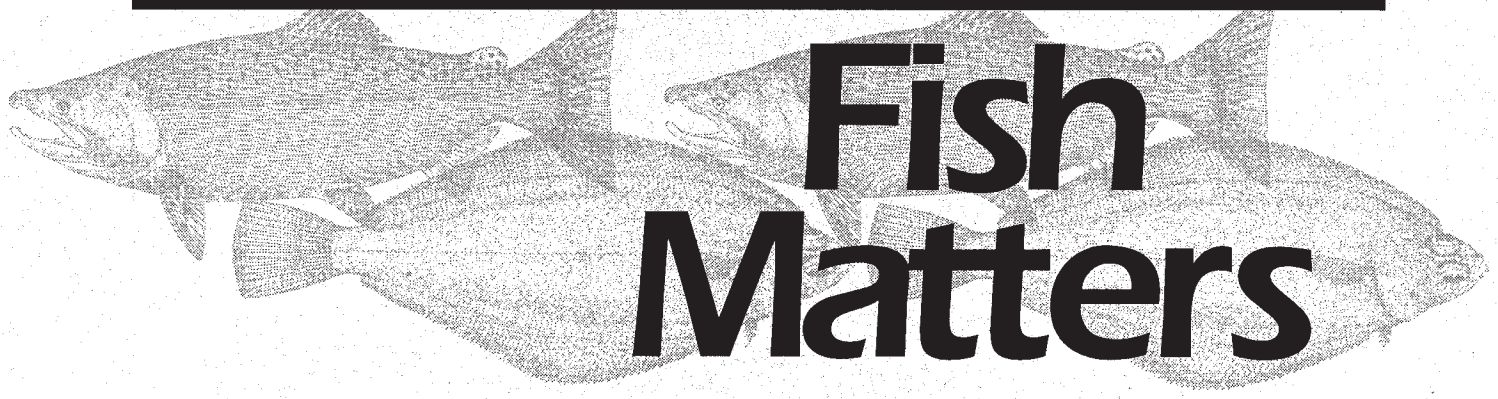
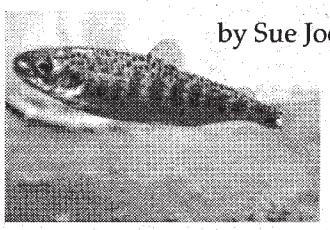
Northwest Fisheries Science Center



Fish Matters

Making them wild-- a boot camp for smolts

by Sue Joerger



"One, two, three, four! Stroke, stroke, stroke, stroke! Abooouut face!" I can almost hear a drill sergeant shouting encouragement to the tiny salmon smolts that will soon be training at the new exercise raceways at Northwest Fisheries Science Center's Manchester Research Station.

Today's typical "civilian" smolt is overweight, out of shape and has difficulty catching live food, recognizing dangerous predators, and adapting to natural stream habitats. Scientists believe basic training at hatchery "Boot Camps" may be what hatchery smolts need in order to increase survival rates from the estimated 1-2% current rate.

In 1991 Station scientists created the Natural Enhancement Rearing System (NATURES) research project. The underlying assumption is that rearing smolts in a semi-natural habitat will increase post-release survival rates, by decreasing stress, reducing domestication, and acclimatizing fish to their natural habitats. Salmon smolts raised under NATURES were expected to be "wilder" - more like wild smolts in both appearance and behavior.

"My goal," said Dr. Desmond Maynard, one of the lead NATURES scientists at Manchester, "is to increase the survival rate of hatchery fish so we can eventually release fewer hatchery fish, get higher rates of return, and reduce harmful competition between hatchery and wild fish."

In recent NATURES pilot studies hatchery smolts raised in semi-natural habitats increased their instream survival rates by 12-50%. In these studies, smolts were raised in raceways and tanks that had overhead canopies, natural gravel substrates, and woody debris in the form of discarded Christmas trees. Conventional raceways and have gray tanks with none of these instream attributes.

"The biggest challenge now," says Maynard, " is to take what we've learned from the small

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Winter 1998

Navy sailors help save fish

By Cathy Fallon

Large Marge may not be able to say "Thanks," but her good health came several lug bolts closer to being preserved in June when U.S. Navy divers from the *USS Arkansas* repaired a water pipeline serving Large Marge's living quarters.

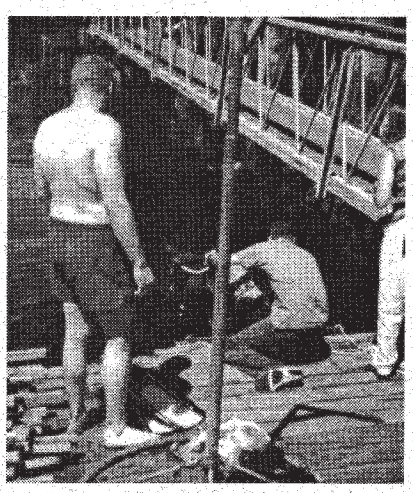
Large Marge is a fully grown lingcod who spends her days lazing about in a giant saltwater rearing tank at the Northwest Fisheries Science Center's Manchester Research Laboratory, in Puget Sound, Washington. NWFSC scientists conduct crucial marine research at the Manchester laboratory. Situated on Clam Bay, the laboratory has access to some of the highest quality seawater in the Northwest, enabling scientists to conduct studies that couldn't happen elsewhere.

Large Marge is a key participant in the NWFSC's recently established Marine Fish Culture Program. One program goal is to help ensure species abundance by developing techniques for spawning and raising various types of fish, including lingcod, in captivity. The laboratory also supports many other important research programs, including those that focus on early life history of fish species and restoration of threatened or endangered stocks.

Seawater from Clam Bay is pumped to Manchester's shore-side rearing tanks and other research facilities through an underwater pipeline at a rate of nearly 800 gallons per minute. The pipeline originates at the end of a 650-foot-long pier that Manchester shares with a nearby Environmental Protection Agency laboratory. The seawater is routed through filters and purifiers to help remove disease organisms and other components that could harm the laboratory's fish.

Saltwater pipelines serving the research laboratory.

Navy crew from the *USS Arkansas* repaired an eroded overflow channel of Beaver Creek.



Diver preparing for inspection of Manchester's saltwater pipelines.

Without this system, the laboratory's seawater-dependent projects would fail, says Earl Prentice, a researcher who has worked at Manchester for nearly 20 years. So maintenance activities that might otherwise seem mundane, like replacing bolts, are actually very critical. The laboratory has no scuba divers on staff and no funding exists to pay commercial divers. When the Navy offered up divers, laboratory scientists didn't hesitate to accept.

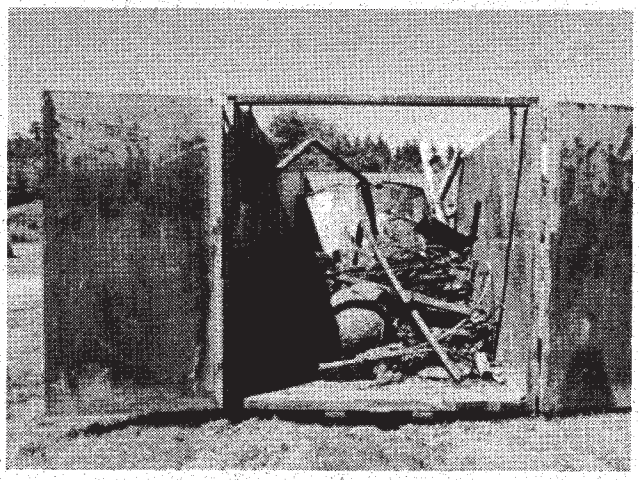
Diving isn't the only service the Navy has contributed. So far this year, the Navy has donated the labor of shipboard crews to: rebuild a severely eroded fish ladder between Beaver Creek and Clam Bay, remove 40 yards of debris from critical shoreline habitat in front of the station, haul several truckloads of crushed rock from the beach area to repair an eroded high-flow spillway for the fishladder. Beaver Creek serves as the laboratory's only source of surface freshwater and was dammed in the 1940s to create a small reservoir. A fishladder between the pool and saltwater allows a natural run of coho and chum salmon and steelhead trout to continue accessing the creek and spawning grounds. The water from the pond is used for many of the laboratory's freshwater studies.

Over the years, the fish ladder foundation became eroded, and the structure threatened to crumble until crew from the Navy's *USS Carl Vinson* stepped in to help in May. About

50 sailors spent two days at the site pouring concrete and cleaning up the beach near the fish ladder. The beach cleanup will help establish an environment that looks inviting to spawning herring and sandlance–important food sources for salmon.

The sailors from the *Carl Vinson* became so committed to the purpose of the beach project that they went to extremes–and acquired a few sore muscles–in digging up a massive anchor manufactured from a railroad car wheel that had become deeply embedded in the beach sand over the many years it had been there. The sailors voluntarily worked that hard because they liked the idea of helping restore local salmon populations, a Navy spokesperson told reporters from the Bremerton Sun.

Pumping concrete to repair the lower fish ladder foundation.



Beach cleanup efforts by crew from the Navy's *USS Carl Vinson* resulted in a dumpster full of trash.

Crew from the *USS Arkansas* in June continued where the *Carl Vinson* sailors left off. They spent a day filling in an eroded highwater overflow area of Beaver Creek with crushed rock that had been dumped on the beach many years ago in an attempt to build vehicle access to a commercial fish-rearing operation. The rock was sharp enough to prevent herring and sandlance from using the beach to spawn.

This isn't the first time the Navy has volunteered to help the Manchester scientists. In fact, it's because of the Navy that the research laboratory exists at all. The Navy's Manchester Fuel Depot, established 100 years ago, adjoins the laboratory's property. The Navy originally owned all the land that fronts Clam Bay, but, in 1968, 22 acres were deeded to the National Oceanic and Atmospheric Administration. A fire-training building was remodeled in the 1970s to serve as Manchester's first laboratory. Since then, the Navy has provided security for the Manchester facilities and routinely offers to help with maintenance projects.

When the laboratory needed to expand its capacity for freshwater–to accommodate captive breeding of endangered salmon–the Navy even drilled a well on their own property and supplied a pipeline to route the water to the laboratory facilities. All this at no charge to NWFSC. In short, the Navy has been "a very generous, helpful, and a pro-environment neighbor," says Prentice.

According to Navy officials, the agency's involvement with restoring the Manchester facilities will continue as long as there is work to be done. "Without the Navy's assistance we could not carry out many of our current research projects directed at Pacific Northwest salmon stock restoration," says Prentice.

The Navy has a responsibility to help protect the natural resources that occur on its property, and that includes fish, says Dean Smith, regional fishery biologist for the Navy's Engineering Field Activity Northwest, in Poulsbo. Smith assesses what the repercussions of Navy activities on its Northwest properties will be and develops plans to help protect them. At Manchester, he keeps in close contact with laboratory scientists to devise ways to help promote the health of local fisheries.

This year's restoration projects have involved heavy work, but the sailors loved it, said Anthony Pa, public affairs officer for the *Arkansas*. The *Arkansas*, scheduled to be decommissioned this summer, contributed about 120 crew members to work for a day on Manchester's maintenance projects. The participating sailors were enthusiastic, said Pa.

"Their job in the Navy is going to sea, and the opportunity to do something for the community is really great for them," Pa said. "This is our big (project), and a lot of guys are enjoying this because they know it's for a good cause."

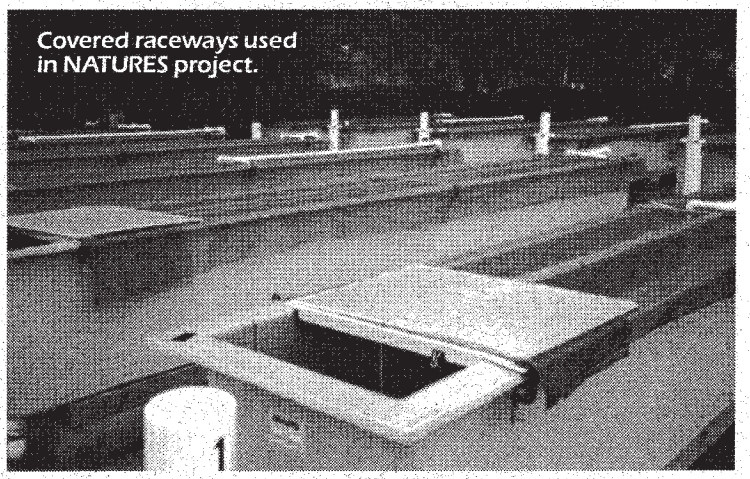
scale instream semi-natural habitat research and take it to the production level to see if we are able to get the same level of benefits in terms of increased smolt to adult survival rates."

Two years ago the Northwest Fisheries Science Center, Washington Department of Fish and Wildlife, Long Live the Kings, and Weyerhaeuser put together a cooperative research project to determine if instream semi-natural habitat in hatcheries would increase survival rates on a production scale. The research is being conducted at the Forks Creek Hatchery in Willapa Harbor. There, 200,000 smolts have been raised each year in six fiberglass raceways. Three of the raceways are the conventional gray raceways and the other three have semi-natural habitat including a gravel substrate (set in an epoxy resin for easy cleaning), Christmas trees suspended by cables, and camouflage net covering 80% of the raceways. Each smolt has a coded wire tag in its nose to track which raceway it came from.

The smolts were placed in the raceways in late February 1997 and January 1998 and released to go to sea in early June 1997 and 1998. The first adults are expected to return in 1999. Based on the number of adult returns, scientists will be able to calculate smolt to adult survival rates. If this production scale experiment results in increased smolt to adult survival rates Boot Camp may become a reality for hatchery raised smolts.

NATURES research is also looking at a number of other areas that in combination with the semi-natural habitat acclimatization, may further increase smolt to adult survival and provide more basic training options for smolt.

Hatchery salmon smolts have shown a 26% increase in survival rates after undergoing predator training. Live mergansers were placed in cages over the raceways. Smolts learned very quickly that if one of their cohorts swam into the cage while a merganser is present it will be eaten so they learned to avoid the cage until the merganser was removed. Chemical stimuli have also been shown to be effective. Ground up skin tissue from chinook, released upstream, in association with a predator, has been shown to alter the behavior in downstream smolts.


Covered raceways used in NATURES project.

The first smolt physical fitness experiments have been completed and data is being analyzed. The exercise raceways, which were installed this spring, are designed to improve the physical fitness of salmon smolts by pumping water through PVC pipes, located in the middle of the tank at the surface, to create currents in the normally slack water raceways. These currents, which can be varied in strength, allow smolts to swim as actively as they would in a natural stream or river. Physically fit smolts, scientists theorize, will develop more muscles so they will be better able to escape their fish predators by moving more quickly and having more endurance.

Research results indicate hatchery smolts whose diets were supplemented with live food (brine shrimp and a variety of insect larvae) increased their ability to forage in both laboratory and natural settings and improved their camouflage coloration. These foraging experiments were conducted in small laboratory scale tanks.

The results of the NATURES project will be used to improve hatchery practices by providing the basis for protocols or guidelines that can be used to reform the operation of traditional production hatcheries to produce more wild-like smolts.

Maynard is also hopeful that the NATURES techniques being developed "will be used with captive broodstocks of endangered species prior to their release back into their natural habitats".

The bottom line for NATURES research is the production of hatchery smolts that are better able to survive in the wild whether they are used for mitigation, harvesting, or the restoration of endangered species purposes.

"We're looking for a few good wild-like smolts" may just be the hatchery motto of the future.