a depression in the gravel streambed, and lays her eggs there. She then covers them with more gravel to protect them from predators and to keep them from being washed away. The resulting structure, a redd, is an oblong mound of cleaned and sorted gravel, preceded by a small depression.

Although this structure has proven successful over the years at protecting salmon eggs from many forms of danger, it is not enough to protect them from a human foot. Therefore, it is our responsibility to recognize redds in the stream and to avoid them to the best of our ability.

Redds come in a wide variety of sizes, depending on the species of salmon that created it. Large chinook salmon build redds three to six feet wide and eight to 12 feet long. These huge structures can be seen and counted from a helicopter flying above the stream. Cutthroat trout, on the other hand, build tiny redds that can be less than one square foot in area. These small mounds are extremely difficult to recognize by all but the most experienced biologists.

The graphics on this page represent an 'average' redd. There is a small depression at the upstream edge of the redd, followed by a mound of cleaned gravel. This mound covers the eggs laid by the female salmon. The gravel is cleaner than the surrounding streambed because the rocks have been dislodged and the clean undersides have been exposed. Within a few weeks algae will have formed on the exposed surfaces, returning them to their previous color. But it is the first two weeks after the eggs have been laid, when the redd is most obvious, that are most important. The eggs are most fragile during this time, and the slightest disturbance can kill the entire nest.

If you find a redd, do not disturb it. Do not step on it or dig it up. Avoid working near it if possible. Also, avoid causing erosion upstream of it, because silt can clog the redd and smother the eggs inside by preventing water from flowing through the gravel.




### Redd Identification & Avoidance

1. **What a redd looks like;**
   a round or oval mound of cleaned gravel, often preceded by a small depression.
2. **Where to find redds;**
   on or around sand bars, on riffles, and the downstream edge of pools.
3. **The time of year to find redds;**
   mostly fall and winter, although some trout (including steelhead) redds are laid in spring.
4. **When redds are most vulnerable;**
   the first two weeks after being laid, when the gravel is still very clean and the redd is most easily seen.

## Step by Step Survey Instructions

### Step 1 - Stream and Site Selection

Fish surveys and habitat surveys have different requirements. For fish surveys look for places where fish can hide, like pools, undercut banks, and under logs. You should also have a discrete access route and observation spot so you can survey without fish seeing you. For habitat surveys pick a spot with 200' of streamside access, or as close to 200' as possible.

### Step 2 - Decide what you want to do

Perhaps you simply wish to see fish in your local stream. Or you may have more ambitious plans and want to conduct a thorough evaluation of your stream's health. Perhaps you even wish to change local land-use regulations. Knowing what you want to accomplish is an important part of surveying a stream. If you aren't sure what you want to do, pick a temporary goal; you can always change it later.

### Step 3 - Learn about your stream

What kind of fish use your stream? Are there any blockages that prevent salmon from migrating to your observation site? Have there been any recent pollution problems? What time of year do salmon typically spawn in your stream? The more you know about your local stream, the more you will gain from your surveys.

### Step 4 - Decide on a survey schedule

Most salmon migrate upstream to spawn anytime from September through December. Assuming that salmon are in your stream, the best way to see them is to survey your stream every two weeks for those four months. Unfortunately this requires a significant commitment, and monthly surveys are quite acceptable. Monthly surveys do have a slight risk of missing an entire salmon run if it is short, but the trade-off in time is often worth it.

Habitat surveys can be conducted quarterly or seasonally (four times per year.)

### Step 5 - Survey your stream

Now that you have decide what you want to do, where you can do it, and how often to do it, do it! As you observe fish or measure the riparian habitat, you can take notes or record your observations on the Data Input Form (page 14). Make copies of the form for future surveys.

Use your data to track your stream's health from survey to survey, and from year to year. You can also mail copies of completed data sheets to WDFW at the address below, where they will be put on file.

Washington Department of Fish and Wildlife
NatureMapping / Outreach and Education
600 Capitol Way North
Olympia, WA 98501-1091

## Table 3 Survey Calendar

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| spawning surveys | **Watch for salmon and trout redds !** | | | | | | | | survey from bank do not disturb fish | | | |
| juvenile surveys | | | look for smolts in spring | | | look for fry in summer | | | | | | |
| habitat surveys | winter survey | | | spring survey | | | summer survey | | | autumn survey | | |
| stream bugs | | | | look for EPT bugs in spring and summer | | | | | | | | |

# Data Input Form

Date_____ Name of Observer(s)_____

*Stream Info* Name_____ WRIA # (if known)_____ Empties to _____

*Location* County_____ Township/Range/Section_____ or Lat/Long _____

Property Owner Name _____ Phone # _____

| **Fish Survey** | number | sex (optional) #male/female | age (optional) #adult/jacks/juvenile | Behaviors/ Activity |
|---|---|---|---|---|
| species 1_____ | _____ | _____/_____ | _____/_____/_____ | |
| species 2_____ | _____ | _____/_____ | _____/_____/_____ | |
| species 3_____ | _____ | _____/_____ | _____/_____/_____ | |
| species 4_____ | _____ | _____/_____ | _____/_____/_____ | |

Redds (optional) No. of redds _____ Probable species _____

| **Habitat Survey** | (circle or fill in blanks) | better/worse/unchanged from last survey or previous year | source of problem or recommended solution |
|---|---|---|---|
| *Clean Water* | | | |
| garbage | **stream bank riparian zone** | _____ | _____ |
| silt | **high medium low clear** | _____ | _____ |
| *Shelter* | | | |
| canopy | _____-_____% | _____ | _____ |
| LWD | # of LWD in 200' survey area _____<br>#fixed/floating _____/_____<br>#conifer/decid. _____/_____ | _____ | _____ |
| pools | # in 200' survey area_____ | _____ | _____ |
| *Access to spawning areas* | | | |
| spawning gravels | bedrock _____%<br>boulders (>12") _____%<br>rubble (3-12") _____%<br>spawning gravel (.25-3")_____%<br>sand/silt (<.25") _____% | _____ | _____ |
| barriers | present ? (y/n)_____ Describe barriers and indicate locations on separated sheet. | | |
| *Temperature* | _____F or _____C | _____ | _____ |

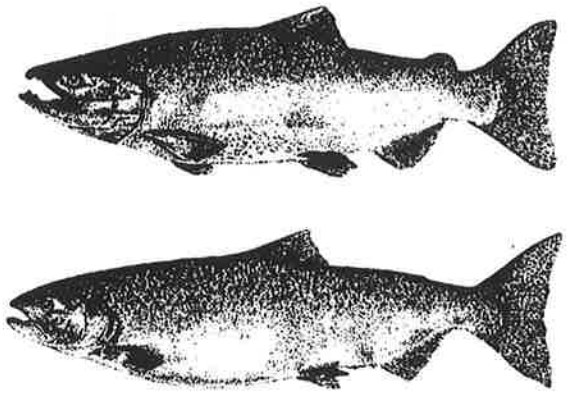
**Benthic Macro-Invertebrate Survey**

(check if present) mayflies _____ stoneflies _____ caddisflies _____

# Washington State Salmon

## chinook salmon

*Oncorhynchus tshawytcha*



other names: king, tyee, blackmouth (immature)
average size: 10-15 lbs, up to 135 lbs
fall spawner fall, spring, and summer runs

Chinook salmon are the largest of the Pacific salmon, with some individuals growing to more than 100 pounds. Such huge fish are rare, as most mature chinook are under 50 pounds.

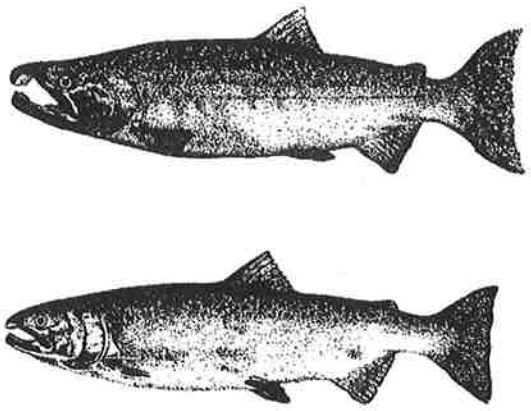
**Spawning** - Most chinook spawn in large rivers such as the Columbia and Snake, although they will also use smaller streams with sufficient water flow. They tend to spawn in the mainstem of streams, where the water flow is high. Because of their size they are able to spawn in larger gravel than most other salmon.

Chinook spawn on both sides of the Cascade Range, and some fish travel hundreds of miles upstream before they reach their spawning grounds. Those fish headed to eastern Washington must enter streams in spring and summer in order to reach their spawning grounds by fall, when they spawn. These long-distance travelers are called spring chinook or summer chinook. Fall chinook spawn closer to the ocean and more often use small coastal streams. All chinook spawn in the fall.

**Rearing** - Chinook fry rear in freshwater from three months to a year, depending on the race of chinook and the location. Spring chinook tend to stay in streams for a year; fish in northern areas, where the streams are less productive and growth is slower, also tend to stay longer. Rearing chinook fry use mainstems and their tributaries.

## coho salmon

*Oncorhynchus kisutch*



other names: silver
average size: 6-12 lbs, up to 31 lbs
fall spawner

Coho are a very popular sport fish in Puget Sound. This species uses coastal streams and tributaries, and is often present in small neighborhood streams. Coho can even be found in urban settings if their needs of cold, clean, year-round water are met.

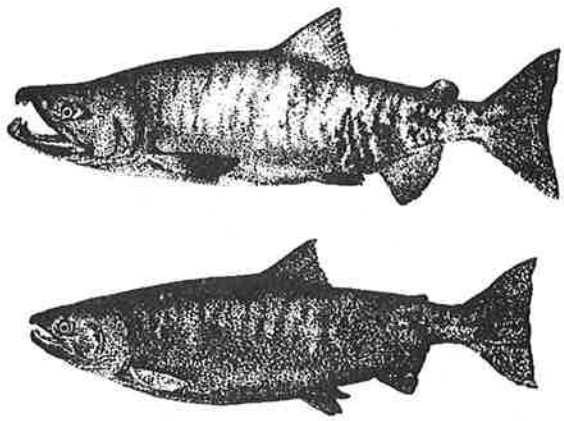
**Spawning** - Coho spawn in small coastal streams and the tributaries of larger rivers. They prefer areas of mid-velocity water with small to medium-sized gravels. Because they use small streams with limited space, they must use many such streams to successfully reproduce, which is why coho can be found in almost every small coastal stream with a year-round flow.

Returning coho gather at the mouths of streams and wait for rivers to rise, like after a rain storm. Only when the river rises will coho head upstream. The higher flows and deeper water enable the fish to pass obstacles, such as logs across the stream or beaver dams, that would otherwise be impassable.

**Rearing** - Coho have a very regular life history. They are deposited in the gravel as eggs in the fall, emerge from the gravel the next spring, and in their second spring go to sea, about 18 months after being laid as eggs. Coho fry can be found in the pools of small coastal streams and the tributaries of rivers.

## chum salmon

*Oncorhynchus keta*



other names: dog salmon, calico
average size: 10-15 lbs, up to 33 lbs
fall spawner

Male chum salmon grow large "teeth" during spawning, which look like canine teeth or fangs. This many explain the nickname "dog salmon." The other possible explanation is the tradition of feeding chum to dogs, because the flesh was not considered flavorful enough for humans.

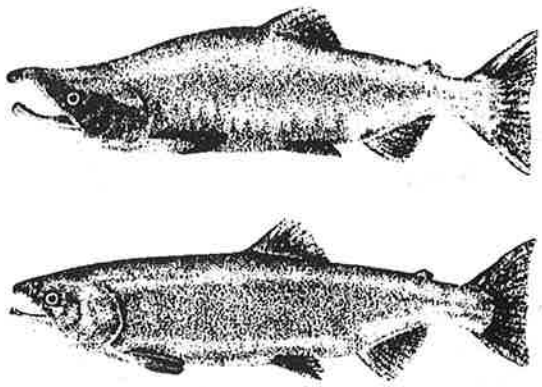
**Spawning** - Chum use small coastal streams and the lower reaches of larger rivers. They often use the same streams as coho, but coho move further up the watershed and chum stay closer to saltwater. This may be because of their larger size, which requires deeper water to swim in, or their limited jumping ability. Either way, the result is a watershed divided between the two species with all the niches filled.

Like coho, chum can be found in almost every small coastal stream. In the fall, large numbers of chum can be seen in most small Puget Sound streams. These large runs are one of the best chances to see native salmon spawning in a natural environment.

**Rearing** - Chum fry do not rear in freshwater for more than a few days. Shortly after they emerge, chum fry move downstream to the estuary and rear there for several months before heading out to the open ocean.

## sockeye salmon

*Oncorhynchus nerka*



other names: red salmon, blueback, kokanee 'silver trout'
average size: 5-8 lbs, up to 15 lbs
fall spawner

Sockeye are the most flavorful Pacific salmon. In Washington, sockeye are found in Lake Washington, Baker Lake, Ozette Lake, Quinault Lake, and Lake Wenatchee.

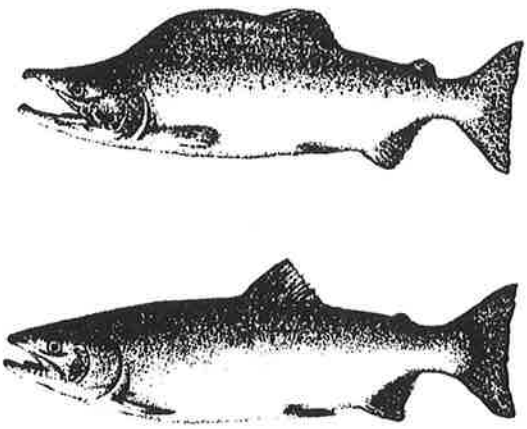
**Spawning** - Sockeye are unique in that they need a lake to rear in as fry, so the river they choose to spawn in must have a lake in the system. This seems to be the most important criteria for choosing a spawning ground, as sockeye can adapt to a wide range of water velocities and substrates.

Large rivers that supplied enough room for spawning and rearing historically supported huge runs of sockeye, numbering into the millions. One such run still exists today on the Adams River in British Columbia, a tributary to the Fraser River. The Canadian government has built viewing platforms for visitors where annual runs of more than a million sockeye are common. In Washington, there are several healthy sockeye runs on the west side of the Olympic Peninsula.

**Rearing** - Juvenile sockeye rear for one or two years in a lake, although they are also found in the inlet and outlet streams of the lake. Sockeye fry are often eaten by resident lake fish, and because they use freshwater year-round, they are susceptible to pollution.

## pink salmon

*Oncorhynchus gorbuscha*



other names: humpie, humpback salmon
average size: 3-5 lbs, up to 12 lbs
fall spawner

Male pink salmon grow a large hump on their back during spawning, hence the nickname humpback salmon. This is the smallest fall-spawning Pacific salmon. In Washington, pink salmon runs only occur in odd-numbered years.

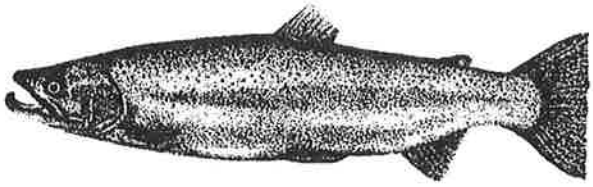
**Spawning** - Pinks use the mainstems of large rivers and some tributaries, often very close to saltwater. Because pink fry go straight to sea after emerging, the closer they are to saltwater the better. The shorter journey reduces predation and increases survival. Some pinks spawn right in saltwater, avoiding freshwater altogether.

Pinks have a very regular life history, living for two years before returning to spawn the next generation. This is why pink runs in Washington only occur every other year; there are no one-year-old or three-year-old fish to establish runs in even-numbered years.

**Rearing** - Pink fry do not rear in freshwater. Immediately after emerging they move downstream to the estuary and rear there for several months before heading out to the open ocean. Because of this, pink fry have no spots to provide camouflage in streams, but are bright chrome for open water camouflage. They are the only salmon fry that never have spots.

## steelhead

*Oncorhynchus mykiss*



other names: steelhead trout, sea-run rainbow trout
average size: 8-11 lbs, up to 40 lbs
spring spawner summer and winter runs

Steelhead and rainbow trout are the same species, but rainbow are freshwater only, and steelhead are anadromous, or go to sea.

**Spawning** - Steelhead spawn in the spring. They seem to choose the most inhospitable water possible; they like very fast water in the highest reaches of the watershed. These streams have areas of steep gradient and large substrate, the perfect rearing environment for steelhead fry. The adults spawn between these steep areas, where the substrate is small enough to dig into.

Steelhead (and cutthroat trout) are unique among members of *Oncorhynchus* because they can survive spawning, go back to sea, and return to their natal stream the following year to spawn again. These "repeat spawners" can be as much as 15% of a run, and some fish can spawn three or four years in a row. Females are more likely to be repeat spawners, because males spend more time in freshwater looking for multiple mates, and they spend energy fighting each other.

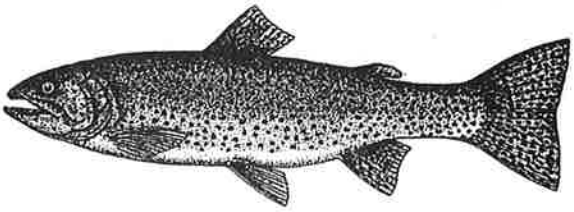
Like chinook, steelhead have two runs, a summer run and a winter run. The summer runs spawn primarily east of the Cascades, and enter streams in summer to reach the spawning grounds by spring. Winter runs spawn closer to the ocean, and require less travel time.

**Rearing** - Steelhead fry emerge from the gravel in summer and rear for one to four years, depending on the productivity of the stream. High altitude and northern streams are generally less productive. In Washington, most wild steelhead rear for two years.

Fry use areas with fast water and large substrate for rearing. They wait in the eddies behind large rocks, allowing the river to bring food to them.

## cutthroat trout

(coastal subspecies)
*Oncorhynchus clarki clarki*



other names: sea-run cutthroat, harvest trout, "blueback"
average size: 1-4 lbs, up to 6 lbs
spring spawner

Thirteen subspecies of cutthroat trout are indigenous to North America, but only this subspecies, the coastal cutthroat, is anadromous.

**Spawning** - Like steelhead, cutthroat are considered spring spawners, although spawning may start in mid-winter. These small fish seek the headwaters of coastal streams where the flow is very low and the substrate is small, almost sand. They prefer the upper-most portions of streams, areas that are too shallow for other salmon. This benefits their offspring, which are smaller than other salmon fry and do not compete well for food and space.

Unlike other salmon species that spend multiple years feeding far out to sea, cutthroat always overwinter in freshwater and only feed at sea during the warm months of the year. They also remain within a few miles of their natal stream. Protected estuaries and bays are excellent cutthroat habitat and are often quite productive.

Cutthroat (and steelhead) are unique among members of *Oncorhynchus* because they can survive spawning, go back to sea, and return to their natal stream the following year to spawn again. These "repeat spawners" can be as much as 15percent of a run, and some can spawn three or four years in a row.

**Rearing** - Most cutthroat rear in-stream for two to four years before first venturing into saltwater. Emerging fry are less than an inch long, and are poorly equipped to compete with larger coho and steelhead fry for resources. To compensate, cutthroat fry use headwaters and low-flow areas that coho and steelhead avoid.

# Washington Inland Fish

The following is a list of 82 fish species in Washington state that can be found in freshwater. This list includes anadromous fish, marine fish which occasionally occur in freshwater, and freshwater species.

**Key**
F = freshwater species
A = anadromous species
B = species with both freshwater and anadromous life histories
M = marine species
I = introduced species

| | | | |
|---|---|---|---|
| Family - Petromyzontidae (lampreys) | | | |
| Western brook lamprey | <7" | F | coastal streams west to Yakima River |
| River lamprey | 5-12" | A | probably in most major coastal rivers |
| Pacific lamprey | 5-30" | A | coastal streams west to Yakima and Snake rivers |
| Family - Acipenseridae (sturgeon) | | | |
| white sturgeon | 1-20' | B | Columbia, Chehalis, and Snake rivers; marine water |
| green sturgeon | 1-7' | A | Large coastal rivers, e.g., Columbia and Chehalis |
| Family - Clupeidae (herrings) | | | |
| American shad | 4-22" | A,I | Columbia River, with smaller runs in the Willapa and Chehalis |
| Family - Salmonidae (salmon, trouts, chars, whitefish and graylings) | | | |
| arctic grayling | 4-18" | F,I | one population in Washington, in one lake |
| lake whitefish | 6-24" | F,I | Banks and Roosevelt lakes (Columbia system) |
| pygmy whitefish | 2-7" | F | mostly in Columbia system lakes and streams |
| mountain whitefish | 3-17" | F | statewide |
| Atlantic salmon | | B,I | no known naturally reproducing population in Washington; occasional escapees from salmon farms |
| brown trout | 4-27" | F,I | statewide; warm water streams and lakes (68-75 F) |
| golden trout | 2-14" | F,I | several lakes above 5000' |
| Dolly Varden | 3-18" | B | statewide |
| bull trout * | | | |
| brook trout | 3-14" | F,I | cool streams and lakes |
| lake trout | 5-30" | F,I | cold, deep water lakes, mostly in eastern Washington |
| chinook salmon | 36-52" | A | See Appendix 1 |
| coho salmon | 16-30" | A | See Appendix 1 |
| sockeye salmon | 14-24" | A | See Appendix 1 |
| pink salmon | 12-18" | A | See Appendix 1 |
| chum salmon | 26-36" | A | See Appendix 1 |
| steelhead or rainbow trout | 10-32" | A | See Appendix 1 |
| coastal cutthroat trout | | | |
| sea-run form | 8-18" | A | See Appendix 1 |
| resident form | 6-18" | F | small coastal streams and associated lakes |
| westslope cutthroat trout | 7-12" | F | Eastern Washington streams and alpine lakes |
| lahontan cutthroat trout | 20-30" | F,I | Lenore Lake and Omak Lake; no natural spawning |

| | | | |
|---|---|---|---|
| Family - Osmeridae (smelts) | | | |
| eulachon | 1-7" | A | coastal rivers, particularly the Columbia River |
| longfin smelt | 1-5" | A | coastal rivers (a landlocked pop. in Lake Washington) |
| Family - Umbridae (mudminnows) | | | |
| Olympic mudminnow | 1-2" | F | endemic to Olympic Peninsula swamps and bogs |
| Family - Esocidae (pikes) | | | |
| grass pickerel | 4-10" | F,I | Palouse river drainage only |
| northern pike * | | F,I | Spokane river system; a few lakes in NE Washington |
| tiger muskie | to 50" | F,I | Mayfield, Merwin, Newman lakes |
| Family - Cyprinidae (minnows) | | | |
| carp | 7-23" | F,I | statewide |
| goldfish | 1-18" | F,I | range variable, population of discarded pets |
| tench | 5-18" | F,I | Columbia system, Spokane River, Lake Washington |
| lake chub | 2-5" | F | Columbia River system |
| peamouth | 4-13" | F | coastal and Puget Sound drainages, Columbia system |
| tui chub | 2-13" | F | central Washington, east of Columbia River |
| northern squawfish | 2-20" | F | coastal and Puget Sound streams, Columbia system |
| chiselmouth | 2-10" | F | Columbia river system, primarily east of Cascades |
| redside shiner | 1-6" | F | statewide |
| longnose dace | 2-4" | F | statewide |
| leopard dace | 1-3" | F | Columbia river system, east of Cascades |
| speckled dace | 1-4" | F | statewide |
| Family - Catostomidae (suckers) | | | |
| longnose sucker | 2-17" | F | primarily in Columbia River system |
| largescale sucker | 2-17" | F | statewide |
| mountain sucker | 1-8" | F | Columbia River system |
| bridgelip sucker | 3-15" | F | Columbia River system |
| Family - Ictaluridae (catfishes) | | | |
| tadpole madtom | 1-4" | F,I | Introduced to Snake River, Idaho; now in Walla Walla River; range may be slowly expanding |
| channel catfish | 2-30" | F,I | Columbia, Snake, and Walla Walla systems; lakes |
| yellow bullhead | 3-15" | F,I | uncommon |
| brown bullhead | 3-12" | F,I | statewide |
| black bullhead | 1-13" | F,I | uncommon |
| blue catfish * | | F,I | uncommon, Snake and mid-Columbia only |
| Flathead catfish | | F,I | uncommon, Snake and mid-Columbia only |
| Family - Poeciliidae (livebearers) | | | |
| mosquitofish | 1-2" | F,I | statewide (introduced yearly for mosquito control) |
| Family - Gadidae (cods) | | | |
| burbot | 9-30" | F | Columbia system and deep lakes |
| Family - Gasterosteidae (sticklebacks) | | | |
| three-spine stickleback | 1-3" | B | statewide |

| | | | |
|---|---|---|---|
| Family - Percopsidae (troutperches) | | | |
| sandroller | 2-5" | F | large coastal river systems |
| Family - Percichthyidae (temperate basses - true basses) | | | |
| striped bass | 5-30" | B | Columbia River, very rare |
| Family - Centrarchidae (sunfishes) | | | |
| largemouth bass | 3-18" | F,I | statewide |
| smallmouth bass | 3-18" | F,I | statewide |
| rock bass | 1-9" | F,I | statewide |
| black crappie | 3-11" | F,I | statewide |
| white crappie | 3-11" | F,I | statewide |
| bluegill | 2-8" | F,I | statewide |
| pumpkinseed | 1-7" | F,I | statewide |
| green sunfish | 2-9" | F,I | Found in Sacheen Lake and Diamond Lake |
| warmouth | 2-9" | F,I | Silver Lake, Sacajawea Lake, possibly other lakes |
| Family - Embiotocidae (surfperches) | | | |
| shiner perch | 3-5" | M | Puget Sound, bays and estuaries |
| Family - Percidae (perches) | | | |
| walleye | 5-30" | F,I | Columbia River and associated lakes |
| yellow perch | 4-12" | F,I | statewide |
| Family - Cottidae (sculpins) | | | |
| Pacific staghorn sculpin | 3-10" | M | Puget Sound and estuaries |
| coastrange sculpin | 1-4" | F | coastal and Puget Sound streams; Columbia River |
| shorthead sculpin | 1-4" | F | statewide |
| Piute sculpin | 1-4" | F | Eastern Washington |
| torrent sculpin | 1-5" | F | statewide |
| slimy sculpin | 1-4" | F | upper Columbia River |
| prickly sculpin | 1-5" | F,(M) | coastal streams; also estuaries (saltwater tolerant) |
| margined sculpin | 1-3" | F | Walla Walla, Touchet, and Tucannon rivers only |
| mottled sculpin | 1-5" | F | Columbia and Yakima drainages, and White River |
| riffle sculpin | 1-3" | F | coastal streams |
| reticulate sculpin | 1-3" | F | coastal streams |
| Family - Pleuronectidae (right-eye flounders) | | | |
| starry flounder | 5-25" | M | marine waters and coastal rivers |

# Critical Salmon and Steelhead Stocks

The following 12 stocks have been listed as **Critical** in the 1992 Washington State Salmon and Steelhead Stock Inventory (SASSI). A **Critical** stock is defined as *a stock of fish experiencing production levels so low that permanent damage to the stock is likely or has already occurred.*

Volunteer monitoring of these stocks or of the streams that these stocks inhabit should only occur with the expressed approval of WDFW fish management biologists.

| Drainage | Stock Identification | Fish Species |
|---|---|---|
| Nooksack/Samish | North Fork Nooksack | chinook |
| | South Fork Nooksack | chinook |
| Skagit | Baker River | sockeye |
| Stillaguamish | Deer Creek | steelhead - summer run |
| Puyallup | White River | chinook - spring run |
| Hood Canal | Hood Canal | chum - summer run |
| Strait of Juan de Fuca | Dungeness River | chinook - spring/summer run |
| | Discovery Bay | chum - summer run |
| | Discovery Bay | coho |
| | Lower Dungeness | pink |
| | Elwha River | pink |
| Upper Columbia | Asotin Creek | chinook - spring run |

In addition to these 12 **Critical** stocks, there are 122 **Depressed** stocks throughout the state, 113 **Unknown** stocks, and 187 **Healthy** stocks.

**Depressed Stock** - a stock whose production is below expected levels based on available habitat and natural variations in survival rates.

**Unknown Stock** - a stock for which there is insufficient information to rate stock status.

**Healthy Stock** - a stock of fish experiencing production levels consistent with its available habitat and within the natural variations in survival for the stock.

# Glossary

**Adult** A sexually mature salmon; also referred to as a spawning adult.

**Alevin** A juvenile salmonid immediately after hatching. Alevin remain within the gravel of the redd until their egg sac has been fully absorbed, at which time they are ready to feed in the stream as a fry.

**Anadromous** Fish that live part of or the majority of their lives in saltwater but return to freshwater to spawn.

**Barrier** Also known as a fish-passage barrier; any natural or man-made structure which prevents anadromous fish from migrating upstream. Barriers can be either complete barriers, which prevent all fish from moving upstream, or partial barriers which only block some fish or may only be a barrier some of the time.

**Broad-leaved** Trees that produce typical wide, flat leaves; the opposite of conifer.

**CFS** Cubic Feet per Second. The amount of water flowing past a given point on a stream.

**Canopy** The overhead matrix of trees and shrubs that shade a stream.

**Confluence** The place where two streams or tributaries join. Can be either the joining of two similar sized streams, or where a tributary joins a larger stream.

**Conifer** Although originally intended to refer to cone-bearing trees, in practice it refers to trees whose leaves are needles (pines, firs, spruces, larches, hemlocks) or scale-like (cedars). The opposite of broad-leaved.

**Deciduous** Trees that lose their leaves in the winter months; the opposite of evergreen.

**Distribution** In biology, the range or location of a particular taxon, usually determined to the furthest extent.

**Egg** The reproductive cell, or gamete, produced by a female fish. This term also refers to eggs which have been fertilized by the male gametes, but have not yet shown significant changes.

**Evergreen** Trees and shrubs that retain green leaves year-round; the opposite of deciduous.

**Eyed-egg** A significant stage in the development of a fertilized egg, in which a black dot or "eye" becomes visible on the surface of the egg. This stage of development is very important in fish production because the egg is very hardy at this point, and can be handled or transported with minimal mortality.

**Fry** A juvenile salmonid that has absorbed its eggs sac and is rearing in the stream; the stage of development between an alevin and a parr.

**Gradient** The slope of a streambed, expressed as a percentage.

**Habitat** The place an organism lives; healthy habitat provides for an organism's needs (food, shelter, etc).

**Jack** A spawning salmon that has reached sexual maturity a year earlier than most members of its species. Because they are a year younger, jacks are usually significantly smaller than other spawning adults. They are almost exclusively males.

**Juvenile** A sexually immature fish. For salmonids, alevin, fry and smolts are all considered juveniles.

**Kelt** An adult fish in freshwater that has spawned but is not yet dead. In sea-run trouts, kelts often survive spawning and can spawn again the following year.

**Lifestages** The various stages of a species' life cycle from egg to death.

**LWD** Large woody debris, also known as large organic debris (LOD). Refers to logs and rootwads that have fallen in the stream and contribute to the overall ecological and structural health of the stream.

**Migration** The seasonal movement of a group of similar organisms. Salmonids have two types of migrations; the spawning migration, in which sexually mature adult fish return en masse to their freshwater spawning grounds, and the smolt out-migration, in which juvenile fish leave freshwater and enter saltwater for the first time.

**Parr** Also known as a fingerling; an immature salmonid of approximately two to six inches long. The term "parr" refers to the camouflage "parr marks" on the side of freshwater rearing species (coho, chinook, steelhead). Parr are the salmon lifestage between fry and smolt.

**Polarized Sunglasses** Specially constructed sunglasses which allow light to enter the eye in such a way as to give increased vision to the wearer when looking into water. An important tool for fish identification.

**Pool** An area of relatively slow, deep water in a stream, often on the outside of a bend or downstream of an obstacle (culvert, LWD, rocks, etc.). Pools offer shelter and resting places for fish.

**Redd** A salmonid egg nest. A redd looks like a small mound of gravel in the stream, usually with a depression directly upstream of it, and the gravel may be cleaner or lighter in color than the surrounding gravel.

**Riffle** A shallow, gravelly area of streambed with swift current and increased dissolved oxygen, used for spawning and rearing; the most productive area of a stream.

**Riparian Area of Influence** The area around a stream or river which influences it by providing shade or by contributing organic debris. The size of this area is heavily dependent on the surrounding geology and the surrounding plant community; a stream in a flat grass field will have a very small area of influence, while a stream in the bottom of an old-growth canyon will have an area of influence to the top of the canyon walls.

**Riparian Zone** The area directly adjacent to a stream or river that has both terrestrial and aquatic influences. This area has moist or wet soils, and its plant community is uniquely adapted to wet conditions.

**Run** A stretch of fast, smooth current, deeper than a riffle and more shallow than a pool.

**Salmonid** Members of the family Salmonidae; includes salmon, trout, char, grayling, and whitefish.

**Silt** Tiny particles or debris in water, smaller than sand. Silt makes water appear cloudy or dirty, and creates health problems for most in-stream fauna.

**Smolt** A juvenile fish which has successfully reared and is undergoing physiological changes for transition from freshwater to saltwater.

**Spawn** The method of reproduction used by fish in which a female deposits her eggs and the male fertilizes

them. Can also refer to the reproductive process of migrating upstream to reproduce.

**Spawning Gravels** The gravel size best for the construction of salmon redds.

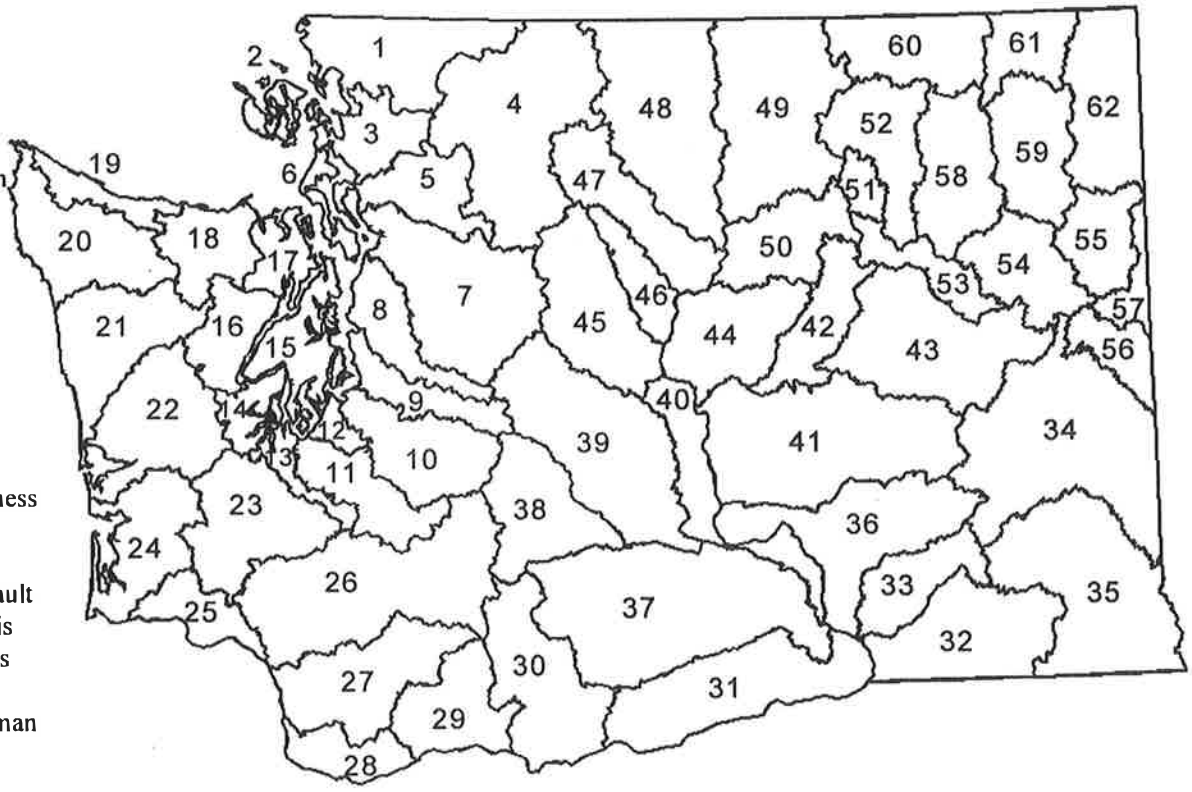
**Spawning Habitat** The preferred habitat for spawning; varies from species to species.

**Sub-adult** The salmon lifestage between smolt and spawning, or mature, adult. Sub-adult salmon live in the ocean but have not yet reached sexual maturity.

**Substrate** The material which comprises a stream bottom.

**Turbidity** A measure of the cloudiness or opaqueness of a sample of water, usually caused by fine sediments suspended in the water.

**WRIA** Water Resource Inventory Area. Washington State is divided into 62 WRIAs, each of which is assigned a name and number. Pronounced as "wy-ra."




1 Nooksack
2 San Juan
3 Lower Skagit
4 Upper Skagit
5 Stillaguamish
6 Island
7 Snohomish
8 Lk Washington
9 Duwamish
10 Puyallup
11 Nisqually
12 Tacoma
13 Deschutes
14 Shelton
15 Kitsap
16 Hood Canal
17 Quilcene
18 Elwha-Dungeness
19 Lyle-Hoko
20 Soleduck-Hoh
21 Queets - Quinault
22 Lower Chehalis
23 Upper Chehalis
24 Willapa
25 Grays-Elochoman
26 Cowlitz
27 Lewis
28 Salmon-Washougal
29 Wind-White Salmon
30 Klickitat
31 Rock-Glade
32 Walla Walla
33 Lower Snake
34 Palouse
35 Middle Snake
36 Esquatzel Coulee
37 Lower Yakima
38 Naches
39 Upper Yakima
40 Alkali-Squilchuck
41 Lower Crab
42 Grand Coulee
43 Upper Crab-Wilson
44 Moses Coulee
45 Wenatchee
46 Entiat
47 Chelan
48 Methow
49 Okanogan
50 Foster
51 Nespelem
52 Sanpoil
53 Lower Lk Roosevelt
54 Lower Spokane
55 Little Spokane
56 Hangman
57 Middle Spokane
58 Middle Lk Roosevelt
59 Colville
60 Kettle
61 Upper Lk Roosevelt
62 Pend Oreille