COHO MONITOR

Santa Rosa, California **August 2006**

Bringing endangered species into hatcheries: A transition from fish farming to species recovery

Louise Conrad, Don Claussen Warm Springs Hatchery and Pacific States Marine Fisheries Commission

The near extinction of numerous wild salmon stocks over the last twenty years has redefined hatcheries as key players in recovery efforts for endangered species. This is a critical complimentary role to habitat restoration and ocean population management efforts underway to reverse the decline of wild populations. Specifically, hatcheries can provide a safe haven for wild fish that are otherwise on the path to extinction, as well as a vehicle for a needed population boost.

Bringing endangered fish into hatcheries for the purpose of their recovery places new demands on hatcheries. Recovery hatcheries must consider how every aspect of their operation contributes to the reconstruction of a self-sustaining, wild population. In some cases, hatcheries may need to adopt entirely new responsibilities. Many programs, like the Russian River Coho Salmon Captive Broodstock Program (RRCSCBP), require wild fish to be raised to adulthood in captivity. This new demand calls for changes in facilities that will suit the biological needs of maturing salmon. Captive broodstock programs must be equipped with large, circular tanks offering enough space to raise adult fish. The RRCSCBP is also investigating appropriate rearing temperatures (see article "Research to Improve …"), as well as the benefits of adding natural food (krill) to the broodstock diet.

Traditional hatchery programs sample genetics of individual fish throughout the spawning season, but do not know the genetic similarity between the individuals in a breeding pair. In contrast, recovery programs take care to avoid the harm that inbreeding can have on an endangered population. The RRCSCBP uses a breeding matrix prepared by geneticists at the Southwest Fisheries Science Center (NOAA Fisheries) that allows staff to avoid pairing fish that are half-siblings or closer in relation.

Rory Taylor releases juvenile coho by hand into individual pools to an overall stream density of 0.5 fish for every square meter.

Once progeny are produced, recovery hatcheries strive to release fish that will survive and reproduce in the wild. To do this, recovery programs control juvenile growth to match the body size of wild juvenile salmon, and use modified rearing environments to encourage development of wild-type behavior. Many programs opt to release fish at a young age, thus allowing the majority of the rearing to occur in natural systems. The RRCSCBP releases fish at six and nine months of age into small Russian River tributaries. Additionally, instead of releasing thousands of fish in a single location, RRCSCBP releases fish along an entire stream at densities that match those of wild stocks.

Inside this issue

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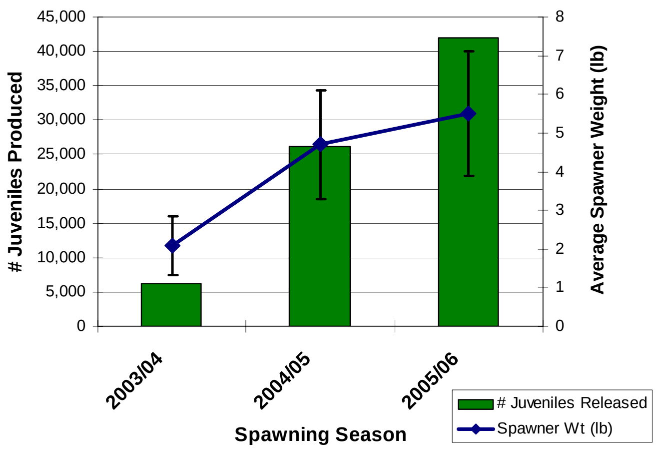


History of RRCSCBP juvenile production and corresponding increase in broodstock body size. Improvements in broodstock care have resulted in larger, healthier spawners. The outcome is an increase in the number of juvenile coho available for stocking.

Several recovery hatchery programs, such as the Winter-run Chinook Captive Broodstock Program of the Sacramento River, have already made invaluable contributions to population recovery. The RRCSCBP has completed three years of broodstock spawning and juvenile release, and made improvements in broodstock health and juvenile production each year (see figure "History of RRCSCBP…").

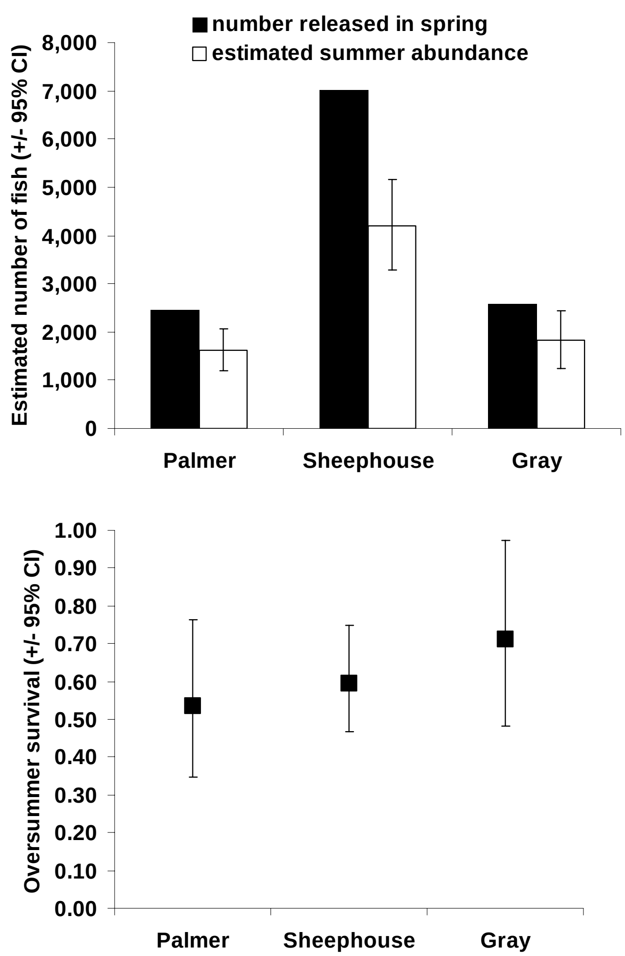
Over summer survival of juvenile coho released into program streams

Mariska Obedzinski, University of California Cooperative Extension

Because the long-term goal of the RRCSCBP is to produce self-sustaining runs of fish that no longer require hatchery supplementation, it is important to determine whether released fish can survive in the streams during all seasons. Juvenile coho that are stocked in the spring must survive one full year in the streams before migrating out to sea as smolts. This includes the summer, when temperatures are warm and the streams are often reduced to intermittent pools, and the winter, when stream flows can be extreme. By monitoring survival during both seasons program partners can begin to identify and address any bottlenecks to long-term coho recovery.

During the spring of 2005, coho were released into Sheephouse, Palmer, and Gray Creeks. To estimate summer survival, UCCE conducted basinwide population estimates in each creek. We used a combination of habitat typing, snorkeling, and electrofishing to estimate the number of coho remaining in each creek at the end of the summer. By comparing this number to the number of coho released in the spring, we were able to estimate summer survival rates (see figure "Number of juvenile…"). For the summer of 2005, summer survival rates were encouraging, over 50% in all three streams.

These rates are comparable to summer



Number of juvenile coho released in spring 2005 and subsequent summer abundance estimates (a) and oversummer apparent survival (b).

Counting juvenile coho for summer abundance estimates.

survival rates in relatively pristine streams in Northern California and Oregon. It is likely that the high survival rates were a result of rain late into the spring in 2005. Spring of 2006 has been extremely different, with all significant rainstorms ending in April. Because of these year-to-year differences, it is important that monitoring be continued for multiple years. Through this long-term monitoring we will compare winter and summer survival rates and survival between years to inform future coho release decisions.

Research to Improve Captive Broodstock Rearing and Spawning

Kristen D. Arkush, Bodega Marine Laboratory

In 2004, faculty and staff of the Bodega Marine Laboratory began actively participating in the RRCSCBP. Initially, we provided advice on several aspects of broodstock management, including the use of ultrasound to assess gender and adult fish maturation, and the preservation of sperm and eggs for later use. A more formal collaboration is now underway to improve upon current rearing conditions by understanding the role water temperature has on sexual maturation and reproductive success.

Temperature is regarded as one of the most important environmental factors controlling sexual maturity and spawning time in salmon. Delayed maturation was observed in the first year class (broodyear 2001) of coho salmon reared at Warm Springs Hatchery (WSH), and approximately 30% of the entire

Diverting Salmon from Diversions

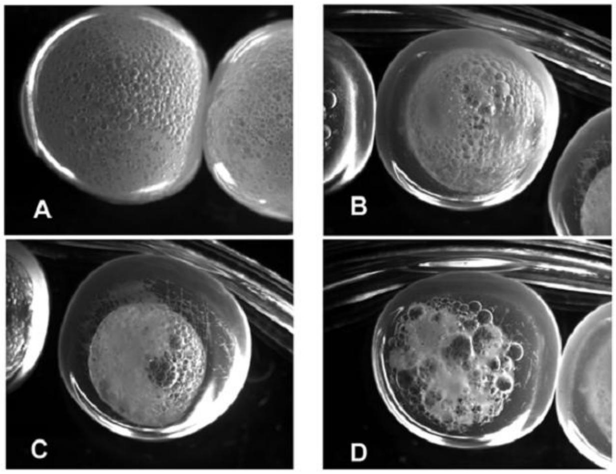
Juvenile salmon and other young fish rear in tributary streams of California's major river systems. They have evolved into formidable swimmers with the strength and stamina to swim with and against streamflow. They do, however, have limits to their abilities. This is particularly true in the face of flow direction alterations that can arise from water diversions. Pump intakes can entrain and kill young fish as they move past the intake opening.

In an effort to reduce these risks and find solutions for continuing diversions, NOAA Fisheries and California Department of Fish and Game have developed policies and criteria for screening diversions. Screens that are properly designed, installed, and maintained protect young fish from pump intakes. The developed criteria include specifications for screen design and installation. Using research results of fish swimming performance, these criteria provide limits for the **approach velocity –** water velocity in the direction perpendicular to the screen surface, **sweeping velocity –** water velocity in the direction parallel to the screen surface, and **screen mesh opening –** largest opening in the screen.

Criteria are available from both CDFG (http://www.dfg.ca.gov/nafwb/fishscreencriteria.html) and NOAA Fisheries (http://swr.nmfs.noaa.gov/hcd/fishscrn.htm). These two agencies have coordinated their policies and drafted these criteria so they are in agreement with each other. Staff from both agencies can be available for informal review of screen and intake plans prior to and after installation and adapting specifications to your site-specific situation. For NOAA Fisheries contact their Engineering Team in the Santa Rosa office at 707-575-6063. For CDFG begin with their regional office in Yountville at 707-944-5500 and ask for information from their Fisheries Engineering Program.

year class produced over-ripe, water-hardened eggs that were not viable. This condition has been observed in other coho captive broodstock programs and may be the result of inappropriately warm environmental temperatures. Given the limitations of broodstock facilities with regard to water temperature control and the expense of chilling water, it is critical to determine if inappropriate water temperature contributes to delayed maturation and poor egg quality.

This past spawning season, we conducted an experiment to determine the effects of two temperature regimes on spawn timing and egg fertility of coho captive broodstock. In one tank, fish were reared to maturity at 9°C (48.2°F) (low temperature group), and in another tank the fish were reared at 14°C (57.2°F) (high temperature group). We found that temperature affected both spawn timing and egg quality. Fish in the low temperature group spawned earlier (between February 2 and March 7) than fish in the high temperature group. A portion of the fish in the high temperature group failed to spawn even by early April, months after the typical spawning time in the wild. Eggs collected from females in the low temperature group were viable, hatching at rates comparable to those of the Russian River coho salmon held at the Warms Springs Hatchery. However, eggs harvested from females in the high temperature group could not be fertilized and were abnormal (see figure "*Coho eggs…*"). Milt (sperm) quality, although not quantified, did not show any appreciable differences between the two temperature treatments. Warm Springs Hatchery staff is using these results to guide temperature regulation for coho broodstock.



Coho eggs, approximately an eighth of an inch wide, observed under a dissecting microscope. A normal viable egg (A), taken from a female coho reared at 9°C(48.2°F) and abnormal nonviable eggs (B-D) from coho salmon reared at 14°C (57.2°F).

Partners Improve Migration in Austin Creek

Rob Dickerson, Trout Unlimited
Jacob Katz, NOAA Fisheries/Trout Unlimited
David Hines, NOAA's National Marine Fisheries Service

Austin Creek empties into the Russian River estuary five miles from the Pacific Ocean near the town of Duncans Mills, California. NOAA's National Marin Fisheries Service (NMFS) considers this 68.7 square mile watershed to be key to recovery of Russian River Basin coho and Chinook salmon, and steelhead trout. The lower reach of Austin Creek is a migration corridor for adult coho and steelhead trout returning to spawn, and rearing habitat for their offspring. For many reasons, this portion of the stream had become aggraded with few deep pools and limited structure including large wood (see inset "Large **Wood**

Large Wood, the Habitat Maker

Coho salmon have evolved to spawn and rear in forested streams from California to Alaska. One typical habitat feature they have come to rely upon is deep cool pools. Large wood is actually a critical instrument in the formation of these pools and the resulting habitat. As a hard structure that directs flow into the loose streambed, they cause scour of stream sediments that result in pool formation. To learn more about large wood, its role in stream ecology, and the role you can have to facilitate habitat formation download *Maintaining Wood in Streams: A Vital Action for Fish Conservation* **(**http://anrcatalog.ucdavis.edu/pdf/8157.pdf**).**

Stream flow around these installed large wood, root wad, and boulder structures scours gravel out downstream of the structures to form deep pools and cover for adult and juvenile salmon.

the Habitat Maker”). The result was an undefined channel with low stream depth that impacted fish migration.

In 2003, Trout Unlimited (TU), Bohan and Canelis (landowners), California Department of Fish and Game (CDFG), California Conservation Corps (CCC), NMFS, Sonoma County Water Agency (SCWA) and local volunteers formed a partnership to address these limiting factors through an initiative titled the Lower Austin Creek Migration Improvement Project (LACMIP). The partnership’s goal is to improve juvenile and adult steelhead trout and coho salmon migration and rearing in lower Austin Creek while allowing the continued commercial extraction of gravel by the landowner. This is envisioned through the creation of a low flow channel, which will remain wetted year round, providing access to returning coho salmon in the fall and year-round rearing habitat for juvenile salmonids.

Partners focused restoration efforts on a 4,000 foot reach of lower Austin Creek, where they innovatively modified gravel bars to reflect natural conditions, with alcoves and a low stream flow channel. They have installed log, root wad and boulder structures that scour gravel, generate pools and provide resting cover for salmon (see photograph “Stream flow …”).

As part of the project a monitoring, program to track physical and biological responses to the restoration and to validate project success is being conducted. Habitat measurements include pool and channel development, gravel deposition, and other physical aspects in the restoration reach, while biological monitoring efforts focus on determination of baseline salmonid abundance at the juvenile and adult life stages.

In 2006, partners installed and operated a rotary screw trap – a floating structure in which migrating fish are captured for observation and released downstream on a daily basis - as part of their efforts to document juvenile salmonid populations. Two wild coho smolts were identified through this effort, marking the second year in a row that wild coho smolts have been identified in the Austin Creek watershed. A total of 97 coho smolts were measured and released during the two-month monitoring period, including 95 released to Gray and Ward creeks through the RRCSCBP.

Lamprey - the Good, the Bad, and the Ugly

Shawn Chase, Sonoma County Water Agency

Three of the over 40 world-wide species of lamprey are found in the Russian River. Lamprey have a separate evolutionary lineage and are not a true fish and thus NOT an eel. They lack jaws and paired fins that are characteristics of fish. In fact they are descended from a group known as ostracoderms, the first known vertebrates which were heavily armored and lived off of organic sediments from ocean, lake and river bottoms. The ostracoderms largely died out around 400

Mouth of a lamprey.

million years ago, coincident with the appearance of the true fish. The group today is represented by the lampreys and hagfish.

While lamprey have a bad reputation because of some species predatory (parasitic) feeding behavior, not all lamprey are parasitic. Lamprey can be summed up by plagiarizing the classic spaghetti western title. **The Good:** regardless of feeding strategy employed as an adult, all lamprey contribute to a healthy aquatic ecosystem. **The Bad:** sadly, as a group, populations of lamprey are declining across their range. **The Ugly:** lamprey sport a face even a mother would have trouble finding cute, but as a group, they are highly successful, and they and their ancestors have been around for over 300 million years.

The Good - What comes around goes around

Juvenile lamprey, called ammocoetes, are eyeless, worm-like looking creatures that burrow into soft sediments, feeding on algae and detritus. Ammocoetes in turn provide a food source for other fish. Anadromous juvenile lamprey (called macropthalmia) go through a physiological process, much like salmon and steelhead that allows the animal to leave freshwater and take up a marine existence (see photograph "Newly transformed Pacific…"). As adults in the ocean, lamprey feed on fish (ironically, some of those that fed on them as juveniles). Adult lamprey migrate back to freshwater to spawn. After spawning, lamprey die and release nutrients back into the freshwater environment, starting the cycle anew.

In some parts of the Pacific Northwest lamprey are a traditional food item for Native Americans and are an integral part of their culture. Pacific lamprey migrate into rivers to spawn prior to the start of the salmon runs when food sources are scarce. As a source of food which is rich in nutrients during these lean times, they earned an honored position in Native American culture.

There are three species of lamprey in the Russian River; the Pacific, river, and western brook. The Pacific is the largest growing to a length of about 1.5 to 2.5 feet. Adult Pacific

Newly transformed Pacific lamprey "macropthalmia."

lamprey spend approximately 18 months in the ocean, feeding on a wide variety of fish. They feed by attaching to the sides of fish with their sucking disk and boring a hole into the fish's side with their tongue, covered with sharp horny plates. They then ingest body fluids and blood and drop off of their host when satiated. Although the feeding wound can be fatal, many fish survive lamprey attacks.

The river lamprey is much smaller, yet no less regal than the Pacific lamprey. River lamprey grow to approximately 10 to 12 inches in length, spend 3 to 4 months in the ocean, and have a predatory adult life history.

The Western brook lamprey are derived from river lamprey, although they are non-predacious and spend their entire life in freshwater. Western brook lamprey do not feed as adults, but rather transform into the adult stage, reproduce, and then die.

The Bad

At one time, lamprey were abundant throughout the Pacific Northwest. For example, the Eel River was named for the large numbers of lamprey that once migrated and spawned there - the "Lamprey River" has a nice ring to it, don't you think?. Sadly, lamprey populations are in decline over a large segment of their range and regrettably we have little documentation to understand their status.

And the Ugly

Lamprey have the disadvantage of being relatively homely (let's be honest, as fascinating as lamprey are, they are fairly unattractive creatures) and they are not a traditional food item for descendents of European ancestry. As a result, they have been largely ignored. Nonetheless, they are an important part of our local streams ecology and deserve attention if they are to thrive.

Community Outreach at West Side Elementary School

Julie Davis and Greg Vogeazopoulos, UCCE

West Side School in Healdsburg approached the RRCSCBP, asking how their students could learn about the program and its efforts. This resulted in the sixth grade participating in the 2006 fish trapping season at the Mill Creek downstream migrant trap site. The students were introduced to the program and trapping of outmigrating coho smolts through a classroom presentation given by team members from University of California Cooperative Extension. The students' pre-existing knowledge of salmonids was impressively demonstrated through insightful questions about smoltification and species identification. Their motivation was encouraging to experience, as they will soon be the stewards of this unique resource.

Greg Vogeazopoulos and Julie Davis collect coho smolt length and weight measurements with West Side sixth graders.

From April to June, small groups of sixth graders visited the trap site with a teaching assistant provided by the school. The students kept their own data sheet and recorded air and water temperature, streamflow height, and the numbers of coho, Chinook, and steelhead found in the trap each day. The most sought after task was using the detector wand to locate coded wire tags implanted in each fish to identify it with a release group. While the wands provided entertainment for detecting zippers, belts, and various metal plates and screws, many students enjoyed species identification as well. In addition to identifying the salmon species, the students were also introduced to other native and non-native species that inhabit the Mill Creek system. Among their favorites were bullfrogs, crayfish, and especially, the awe-inspiring lamprey (see article "Lamprey…").

Thanks to Principal Rhonda Belmer, Sixth Grade Teacher Teresa Brooks, and Teacher's Assistant Gail Brunson for their continued cooperation and enthusiasm. We look forward to meeting next year's sixth graders!

Coho Returning and Your Role

This fall the coho released in October 2004 are expected to return to spawn. Documenting how many fish return and in which streams they return to is important in understanding where the program is successful and where alterations are needed.

Program partners will document these returns through stream surveys of returning spawners and redds or nests they build. However, the number of returning fish for this first year of returns will be small, and the region to survey in is large.

Should you see spawning salmon please do the following:

1. Avoid disturbing their activities.
2. Make a note of the location.
3. Contact program partners that can make observations to determine if they are program fish. Call us at **707-565-2621** and indicate that you are calling to report "a spawning salmon sighting."

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Russian River

Coho Salmon

Captive Broodstock Program

Editor's Note

Welcome to the second issue of the Coho Monitor. The Russian River Coho Salmon Captive Broodstock Program is possible because of the partnerships and the contributions that each member makes. This is particularly true for the cooperation and participation of private landowners within the Russian River tributary streams where young coho are being released and monitored. This issue illustrates the ongoing collaboration, with contributions from Warms Springs Hatchery, California Department of Fish and Game, NOAA's National Marine Fisheries Service, Bodega Marine Laboratory, Sonoma County Water Agency, Trout Unlimited and others. Program partners have completed the third year of releases and have monitored winter and summer survival of released coho for two seasons. This fall will mark the anticipated return of the first release group as adults. A great deal has been learned in a short time leading to improvements for the program in the hatchery and in the field. The stories in this issue are provided to share those lessons and improvements. We hope you enjoy learning more about the program and look forward to your comments and thoughts as the program progresses. (*Production of this newsletter is made possible with support from the California Department of Fish and Game Fisheries Restoration Grant Program and the County of Sonoma.)*

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