



# *Rearing Pens*

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SALMONID HABITAT RESTORATION  
How-To-Guide for Washington State

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## REARING PENS

Hatcheries have contributed in no small part to the survival of salmon as a species. However, hatchery fish are not the same as wild fish, and in many ways are considered inferior. To critics, hatcheries are a bandage for diminishing salmon stocks rather than a cure. For the successful survival of the species in the long term, wild fish must be able to repopulate native streams successfully. In the meantime we rely on hatchery fish to help propagate the species.

*This is one in a series of Salmonid Habitat Restoration How-To-Guides for projects in Washington State. It was written to help groups and individuals undertaking similar projects and presumes some knowledge of salmon, habitats and project planning.*

*Other guides in the series:*

- Rearing Pens
- Culvert Replacement
- Nutrient Enhancement
- Live Plants
- Habitat Restoration
- Permitting
- Project Funding
- Streamside Incubation

Moving juvenile salmon in numbers from hatchery net pens to offsite net pens works on multiple levels toward the goal of restoring salmon stocks. When and where such rearing pens are permissible, they can be effective both at ensuring a higher survival rate among returning hatchery fish and reintroducing spawning fish to native streams.

Before undertaking such a project, check with the appropriate local and federal agencies to ensure it is legal in your region. For more information on obtaining permits see the related How-to Guide on Permitting.

This guide is an overview for projects in Washington State. It uses Coho salmon, or silvers, as an example throughout. Requirements and specifics for similar projects in other states and involving other species of salmon will vary.

## AN OVERVIEW

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### Wild Fish vs. Hatchery Fish

A “wild fish” is one produced by natural reproduction in a river basin that has historically contained a population of that species. A “hatchery fish” is a fish incubated or reared under artificial conditions for at least a portion of its life. These simple classifications can lead to several different combinations.

A wild fish may have had ancestors who were hatchery fish that successfully spawned in the stream—as long as there has been a continuous natural spawning population in that stream. A hatchery fish may have had wild parents who were taken from a stream and artificially spawned in a hatchery.

Native fish are wild fish with genetics indigenous to the watershed they live in. The distinctions are important because hatchery fish don’t spawn as well, or as successfully, as wild fish, and wild fish don’t spawn as well as native fish. So the ultimate goal of salmon recovery is not just to increase populations, but to increase self-sustaining populations.

### Rearing Pens

Salmon reared in hatcheries imprint upon the water there, and return as adults to spawn. Each fall hatcheries capture returning salmon and strip them of eggs and milt to fertilize the next generation of fish.

Fertilized eggs sit in trays for about 90 days, and once hatched, the young fish are moved to raceways—net pens—for six to eight months before being released into the stream.

However, in the raceways fry face increased risks of disease from overcrowding. One solution is to separate out some of these fish and rear them offsite in net pens in the actual watershed where they will be released.

### Benefits

Fish reared in offsite pens have been shown to grow at the same rate as those reared in hatchery raceways. But they do so with as much as 40 percent less food, because the water in which they’re kept provides the same natural nutrients they will eat once released.

This reduces the cost of providing food, but it also “trains” the fish to feed themselves. Hatchery fish are reliant upon feed pellets, and when they’re first released into the wild they have to learn from scratch how to find food. For fish reared in offsite net pens, this head start increases the chances of survival.

Pen rearing also allows fish to imprint on a location other than a hatchery, creating future returns to a target area.

## EQUIPMENT & METHODS

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Establishing off-site rearing pens must be done in collaboration with a hatchery. In addition, it’s necessary to se-

cure any permits state or local agencies may require. Typical permits include:

- Water quality permits from Washington Department of Ecology
- Land use leases from the Department of Natural Resources
- Shoreline permits from local government

Salmon return to spawn in late fall, typically October through December. Hatchery fish will sit in egg trays for up to three months, and then once hatched, will move to the raceways for six to eight months.

In the rearing pen model established by Fish First, the hatcheries separate about 25 percent of these fish from the group and provide them for offsite rearing. They'll then sit in the net pens for six weeks, during which time they'll imprint on the water, and at six weeks they'll be released into the river.

At that time, the hatchery will provide another same-sized group of fish for offsite rearing. These fish remain in the net pens until they are released into the river at the same time the hatchery releases the remaining fish. In other words, 25 percent of the total group is released from offsite pens at the six-week point, and the remaining 75 percent of the total group is released together from both the hatchery raceways and the offsite pens.

Separating out the first 25 percent allows the remaining 75 percent to grow more quickly during critical early development stages, with less overcrowding and less chance for disease. Separating out the second 25 percent has the same effect. Since the fish have grown in size, their numbers need to be reduced again to fit them comfortably into the same space—a fact more important when planning similar projects than the actual percentages or numbers of fish.

## Equipment

Net pens can be set up in the body of the river itself, or in a lake, pond or reservoir in the watershed. Locations should be chosen based on cleanliness of the water, protection from predators and weather, and access for feeding and cleaning.

### NET PENS

Submerged pens, or cages made of netting, are attached to floats, often with wooden decking. Available for purchase or custom-built from many aquaculture equipment providers, net pens come in various sizes and configurations that allow for versatility when installing them in a body of water. Cost and available space determine what option works best for individual applications.

Fish First has net pens in two locations. The pens were designed and built to spec, and cost about \$20,000 apiece.

In each site are 10 pens, and each pen is 20-foot-by-20-foot and made of half-inch square,  $\frac{3}{4}$  inch mesh netting. Each pen is 20 feet deep, but can be shortened for shallower water. When installed, 16 feet of each net is submerged, and four feet climbs above the waterline to hand railings built on the decking.

A second net made of a roughly three-inch mesh is lain across the railings of each 20x20-foot pen to keep birds out. In some locations, all the net pens are surrounded by a larger net, called a predator net, for

additional underwater safety.

## DECKING AND ANCHORS

Decking is 24 inches wide and 18 inches thick and runs the length of each 20-foot net pen. The floats hook together to allow for different configurations.

Pens should be anchored based on location and conditions, using either 55-gallon drums filled with concrete, or cables attached to the shore. They should be checked periodically, especially during times of wind or high water.

## Methods

Fish are transferred from the hatchery raceway by oxygenated tanks installed on trucks designed for transport. They are offloaded from tank to pens by way of a 6-inch diameter aluminum or plastic pipe.

The same truck is used to transfer fish from net pens to the river if the pens are in a location not immediately accessible from the river. Anchors are unhooked, pens are floated to the boat ramp, and the fish are pumped from the net into the transport tank.

In other locations, one side of the net is unhooked from the floats and the other side lifted from the water, releasing the fish from the pens.

## FEEDING

While in rearing pens, salmon will feed on nutrients found in the water, but their diet must also be supplemented with feed pellets. Hatchery biologists can monitor growth to determine amounts. Pellets can be provided by the hatchery or through an aquaculture supply provider.

As a rough guideline, salmon should be about 10-12 to a pound when put into the pens, and about 5-7 to a pound when released.

## UPKEEP

Nets need to be cleaned to keep algae and other growth at bay. While cleaning them weekly will more effectively keep nets clean, the disturbance seems to do more damage to the fish than any growth, and its best to limit cleanings to empty nets.

Between batches of fish, when fish have been released into the water from the nets, nets can be hauled up and washed with fire hoses and scrubbed with brushes. When all fish have been released for the season, nets should be cleaned and soaked in iodine to disinfect them, and dried in the sun.

Floats and decking can remain in the water year round. Nets should be kept in dry storage.

## OTHER CONSIDERATIONS

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- Depending on the site, net pens may be accessible by the public. For these reason, precautions should be taken to ensure the safety of both the fish and any person who enters the area.
- No trespassing signs may not keep curious people away, but they may limit liability. Decks can be slippery, and open water always poses a threat.
- Pens can, and often should, be anchored away from shore. They can be reached by means of a small boat when necessary. It's also possible to anchor them close enough to shore to be reached by a small, floating dock that can be removed and locked up when not in use.
- Pens need to be sited where natural water processes will disperse fish waste.
- Finally, if pens are in an area used recreationally by boaters, No Wake signs should be positioned to keep boat wakes at a minimum to protect the nets and docks and the fish.

## ADDITIONAL INFORMATION & RESOURCES

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Copies of this document are available through Fish First, and can be found on the Web at [www.fishfirst.org](http://www.fishfirst.org). You'll also find a library of how-to guides and fact sheets as well as other resources and information to help with salmon restoration projects.

In addition, the following links can help you find information about pen rearing.

- Washington State Department of Ecology  
[www.ecy.wa.gov](http://www.ecy.wa.gov)
- Washington State Department of Fish and Wildlife  
[www.wdfw.wa.gov](http://www.wdfw.wa.gov)

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