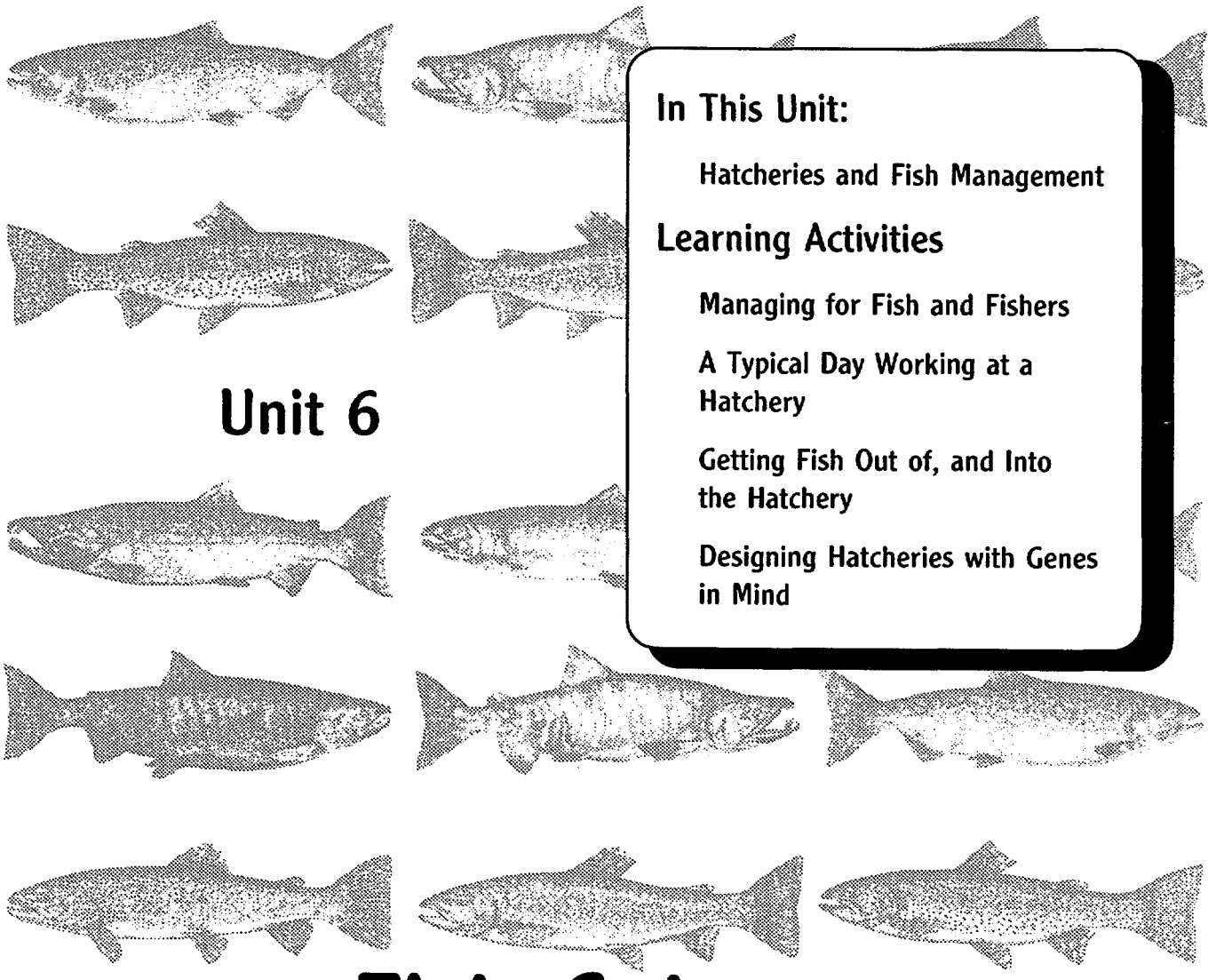


In This Unit:

Hatcheries and Fish Management

Learning Activities

Managing for Fish and Fishers

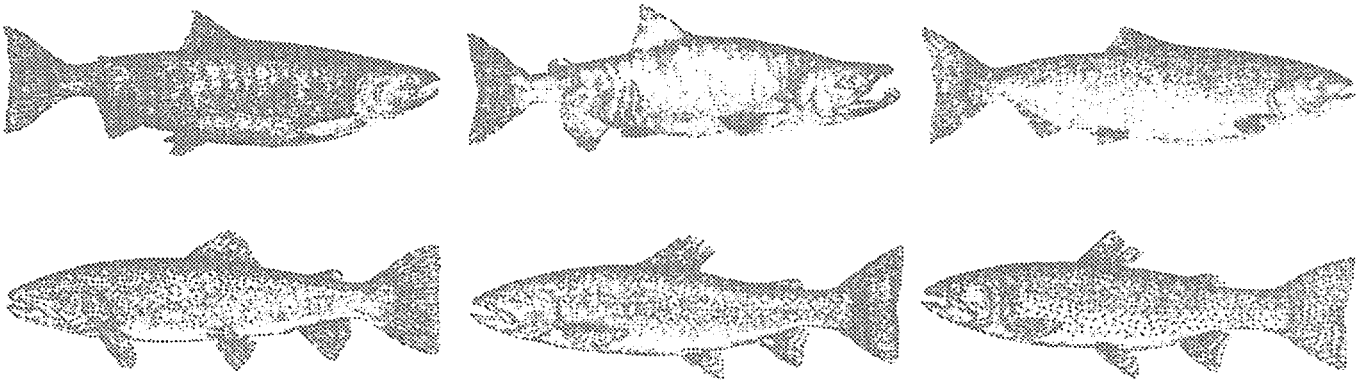
A Typical Day Working at a Hatchery

Getting Fish Out of, and Into the Hatchery

Designing Hatcheries with Genes in Mind

Unit 6

Fish Culture Meets Human Culture



The Hatchery Idea

(Background information for learning activities "Managing for Fish and Fishers," p. 183 and "Designing Hatcheries with Genes in Mind," p.201)

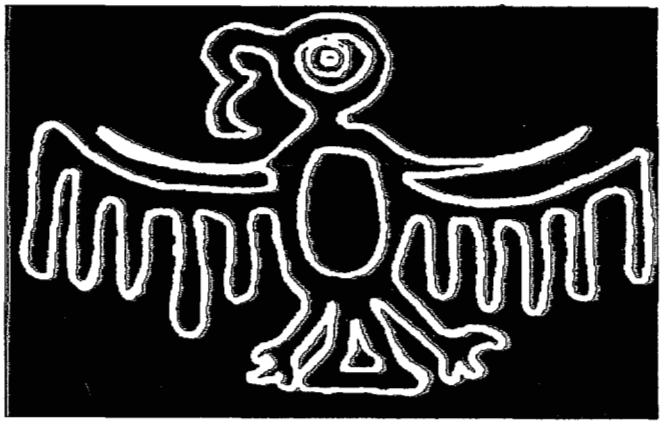
Introduction

The original human inhabitants of Washington had little use for fish hatcheries. Their numbers were relatively few, and the fish they took from their surroundings had little effect on the overall fish population. But fish, especially salmonids, played an important part in their culture. Courtland Smith, in Salmon Fishers of the Columbia, writes:

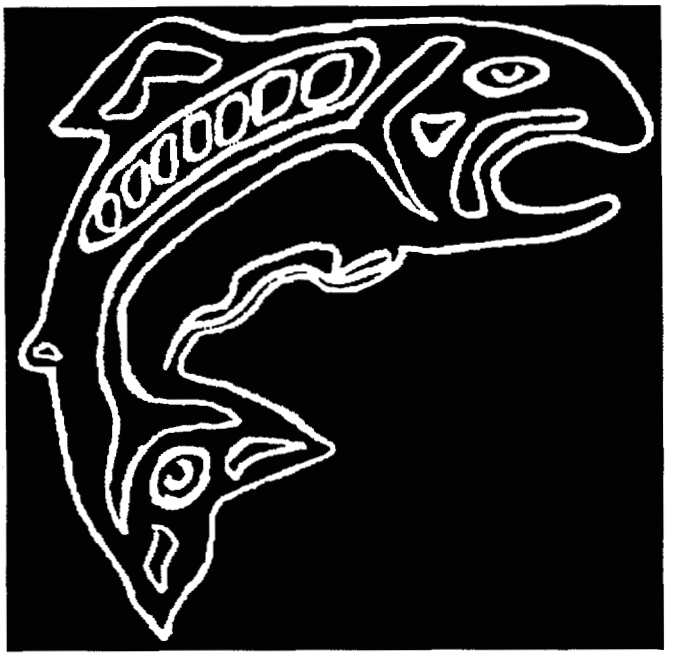
"The Indians' oral literature suggests that they believed in a time when `animals walked about as men,' though having approximately the same mental and, to a large extent, physical characteristics as now. But things were not as they should be and it was necessary for a culture-hero or transformer to rectify the weak points in creation. Coyote was the miracle transformer, but according to anthropologist Edward Sapir, Coyote was not a chief or hero- that special position was reserved for Eagle and Salmon.

...Coyote did much to improve conditions for the people in the Columbia Basin. He created the Columbia River and the fish in it by making an outlet to a pond where two women kept fish. Coyote said to the women, 'Now by what right, perchance, would you two keep the fish to yourselves?' Coyote told of the coming of people to the region, and he said of the salmon, 'those fish will be the people's food.' He provided the people with mouths and then taught them how to catch and cook salmon.

For Native Americans, Coyote was not a chief or hero- that special position was reserved for



For Native Americans, Coyote was not a chief or hero - that special position was reserved for Eagle and for Salmon



Native American fishermen saw Salmon as being immortal; and, because of this, they believed that salmon consciously

Eagle and for Salmon. Oral literature recorded by *anthropologists* indicates the importance of salmon throughout the culture of Columbia River peoples. Most texts include a salmon story.

The salmon story centers around the activities of Salmon in avenging the death of his father, a death attributed to the mischief of Coyote, Skunk (sometimes referred to as Badger), and five Wolves. In the story, Salmon meets and travels with his father's wife, whom he punishes for disgracing his father. Later he restores her as Dove. Salmon has the power to change his form, perform feats of strength, and transform physical phenomena.

As a hero, Salmon was capable of superhuman performances. For example, Salmon created Dove by pouring oil over her five times. 'She had no hair at all and they brought her home lean.' After Salmon's treatment, 'Her body was beautiful in every way.' Another time, in competing to break a pair of antlers in order to marry the chief's daughter, all the animals tried and failed. 'Now there was one person in the house whose body was full of sores and boils.' Blue-Jay said, 'Let him try what he can do, the one whose body is sore all over.' When all the animals had tried and failed, the one with the sores rose and shook his body, his blanket, and his hair. He became very beautiful, and the people saw that he was Salmon. Salmon went to the middle of the house, 'took up the antlers and broke them ... into five pieces and threw them down.'

Native American fishermen saw Salmon as being *immortal.* Because of this, they believed that salmon consciously allowed themselves to be caught. Many forms of gear were used to catch salmon. These included traps, *seines, weirs,* baskets, spears, and hook and line. Coyote was the principal teacher in gear construction and use."

From Subsistence to Trade and Exploitation

There were perhaps 100,000 Native Americans living in the Pacific Northwest in the mid-1700's. When whites began to settle in what was to become the state of Washington in the early 1800s, they found that the Native Americans here relied heavily on salmonids. In the Columbia River alone, a Native American population estimated at 50,000 caught about 18 million pounds of salmon each year. Native Americans who lived along the Columbia River; along the Pacific Ocean coastline from northern California to Alaska and throughout Puget Sound; as well as Great Basin peoples and many others fished for salmon and other fish to eat. Salmon especially was valued as a trade item among the various tribes and bands.

As the influx of whites continued, Native American populations declined significantly, mostly due to settler-introduced diseases. Some tribal groups disappeared. About 1845, the settler population and the Native American population were about equal in size at 10,000 each. By 1870, the settlers numbers reached 100,000 while the Native American population declined to under 10,000. By 1900, the combined population of Idaho, Oregon, and Washington reached 1 million. The settlers who came to the Pacific Northwest after 1800 were primarily farmers. To deal with disagreements between American Indian and non-Indian ways, the U.S. government negotiated treaties with many Indian groups.

Courtland Smith writes:

"Treaties allowed Indians and white settlers to fish in common for salmon. In the 1860s, Columbia River salmon resources were adequate to serve the needs of both. Many settlers had more than their fill of salmon, which, along with potatoes, were staples of their wintertime diet. The salmon resource was perceived as inexhaustible.

Some settlers saw more than subsistence in the salmon. They envisioned riches that could be gained from trade and commerce. Several tried to market salmon, but means of preservation were inadequate.

The first attempt to market salmon-shipment of barrels of salted salmon to Hawaii, the Atlantic Coast, and Europe-was not particularly successful." But when the technology of canning salmon was introduced to the Pacific Coast in 1864, salmon and the salmon trade became the source of livelihood and even riches to many. Biologists believe the Columbia River system alone supported annual runs of 15 million wild salmon and steelhead at this time. Today, the total run is about 2.5 million fish, most of which are hatchery fish.

The Hatchery Idea

To the early settlers of the Pacific Northwest, this place was truly the land of milk and honey. The bounty of natural resources seemed endless. The story here is no different than other 19th Century American histories describing the occupation of wild lands by newcomers of European heritage.

For the new arrivals to the territory, the first job was to survive. The wilderness was not a friendly place for those people not native to the environment, but survive they did. A wilderness tamed soon became a wilderness to be used. Thick carpets of tall trees and clear rivers jammed with fish were no longer considered just wood for shelter and food for individual tables. By the last third of the 19th Century, these resources became the fodder of commerce.

For those who think the "Good Old Days" of fish abundance were in the decades just prior to World War II, consider this: the largest annual harvest of salmon and steelhead from the Columbia River was in 1884. It has been downhill since then.

Rather than focus on the causes of subsequent declines and seek to correct them, leaders of that time adopted what seemed a logical, and relatively painless, solution. If enough fish are not produced

naturally, then they would fill the void themselves.

The earliest Pacific Northwest hatcheries were established in Oregon and operated by private individuals and commercial canneries. In 1890, Washington Governor Eliza P. Ferry appointed James Crawford the state's first Fish Commissioner. The 1891 Legislature appropriated $15,000 for a salmon hatchery. The first Washington State operated hatchery was built along the Kalama River in 1895. Its goal - produce more fish for harvest. The ultimate impact of such no-holds-barred hatchery production was not considered, or even understood as an issue at the time. By March 31, 1917, there were 26 salmon hatcheries, 7 trout hatcheries, and 9 eyeing stations.

The University of Washington, College of Fisheries graduated its first class of five fisheries scientists in 1921. These fledgling biologists entered the working world, assuming that producing fish in hatcheries and fishery management were synonymous. Running hatcheries to churn out more fish was what fishery managers did. New obstacles loomed on the horizon.

Begun in 1933, Bonneville Dam was dedicated by President Franklin D. Roosevelt in 1938. Fortunately, people who better understood salmon and steelhead migration were able to affect changes in the original Bonneville design which did not include any upstream fish passage facilities.

Not so for Grand Coulee Dam on the upper Columbia in Washington State. Completed in 1941, this behemoth forever blocked salmon and steelhead passage to upstream spawning waters and reduced natural production from 11 to 65% on the river, depending on the species.

Once trained fishery managers were in place and effective, the focus gradually began to shift from the exclusive needs of harvesters to the requirements of the fish as well.

Old Methods, Old News

When hatcheries began operation in the late 1800s, operators trapped wild fish to serve as brood stock. In some extreme cases, entire wild runs were trapped out to meet hatchery needs, seriously damaging natural-spawning production.

Early hatchery operators also released their products without thinking of long-term impacts on native stocks already present. The basic concept was that salmon, steelhead and trout were generic. Therefore, there seemed to be no conflict about releasing Columbia River stock fish in mid-coast streams, for example.

Decision-makers supported construction of irrigation and hydroelectric dams that blocked fish passage under the assumption that lost natural production could be replaced or mitigated with hatchery programs.

But times and attitudes change with experience and new knowledge. Policies and methods that have since been proven ineffective or even harmful have been eliminated.

The Roles of Today's Public Hatcheries

The modern public hatchery operates for four basic reasons; in many cases, all four roles are played at the same facility. These basic roles are:

- Enhancement - This was the single role of hatcheries a century ago and remains important today. The goal is production of surplus fish to supplement harvest by sport and commercial users. Current efforts range from coho programs to support ocean fisheries to legal-size trout stocking in mountain lakes.

As long as the public demand to harvest fish exceeds the ability of natural habitats to meet production demands, hatcheries will be necessary. There is no getting around the numbers. Experts estimate that 70 percent of all salmon landed in Washington come from state-owned hatcheries. Loss of these fish would amount to elimination of some fisheries. Addition of these hatchery fish also serves as a buffer to protect against over-harvest of wild stocks using the same waters.

◆ Mitigation - This is also a long-standing function. Most of the Columbia River system hatcheries, for example, are mitigation facilities funded to replace natural production lost when dams cut off or flooded spawning and rearing areas. In most cases, these same facilities also enhance fisheries.

◆ Education - Because many hatcheries are close to population centers, they provide excellent opportunities for the public to see spawning fish. Most hatcheries have areas for interpretive displays concerning fish, habitat issues, and watershed stewardship. Hatcheries are valuable locations to fascinate and inform visitors.

◆ Conservation - This is the growth business for public hatcheries today. These facilities can be used as a key component for rehabilitation of declining natural stocks, be they trout, salmon or steelhead.

In decades past, most public decision-makers and fishery managers accepted the theory that loss of natural production habitats could somehow be covered by increased hatchery output. Essentially, hatchery fish were considered reasonable replacements for wild stocks. This certainly reduced the apparent need to protect habitats that were also desirable for other human uses. Not surprisingly, it was often much easier to get funding for a new or expanded hatchery than for a more vigorous habitat protection and improvement program.

The fact is, replacing wild stocks has not worked in practice. It is difficult for hatchery fish to replace wild stocks. Fishery managers are very aware today that maintaining healthy supplies of native or locally adapted stocks is key to the long-term survival of hatchery programs.

Developing the appropriate hatchery brood stock begins with wild fish adapted to native streams and lakes. In addition, periodic injection of wild vigor into hatchery stocks is important to prevent inbreeding and avoid domestication of hatchery populations.

A protected hatchery environment is also an effective way to boost lagging naturally-spawning stocks by helping more fish survive the challenges of the first several months of life in the wild.

The Future of Fish Production

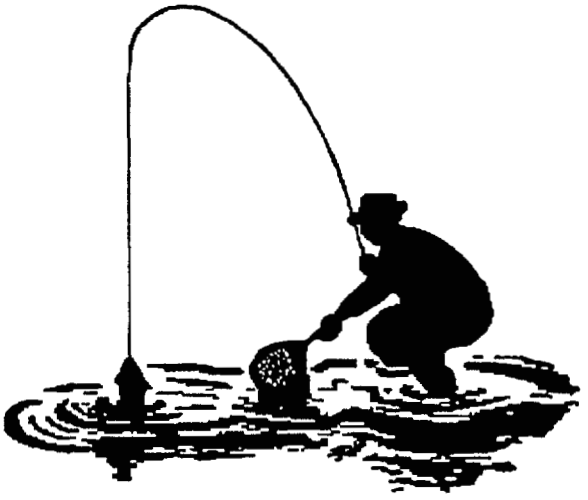
In 1860, hatcheries were unnecessary because the natural bounty exceeded the demand of human users. As this balance changed, hatcheries expanded to meet human needs.

By 1960, hatchery production was poised for massive expansion to meet growing public demand for greater sport and commercial harvest. Efforts were also underway to protect natural habitats and increase production, but more fish now still meant more hatchery fish. Today, this same public demands more fish, but a growing number of Washingtonians, including fishery managers themselves, openly resist further assaults on native fish. Some beleaguered Puget Sound and Columbia River salmon stocks have already been listed as threatened or endangered species. Other fish listings will, no doubt, follow.

Based on current information surrounding wild fish issues, a person might conclude this debate about fish enhancement and protection has become an either/or contest of hatchery fish versus wild fish. But wild fish management is not anti-hatchery; just anti-certain hatchery practices. A complementary program of hatchery and wildlife fish production is the goal.

The Department of Fish and Wildlife's Wild Salmonid Policy sets down strict guidelines on how wild and hatchery stocks can interact: that they should not interact, and certainly not interbreed, where a viable wild population exists. In some water bodies that lack potential conflicts (such as the fish population may be entirely of hatchery origin), the policy would allow the stocking of hatchery fish.

In some cases, creative handling of hatchery salmon releases can provide the enhancement bonus of more fish in ocean and lower river



With the need for recreational and commercial fish, and the need to protect many wild salmon, hatcheries now work in partnership with wild stocks, maintaining healthy supplies of native, locally adapted stocks.

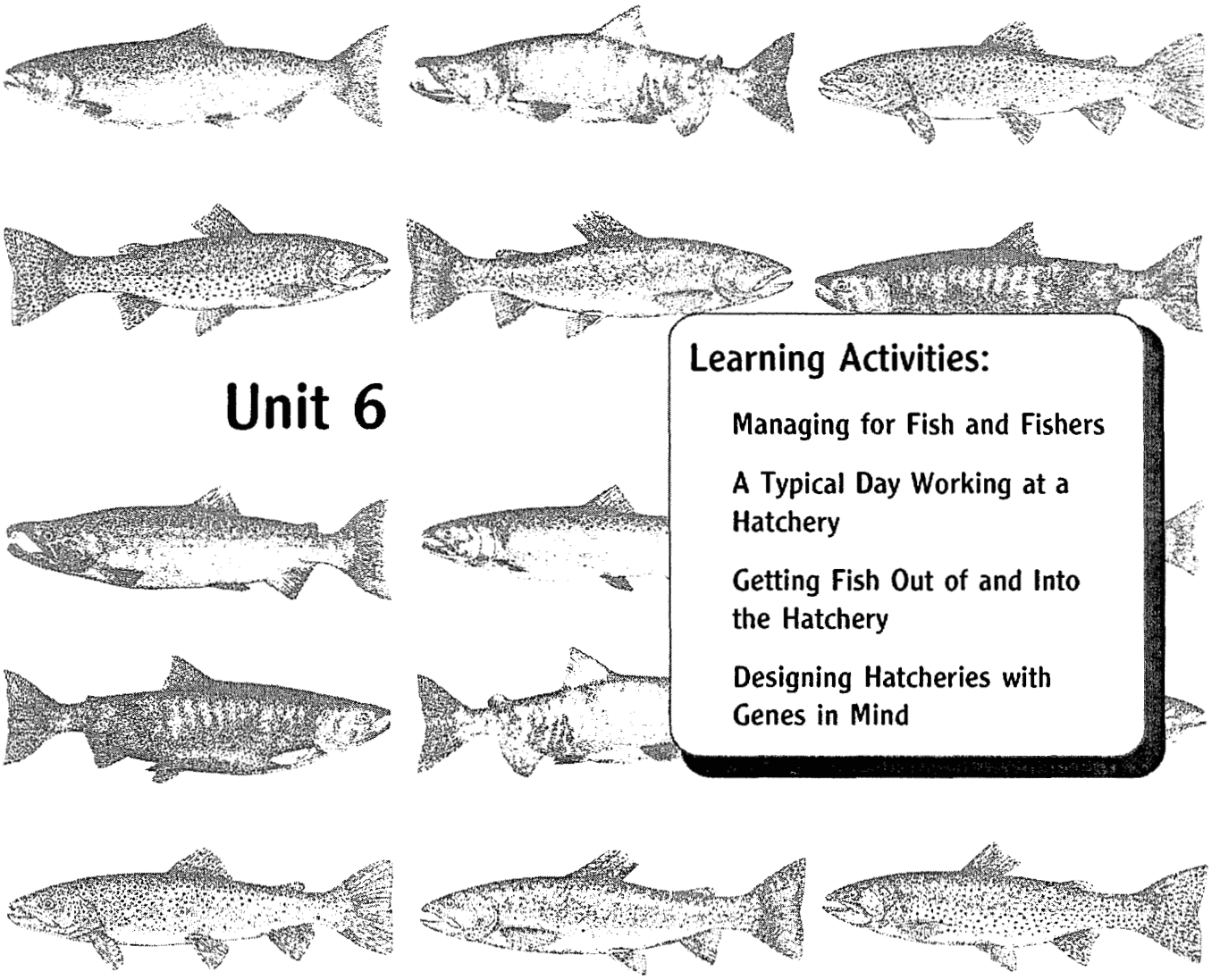
fisheries while avoiding competition with wild salmon stocks spawning and rearing in other tributaries.

Gone are the days of totally trapping out wild stocks to supply hatcheries with brood stock. Fish of the same species, but different origins are no longer mixed without thought of potential impacts. In short, the ways of decades past have been dropped, changed or enhanced where appropriate, reflecting a renewed commitment to protect the important genetic and cultural heritage of Washington's native fish stocks.

More or Fewer Hatcheries?

We are unable to go back to the days when the natural environment was pristine, untouched by humans. Current and future loss of fish habitat and increasing human needs for water have created a potentially irreversible decline in natural production capacity. Even with the increased efforts of the last 30 years to improve and protect fish habitat, declines continue. As human population increases, and with it high standards of living, the loss of habitat seems a sure thing.

Given the need for recreational and commercial fish, it does not appear that the need for hatcheries is going to decline; in fact, it will probably increase. But how hatcheries are used as a tool of fisheries management has, is, and will continue to change and grow as more is learned about the lives and needs of wild fish. Wild fish and hatchery management are partners in the fish resource future.



Unit 6

Learning Activities:

- Managing for Fish and Fishers
- A Typical Day Working at a Hatchery
- Getting Fish Out of and Into the Hatchery
- Designing Hatcheries with Genes in Mind

Fish Culture Meets Human Culture

Unit 6

Managing for Fish and Fishers

Key Concepts:

- Wild fish are the basis of successful hatchery programs because wild fish carry the traits of fish that survived in their genes.
- Hatcheries have a big role in today's and tomorrow's fisheries
- The role of hatcheries in fisheries management is changing to complement wild fish populations

Teaching Information

Read "Fish Culture Meets Human Culture", Unit 6 in "Background Information."

The Student Reading in this section is a shorter version of the information provided in the Unit 6 "Background Information." The "Background Information" is a useful reading for older students.

Materials

Copies of Student Reading

Managing for Fish and Fisher
Student Reading

We Washingtonians live in a special place - a place that allows us to share beautiful lakes, rivers, streams, and a vast ocean. We also inherit an obligation to pass on the quality of life and range of opportunities we enjoy to the next generation of people. But when it comes to fish and fisheries, we are beginning to see that we have not paid enough attention to making sure fish and the places they live will be here in the future.

For more than a century, people have cut off fish passage to spawning grounds, degraded water quality and quantity, and harvested too many fish from some populations. We built and operated fish hatcheries to make up for some of these actions. But we found that some of the ways we operated the hatcheries and used the fish they produced didn't solve the fish problem. Today we know that developing a hatchery "superstock" fish or increasing hatchery fish releases many times over is not the answer.

The answer is where it has always been-in Washington's streams and rivers. It is here that steelhead, salmon and trout have continued to live and reproduce in the natural environment, despite large odds against them. These survivors are our ticket to the fish future, because they carry in their genes the traits of fish that have survived. These wild fish are a precious resource, too valuable to lose.

Today, fisheries scientists are refining their management programs. Wild fish, streams and rivers, and fish hatcheries are partners in the fish and fishing future.

WHAT'S WILD?

To be considered wild, a fish population must meet two tests:

1. It must be a species of salmon, trout, whitefish, or sturgeon native to Washington (Some native, non-game fish listed as "sensitive" species are also included under this definition).
2. It must be naturally spawned and directly descended from a

population that was present in the same geographical area prior to the year 1800.

These fish are clearly the best fish for their native stream or river. If increased fish production is going to happen in these particular streams and rivers, it is the wild fish from that place that will make it happen!

Are there any wild fish populations left in Washington? Yes! Efforts are underway to identify and nurture these wild populations. And even though some earlier fish stocking changed the genetic makeup of some fish populations, the fish are surviving in their natural environments.

WILD AND NATURAL

Remember, wild fish are those that show an unbroken lineage of reproduction in their environment dating back to 1800. Natural production is a little different. It is a broader term that simply means reproduction that takes place in rivers and streams, whether the fish have been reproducing since 1800 or not.

FISHERIES MANAGEMENT AND HATCHERIES

So, where do hatcheries fit in all of this? The Washington Department of Fish and Wildlife's goal is to establish an overall fishery management program that is good for fish and fishermen, and all Washingtonians. This means that everything that affects fish must be considered. These include:

- wild fish conservation
- habitat protection and enhancement
- harvest management
- hatchery operations & stocking

Here's a short look at how these parts fit together.

Wild Fish Conservation:

The goal is to conserve the valuable genetic resources of certain populations. Doing this may mean making some changes in the hatchery practices and stocking methods. For example, a fishery for hatchery-produced salmon in a coastal bay and watershed may be concentrated on the lower portion

of the river system, while the upper portion of the river system is managed for wild populations.

Habitat Protection and Enhancement:

As information about habitat needs and availability is gathered, biologists, land and water managers, and even volunteers can expand the natural production capability of many lakes and streams, resulting in more fish.

Harvest Management:

Managing how many fish are caught by sport and commercial fishermen is something the Department of Fish and Wildlife has been doing for many years. But today, there's a new twist: catch and release fishing. Simply put, anglers release any wild fish they catch, while keeping the hatchery fish.

Using the example of the coastal bay and watershed: fishing regulations in the lower part of the river system would be more liberal, since the fishery concentrates on hatchery fish that are produced for people to catch. Anglers would release any wild fish, which are unmarked. The upper part of the river system would be more restrictive, since the idea is to protect the wild fish there. Differences in the timing of runs of both wild and hatchery fish could also be used to reduce harvest on wild fish, while increasing harvest on hatchery fish.

Hatchery Operations and Stocking:

A few people have concluded that being in favor of wild fish means being against hatcheries. And while some past hatchery practices have not helped natural production, hatcheries have provided lots of fishing opportunities in our lakes, rivers, streams and seas. Hatcheries today have a changing role in fisheries management, and continue to be a vital part of the overall fish future.

Examples of the changing role of hatcheries include:

- Increased emphasis on producing fish stocks that are genetically similar to the fish populations already present in the watersheds where the hatchery fish will be released. This gives both wild and naturally-producing fish

populations a chance to thrive.

- Often, more fish return to the hatchery than are needed for egg-taking and reproduction. When there are no or very few unique, naturally reproducing or native fish above the hatchery, many of the hatchery fish are allowed to pass above and spawn naturally in the hope of gaining some added natural production. To avoid "swamping" the existing fish, if there are significant numbers of naturally reproducing or native fish above the hatchery, the excess hatchery fish are either taken to other streams to spawn or sold for fish fertilizer or other products.

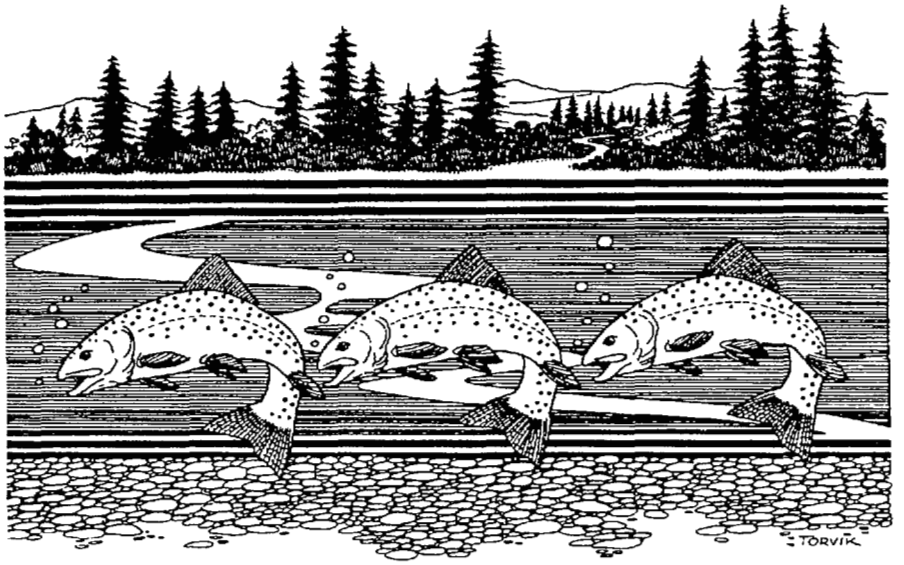
- Building ponds in the lower reaches of watersheds in which hatchery smolts can become "acclimated" to the lower river before they are released. This encourages returning adults to concentrate low in the system, leaving waters above open for natural production of locally adapted fish stocks.

GO SLOW AND GET THERE QUICKER

These changes can not be made overnight, and it may be a decade before all of them are complete. Well-thought-out approaches to hatchery operations, and careful study of the changes that are made will pay off in the long run. This should not require major reductions in hatchery releases or in contributions to hatchery fish to ocean and inland fisheries. And in the end, we will all benefit from a combination of hatchery-produced and naturally spawning fish.

Unit 6

A Day Working at a Hatchery



Key Concepts:

- Work at a fish hatchery varies from season to season and from job to job

Teaching Information

This student reading is written by three hatchery staff members, and is designed to give students a peek into the everyday life of hatchery work. As students read this section, have them circle parts they have questions about. Be certain to include these questions in the list of questions you generate to ask while at the hatchery.

Materials

Copies of Student Reading

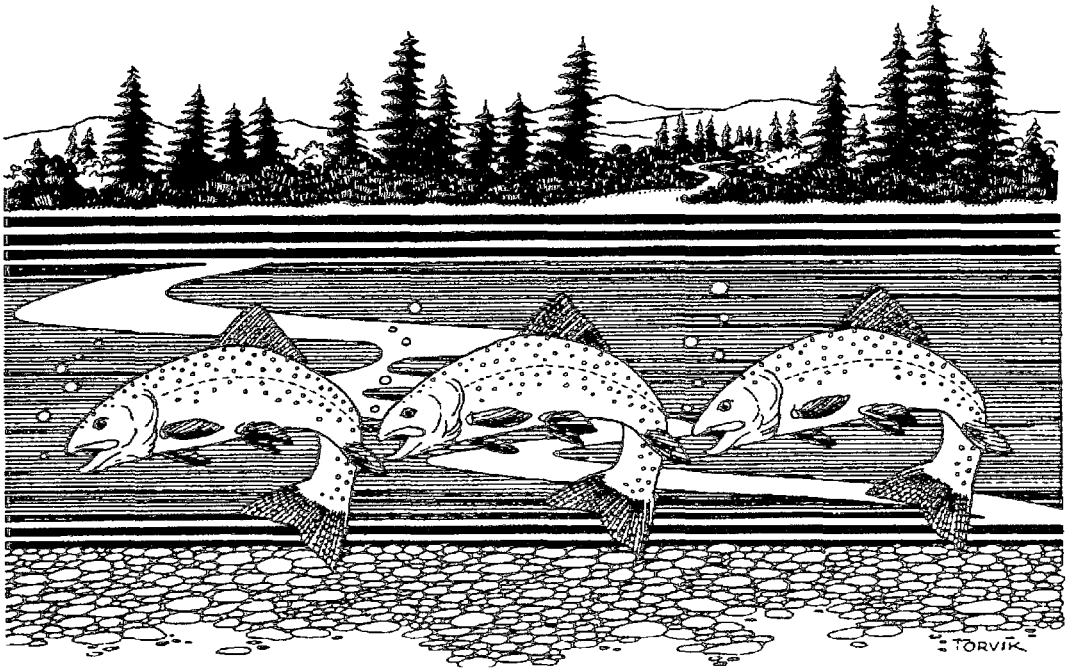
A Typical Day Working at a Hatchery
Student Reading

Hatchery work days are very different as the year passes. Many factors and seasons act upon what any given day in will be like. For example, an employee could be wrestling with adult salmon in the Fall; ponding fry (baby fish) in Winter; releasing or transferring fish in the Spring; and caring for growing fish in Summer. On other days or between fish duties the same employee could be taking care of hatchery maintenance.

In addition, each hatchery in the state can have different species or stocks of fish which they raise, adding to the many factors that dictate what an employee throughout the year.

Included are three stories, set in two different seasons, by hatchery employees describing their typical days.

As you read the stories, circle the parts you have questions about. These questions can be answered during the hatchery visit.



A Typical Day Working at a Hatchery

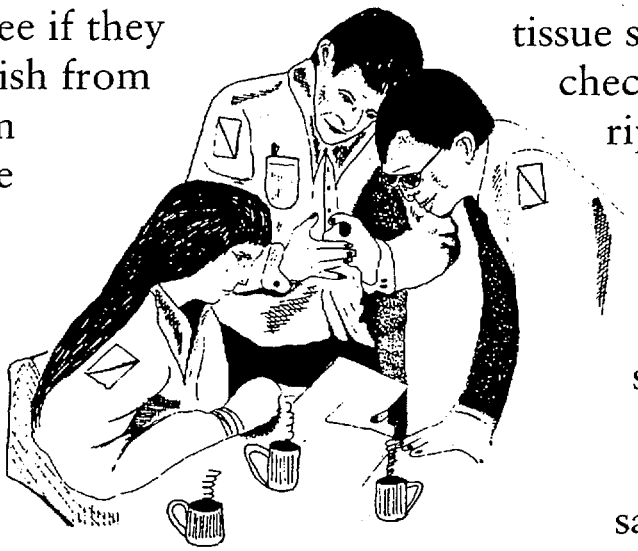
Student Reading

BY

Story One

Hello. My name is Terry, and I am a hatchery manager. Today is the first Monday in September, and before walking down to the hatchery, I am mentally preparing myself for the excessive leaf debris which I am certain blew in on top of the water intake screens in the wind last night.

My day starts at around 7 a.m., and twice this morning I spilled a considerable portion of my coffee on the slippery path from my house to the hatchery. As I pass the fish ponds, I sigh with relief and cheer on the good water flows... no clogged screens. I take a few minutes looking for signs of fur bearing predators (raccoons, opossums, etc.) to see if they have been stealing fish from the ponds again. An excellent start to the day - the water is flowing well, and no signs of any critters having a gourmet dinner at the ponds last night.



I arrive at my office and start planning the weekly work schedule, checking fish counts, and talking to the employee in charge of fish feed; the safety officer; and, the weekend "fish warden" to see if all is going well. I hold a staff meeting at 8 a.m. and set the work schedule in motion.

Only one staff member will stay at the hatchery to tend to the fish, and three staff members, including myself, load into our truck (with water, nets, and chemicals) and drive to the adult salmon trap. The drive takes about 45 minutes. When we arrive, there are around 90 newly trapped adult salmon flopping around with considerable energy. The pathologist meets us at the site, and collects tissue samples as we check each salmon for ripeness. It is much like when you check fruits for ripeness, only this process is much slimier!

As we move the salmon into the

anesthetizer, we find a few steelhead and move them back into the river. Finally, we find 30 ripe and 60 green chinook which is typical for this time of year. We spawn the 30 ripe chinook and place the eggs in net bags which are in a cooler, and drive back to the hatchery. Back at the hatchery, the newly obtained eggs are "trayed down" in incubators.

Shortly after we are back, the hatchery foreman brings in projection and ordering forms. We review, record, and update our spawning information for the headquarters office in Olympia. It seems that we are on target, and I double check for additional parts and supplies we may need when I pick up the next order.

A U.S. Forest Service employee stops by for a meeting concerning water supplies to the local campground. Our conversation digresses to the accident prone hikers we rescued last weekend. I am forced to wrap it up a few minutes after 5 p.m. - I have a date with my ten year old for a mountain bike ride. I quickly set off for the house.

Not too bad a day... who knows what tomorrow will bring.

Story Two

Hello. My name is Mike and I work at the hatchery in Issaquah, Washington. Today is Tuesday and it's October. My day starts at 7:00 am and I hurry over the foot bridge to the hatchery to set the day's schedule with my boss.

Today we must get into the adult salmon holding pond and check female coho salmon to see if they are ready for an egg take. We check by sight and feel. When the females look plump, we feel along their sides and bellies for a certain type of softness that means the eggs are ripe. It takes practice to get good at this. If enough females are ready, we'll gather eggs and select males to gather milt from to fertilize the eggs. If not, we wait for another day or so.

Before we get our waterproof gear on, we finish our coffee and discuss the health of our Lake Washington Steelhead fry in the incubation building. These fish are a special project for Issaquah Hatchery and one we are very proud of. We are trying to restore the steelhead to the tributaries of Lake Sammamish and Lake Washington where they once were in great numbers.

This program is different than our traditional program because we take eggs from about 25 wild steelhead that we catch at the Ballard Locks. We use different parents each year and will probably stop after five years. Hopefully enough adult steelhead will return to spawn in the creeks to keep the run going. Our steelhead receive special treatment like very clean, pathogen-free well water to grow in. This reduces the risk of disease and allows the fish to grow strong and develop their immune system. If there are other fish that are at risk of extinction, Issaquah Hatchery could be used to carefully increase their numbers, also. But in the end, we want the fish to survive without our help.

As I put on my waterproof gear, I look out the window and see two school buses arrive. Many students visit our hatchery to see the salmon in the creek and learn about their life cycle and habitat needs. Today's group is from Seattle. As I walk past, some of them giggle because my waterproof gear is big and bulky and makes me look a little bit like Tweedle Dee or Tweedle Dum from Alice in Wonderland. I pose for them and get a big laugh. There are many community volunteers that work here as guides for the school groups and helpers on spawning days. They make my job a lot easier and more fun, too.

It's time to get into the adult salmon holding pond. A few hatchery workers and some volunteers begin checking the female coho. While some are close to being ready, most are not, so we will wait a few more days.

Last night there was a big rain and many more fish came into the pond. We will have so many this year that volunteers from Friends of Issaquah Salmon Hatchery, the Muckleshoot Indian Tribe, and Trout Unlimited will take about 500 fish to nearby creeks that have no salmon. The adult fish will dig redds (nests), lay eggs, and then die. If the floods aren't too bad, we should see some young fish in the spring. The bodies of the adults will provide food for insects that the young fish can then feed on.

I go back to the office and start phoning our team and telling them that this will be a busy year for placing salmon in creeks. In fact, we better get started tomorrow!

Story Three

Hello. My name is Kurt, and I am a hatchery foreman. Today is Monday and it is January. My day starts about 7:15 am as I hurry down the path from my house to the hatchery. After a brisk walk I arrive at my office to review the work schedule and talk to the manager about what priorities need to be completed today and this week.

Next, I enter the break room where the hatchery crew is having their morning wake up coffee, exceptionally strong this morning. The discussion in the room this morning is over possible water related problems with the intake (the water in-take, the chiller, and the boiler can each have a major effect upon the water quality and must be monitored to provide a healthy environment for the fish). I sit hoping it will be a short talk, and that the intake really is not causing any problems this morning. The conversation moves quickly to what needs to be done today which sets our work day into motion. I drain my mug, and set off for the feed room.

Once in the feed room, I review where we stand with our feed sizes and amounts. At this time of year we are feeding large pellets (4.0 mm) to our smolts - which are growing and scheduled to be released this Spring - and small "starter feeds" to the recently ponded fry - which are small and are from September's egg take.

The crew and I take the feed out to the fish. In addition to feeding fish, we remove mortalities (dead fish) from the ponds. Feeding and mortality removal usually takes about two hours, but this morning we finish early, and enjoy a few extra minutes at break. After break, I prepare for the next project. During January, we are busy moving fry from the incubators and ponding them in outside ponds and/or inside tanks. This year our master plan includes 3 million fry, and space is at a premium.

We call this operation "cleaning up the fry." Cleaning up the fry doesn't involve soap and water but does involve getting dead eggs, dead fry, and silt separated from the healthy fry before they can be ponded. Once the fry are cleaned up from the incubators they are put into a clean pond or tank of running water. If water isn't flowing through the pond or tank

the fish will die because of lack of oxygen. The discussion this morning in the break room about the intakes and proper water flow reflects how important these factors are for the fish to survive.

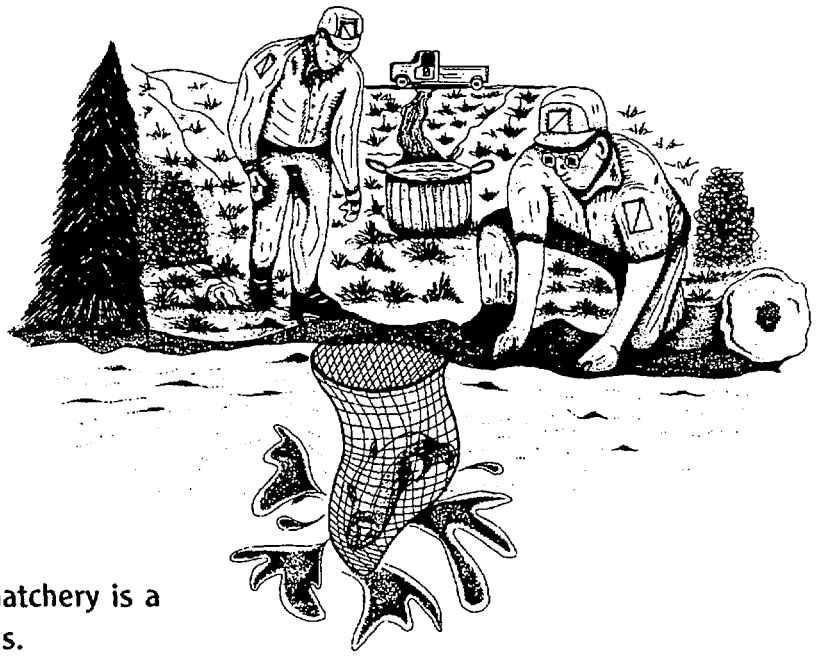
We will clean up and pond 250,000 fry into two tanks, and we plan to have over one million spring Chinook fry ponded by the end of the week. To prepare for this, I send another employee to begin setting up ponds for tomorrow. Last week, the two outside ponds we are using today were pressure washed to remove all dirt and debris. One of the inside tanks was scrubbed down and disinfected in preparation for the fry being ponded. Once cleaned out, we set up the ponds by putting in dam boards which sets the proper water depth, and by installing the small hole size screens so the fry can't escape. As the fish grow, we change these screens to ones with larger hole sizes for better flows and easier cleaning.

As the daylight fades, I sit down and send computer entries to the headquarters office in Olympia with the data about the fry we just ponded. Before leaving, I make one more check to make sure that good water flows are traveling to the incubators and ponds, and that the chiller unit and boiler unit are working properly.

As I end the day, I make a few entries in my work diary, talk with the manager about what was accomplished today, and plan what we want to get done tomorrow.

Unit 6

Getting the Fish Out of - and Into the Hatchery



Key Concepts:

- Moving fish to and from the hatchery is a big part of hatchery operations.

Teaching Information

This student reading is designed to help students expand their thinking about what goes on at a hatchery. Students should circle any parts of the reading that they have questions about, and inquire about the topic during the hatchery tour.

Materials

Copies of Student Reading

Getting Fish Out of - and Into the Hatchery

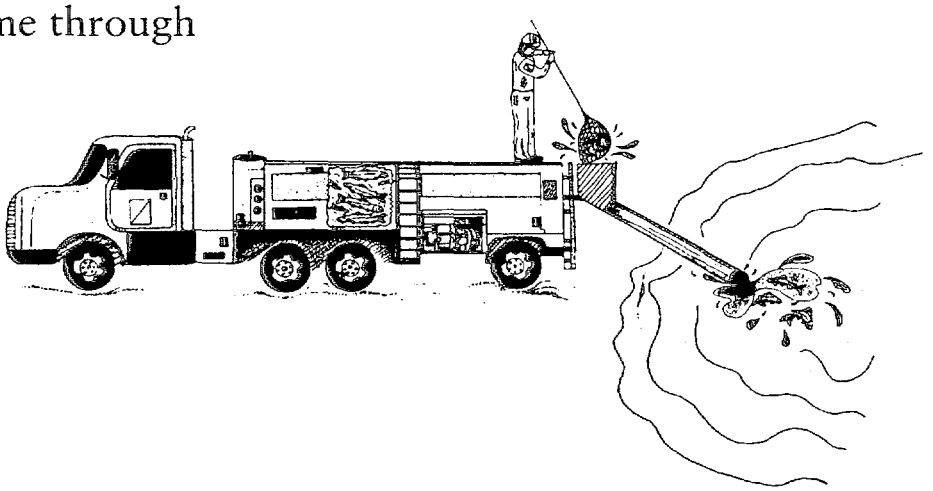
Student Reading

Getting fish out of the hatchery and into the place you want them can be tricky business. For one thing, you have to keep the fish in the water. For another, the place you want them may be miles from the hatchery. Finally, just having water to keep them in isn't enough. The water must be kept cool, as close to the temperature of the hatchery water as possible. And the water must be kept well supplied with oxygen. It's kind of like having to move both the fish and the habitat together!

In days gone by, fish stocking depended on good horses or mules, and even the strong backs of fisheries biologists. Fish were transferred to wooden or metal "kegs" and carried to the release site. Many high mountain lakes saw fish for the first time through this method (a large number of these lakes never had wild fish, and some of them still can't support fish year-round).

Today's hatcheries approach this problem in a variety of ways. The easiest method is to simply release the juvenile fish directly into the stream that normally flows by the hatchery. This is as simple as opening a valve to a holding pond, and "swoosh", the fish are gone. This stream is also where the hatchery may get its water for raising fish in the first place.

Another method involves placing the juvenile fish into tanker trucks, called liberation trucks, and driving the fish to the release point. The trucks are equipped with large tanks that both cool and oxygenate the water. The fish are released by pumping the tanks into a stream, or by using a hand-powered dip net to quickly take the fish from tank to stream.



Stocking high altitude lakes that don't lend themselves to roads and trucks is more exciting, especially for the fish. Helicopters are used to drop the fish into the lake. Surprisingly, the fish seem to survive just fine.

Occasionally, the Department of Fish and Wildlife still stocks some of these lakes by carrying the fish in. Often, volunteers help the Department in this task. Once the fish are out there in the world, they're on their own. They will grow, learn, and many will fall prey to a number of hazards.

Getting fish back to the hatchery involves three basic methods. The easiest one is to take advantage of the homing instinct of anadromous salmonids, also known as "letting the fish come to you". The fish come back to the hatchery outlet, their place of birth. The fish are then trapped or netted and held in a holding pond until they are ready to spawn.

Sometimes the hatchery is interested in obtaining "brood stock", or parents from wild or naturally producing fish populations to use as parents for producing hatchery fish. The brood fish are trapped or netted in a stream or lake and transported by truck (or carried) to the hatchery. The hatchery holds the brood fish in ponds at the hatchery site.

Finally, parent fish may be trapped and spawned on a stream or lake, and the fertilized eggs transported back to the hatchery to be raised in trays.

Unit 6
Designing Hatcheries With Genes In Mind

Key Concepts:

- Traits that enable fish to survive and reproduce are passed along from generation to generation by genes.
- Genetic diversity provides a fish population with a better chance of survival.
- Fish hatcheries can be operated so that both wild and hatchery fish populations benefit.

Teaching Information

This activity presents students with several dilemmas regarding operating a hatchery on a stream with wild fish present. While it has very general coverage of the issue of how to provide sport and commercial fisheries and protect wild fish populations at the same time, it should give students some insight into the factors that have to be considered in hatchery operations.

Background reading for the activity is contained in Unit 6, "Managing for Fish and Fishers." The activity will no doubt foster questions for the hatchery visit; students could write questions in their journals, or a class question list could be kept on a large sheet of paper and posted in your classroom.

Read over the activity and prepare the "clue cards." You should make up one set for each small group you plan to use; a good way to do this is to glue the clues to colored 3X5 cards, one color for each set. This will prevent the card sets from getting mixed up. Duplicate the "Hatchery Operations Decisions" for each group also; these can be glued to larger cards to extend their life.

This is a fairly open-ended activity; the "clue cards" have enough information to guide students to some agreement on the decisions, yet there is some room for discussion. Generally, the decisions should resemble the following:

Decision 1:

It is likely that fish from another stream have a different "library" of genes, genes that enable them to live just fine in their home streams, but not in your stream. To ensure the success of your hatchery, you need to use fish from the stream you are trying to improve,

because those fish have the best chance of survival in that particular place.

Decision 2:

Using fish from only a part of the run greatly limits the size of your gene "library." For instance, if you took fish from only the first part of the run, the resulting fish from your hatchery would likely all spawn early. This means that the population would ALL be affected by a spell of flooding that occurred during spawning time. It would be far better to get fish from the entire run, which would conserve all the genes carried in the population. This would lengthen the spawning time and make it likely that some of the fish would spawn after the flood.

Decision 3:

Biologists estimate that in most situations, you would need at least 100 pairs of spawning salmon to maintain adequate genetic diversity in your hatchery fish population. More is better, so if you can take 300 pairs from your stream and still leave plenty of wild spawners to spawn in the stream, you should do it.

Decision 4:

Increasing the spawning and rearing habitat makes room for more fish, both hatchery and wild, and therefore reduces competition. However, if the riparian and upland areas of the stream are being poorly used, your habitat improvements may not be successful.

Decision 5:

Most habitats are "seeded," or full and there is little room for more fish. The number of hatchery fish released has to be carefully watched, so as to reduce disruption to wild fish. However, you could create more rearing areas in the stream to make room, making it possible to release your hatchery fish in sites not used by wild fish.

Decision 6:

If your objective is to have more adults returning for anglers to catch, you would acclimate them to return to areas not used by wild fish. This reduces the chance that the hatchery fish will spawn with wild fish, protecting the wild fish gene pool. But if you want the returning fish to spawn and be part of the stream-spawned-and-reared population, you want the adults to return to the natural spawning areas. This is a one-time operation, because all you want to do is "jump start" the population so that it will be self-sustaining in future generations.

Decision 7:

You could close the trout fishery while the smolts (juvenile salmon) are migrating to the ocean, which would prevent trout anglers from catching them by mistake. To protect returning adults, you could allow catch-and-release only for wild fish, marking (fin-clipping) the hatchery fish so they could be easily identified by anglers. This would maintain a sport fishery while protecting wild fish at the same time. (This is common practice in Washington).

Once the group discussions are concluded, each group could report their decision and the reasons they made it. This should stimulate even more discussion.

Designing Hatcheries with Genes in Mind

Today there are about 20,000 different kinds, or species, of fish. These fish (and all living things) look and act the way they do because of traits they have inherited from their parents. These traits have developed over millions of years and many, many generations. Traits such as the ability to grow a strong tail fin to propel the fish, a slime layer that helps the fish glide through the water, or a coloring that makes the fish hard to see (camouflage) are easy to observe. But some traits are not so obvious. The "urge" to migrate up a river to spawn, the ability to defend a feeding territory with great vigor, the "drive" to emerge from an egg in the gravel to the stream above, or resistance to disease, are also inherited traits that help the fish survive.

These traits are passed along from generation to generation via structures called "genes", which are contained in the sperm and eggs of the parents.

If all fish in a stream had the same genes, they would all react to a change in the environment in the same way. For instance, if a stream suffered a very low water year, and none of the fish there had the combination of genes (the traits) to withstand a low oxygen, warm water environment, all of them would die. Luckily, fish in a stream do not have exactly the same genes. Over millions of years of spawning, wild fish populations have built up a wide variety of genes, each fish with a slightly different makeup. Some of the fish in the stream probably would survive, because they had inherited the ability to live in a warm water, low oxygen environment. These fish would be the basis of the rebuilding of the fish population in the stream. Some of these remaining fish would also have the inherited ability to survive in a cold water, oxygen-rich environment, which would be important if the stream returned to its original condition over time.

This illustration is an example of why every individual gene in a population is important, especially in a changing environment. The more differences in gene makeup between members of the population, the more likely at least some of the fish can survive the

changes. It is like having a great library, full of books (traits). If you threw away all the books that you didn't need at the time, you might be sorry later when you needed some different information. In the case of fish, it is best to keep as many different genes as possible in the population. Biologists call this "genetic diversity". The goal is to have populations of fish (and all living things) with as much genetic diversity as possible. This is why wild fish are so valuable - because they have developed the most genetic diversity. Suppose you had a situation in a stream where salmon spawning and rearing habitat was in short supply. Since wild salmon (the ones with the greatest diversity) depend on good habitat, wild salmon populations would be in short supply also. So you decide to grow some salmon yourself and SUPPLEMENT the wild fish Population with your own HATCHERY fish. Sounds like a good idea... Right? On the surface, raising a few fish to put into the stream seems fairly simple and in the early days of hatcheries, it was fairly simple. Nowadays, however, the decision is more complicated. This is because we know more about fish and their needs.

The "Hatchery Operation Decisions" below list several things you would have to consider before you built and operated your hatchery. See if your group can decide how to operate your hatchery, using the clue cards provided.

Your group will be given a set of clue cards. Deal these as you would playing cards until there are none left. Each member of the group then reads their clue cards silently. When everyone in the group is finished reading his/her clue cards, begin dealing with Decision 1. Group members can then read any clue cards they think might help in the decision. Once a decision is reached, record your decision (choosing a group recorder is a good idea) and move on to the next decision. Try to make all seven decisions in the time allowed.

Hatchery Operation Decisions

1) A run of salmon from a river system 100 miles to the south is particularly healthy and large. Does this sound like the place to collect males and females to provide eggs and sperm for your hatchery?

2) The run of salmon you want to use for your hatchery begins showing up on their natural spawning grounds in mid-August, and continues until about the middle of November, with peak numbers during late September and early October. Circle the time period in which you would capture fish for your hatchery:

August	September	October	November
- 15 - 30	1 - 15 - 30	1 - 15 - 30	1 - 15 -

3) You must decide how many male and female fish you will need to provide adequate genetic diversity for the fish you will raise in your hatchery. You decide to collect (circle one):

10 pairs 25 pairs 50 pairs 100 pairs 300 pairs

4) Now that you are going to operate a hatchery on your stream, would you need to also increase the spawning and rearing habitat in the stream?

5) You need to decide how many fish to release from your hatchery. Would you release as many as you can produce, or limit the number of fish you release each year?

6) Now you have to think about what will happen when your hatchery fish return to spawn. Would you acclimate your hatchery fish so that they would return to the areas used by wild fish for spawning, or acclimate them to return to areas not used by wild fish in your stream f or spawning?

7) Your stream, like all streams, has certain fishing regulations that apply to it. Given the situation your stream is in and the fact that you are now operating a fish hatchery on it, what regulations would protect your wild and hatchery salmon as they migrate to the ocean and the returning wild adults?

Fish are highly adapted to their home streams. Therefore, they have a better chance of survival in that stream than any other.	Fish are highly adapted to their home streams. Therefore, they have a better chance of survival in that stream than any other.
Even fish from adjacent watersheds or river basins have different "libraries" of genes, genes that enable them to survive well in their own streams, but not in other streams.	If you collected fish for your hatchery from the early part of the run only, the resulting offspring would likely all spawn early when they return as adults. Therefore, the entire population would probably be vulnerable to a spell of bad weather and flooding that occurred during spawning time.
You can get the greatest genetic diversity in your fish population by using the most fish you can when collecting eggs and sperm.	One hundred pairs of salmon are generally considered to be the minimum number needed to provide adequate genetic diversity to pass on to the next generation
Using fish from throughout a run would give you the largest genetic diversity in the off-spring.	The number of fish collected from a stream to use as hatchery brood stock is dependent on the number of wild fish available in the stream. The key is to leave enough in the stream to insure there will be enough to sustain the genetic diversity of the next generation of wild fish.
Hatchery fry released into a stream where wild fry are living can out compete the wild fish for both food and space.	Increasing the spawning and rearing habitat in the stream makes room for more fish, both hatchery and wild.
Creating more good habitat in streams helps the wild fish population grow.	Habitat improvements projects in streams car be ineffective if riparian and upland areas of the stream are being poorly treated.
Most streams habitats are seeded, or full, and there is little room for more fish.	Smolts, or juvenile salmon are usually released in the spring to migrate to the ocean. They are very similar to trout in appearance at this time.

All natural ecosystems have a limit on how many living things they can support, including streams. This is called the stream's "carrying capacity."	Many streams are closed to trout angling until late spring to protect salmon and steelhead smolts from being caught by trout anglers.
Hatcheries whose objective is to increase the number of adult fish returning so more can be caught by anglers acclimate their fish to return to areas not used by wild fish for spawning. This allows the wild fish population to reproduce naturally.	"Catch and Release fishing," where some fish must be returned unharmed to the stream, can protect wild fish while allowing hatchery fish to be caught.
Hatcheries whose objective is to produce returning adults that spawn and become part of the stream-spawned-and-reared population acclimate their fish to return to the stream spawning areas. This is a one-time operation, because the hatchery just wants to "jump start" a population so that it will be self' sustaining in future generation.	Hatchery fish can be marked by clipping the adipose or other fins at the hatchery before they are released. This enables both biologists and anglers to identify the fish. The survival of a fish caught by an angler and released depends on the careful treatment of the fish while playing it, while dislodging the hook and minimizing the amount of handling.
Brood fish are fish kept at the hatchery to supply eggs and sperm for the next generation of fish.	Fish in streams compete for food, shelter and space.