APPROACH TO RECOVERY & DOCUMENT STRUCTURE

The Federal Endangered Species Act (ESA) was signed into law in 1973 for the purposes of conserving species in danger of extinction. The National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) is responsible for ESA implementation for listed marine and anadromous species, including the Central California Coast (CCC) Evolutionarily Significant Unit (ESU) coho salmon (*Oncorhynchus kisutch*). CCC coho salmon are listed as an endangered species and as such, the ESA requires NMFS to develop and implement a recovery plan to ensure the survival and recovery of this species. The plight of CCC coho salmon is severe and unless the causes of their decline are addressed immediately, they will likely go extinct in our children's lifetime.

Recovery is defined as the process of restoring listed species and their ecosystems to the point that they no longer require the protections of the ESA. A recovery plan serves as a road map for species recovery—it lays out where we need to go and how best to get there. Without a plan to organize, coordinate and prioritize the many possible recovery actions on the part of Federal, state, local, and tribal agencies, local watershed councils and districts, and private citizens, our efforts may be inefficient, ineffective, or even misdirected. Prompt development and implementation of a recovery plan will target limited resources effectively. Although recovery plans are guidance documents, not regulatory documents, the ESA clearly envisions recovery plans as the central organizing tool for guiding each species' progress toward recovery.

This recovery plan was constructed to be consistent with the conceptual approach used to establish the scientific biological foundations for this recovery plan developed by NMFS and other scientists (e.g., Technical Recovery Team) for CCC coho salmon viability (see McElhany *et al.* 2000; Bjorkstedt *et al.* 2005; Spence *et al.* 2008). The Technical Recovery Team (TRT) was appointed in 2000 and operated under the guidance of NMFS' Southwest Fisheries Science Center to assist with the development of biological criteria for the recovery plan. The TRT accounted for life history constraints, the physical setting of the ESU, and other aspects of coho historical population structure in establishing a viability framework. Their work sets the stage for coho salmon recovery by establishing minimum population viability targets, as well as the conceptual approach regarding overall ecosystem processes to support these minimum populations.

The TRT framework recommends that recovery planners evaluate the full context of the historical and current population structure. Their framework also recommends implementation of strategies that restore the rates of watershed processes towards their historical range of values. The premise: increasing divergence from the historical conditions under which the species evolved substantially increases the uncertainty regarding the ability of the ESU to persist over long time scales (Bjorkstedt *et al.* 2005).

NMFS recovery planners recognize that restoring all conditions under which CCC coho salmon have evolved, persisted, and thrived for tens of thousands of years across their historical range is unlikely. The challenge then is to establish a balance of providing for conditions that allow the species to thrive in a changing environment. The most immediate goal is to implement restoration, planning and policy actions in time to prevent extinction of CCC coho salmon.

The recovery plan is structured to provide the reader with (1) an overview of CCC coho salmon, Federal Endangered Species Act mandates and the listing factors/protective efforts identified in the *Federal Register*, (2) methods of analysis for populations, assessing current conditions and establishing threats and (3) the overall recovery strategy to include ESU, Diversity Strata and Population (*e.g.*, watershed) priorities for recovery actions.

We believe, if the strategies in this plan are implemented within recommended timescales, coho salmon can survive and will eventually recover. It is our fervent hope that through good stewardship, our children and their children will enjoy the benefits of experiencing abundant and healthy populations of coho salmon.

PROLOGUE

"Dan Jansen looked down from a bluff... "the water was like glass...the [coho] salmon were in rows...they lay there still...every now and then one would wiggle it's tail to keep his place in line. They lay there by the thousands as far as the eye could see..."

Thanksgiving on the Garcia River 1930's (Levene 1976)

LET THE FISH TELL THE STORY

Nearly everyone has a fish story to tell. Some of them include tales of a time when "…salmon and steelhead spawning runs were so thick that a person could walk across the stream on their backs" or when the "big one got away". These tales remind us of a time when coho salmon were so abundant and so prolific across all the coastal streams between Mendocino and Santa Cruz counties they were believed "inexhaustible". Today CCC coho salmon exist in such low numbers there are no longer fish stories to tell. The ones that are told chronicle a species demise.

Photo Courtesy: Kelley House Museum, Fort Bragg, California, 1920's

CCC coho salmon populations persisted for thousands of years in staggering abundance. Now gone from most streams, their precipitous decline is intimately tied to the human story of the region and the expanding human configured landscape and harvest pressure of the last 200 years. While the fate of salmon will depend on us, humans have depended on salmon for hundreds of years. With the paradigm that salmon were inexhaustible there were little controls on harvest and channel/riparian modificatins. Now commercial fishing boats lie idle at the docks, sports fishermen travel north to fish, our young don't fish with grandpa and the social safety net that has preserved this iconic species in the hearts and minds of California is unraveling. Today, when a few dozen wild coho arrive each winter to spawn in Marin's Lagunitas Creek or Mendocino's Pudding Creek, it is reason to celebrate, and to grieve. These few fish represent the struggling remnants of a once abundant species and a thread back in time, not so very long ago, when our creeks were clean, cool, and flowed unimpaired from their headwaters to the sea.

CCC coho salmon are nearly extinct and some argue that nothing can be done to save them; we disagree.

"It is difficult to break old concepts and to think along new lines. But when the evidence points strongly in favor of a change of thought, then it is fair and necessary to do so…"

Shapovalov and Taft 1954

"The dogmas of the quiet past are inadequate to the stormy present. The occasion is piled high with difficulty, and we must rise with the occasion. As our case is new, so we must think anew, and act anew."

Abraham Lincoln, Message to Congress, December 1, 1862

Thousands as Far as the Eye Could See

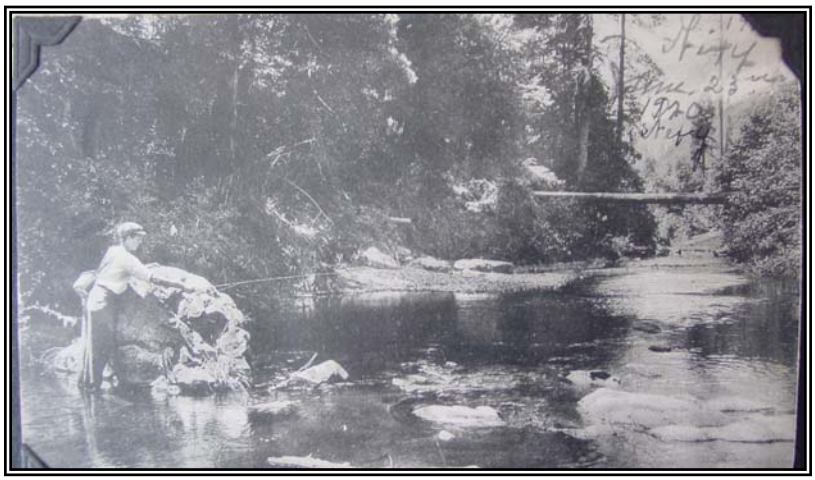

Photo Courtesy: Kelley House, Sheppard Album, Post Cards, Noyo River (1920)

Within the living memories of California's elders are visions of coho salmon in staggering abundance. It was late November in the 1930's when Dan Jansen looked down from a bluff above the Garcia River in Mendocino County. He said the water was "like glass," he could see huge numbers of salmon lined up in rows and "(n)ot a move out of them. Every once in awhile one would wiggle his tail to keep his place in line. They lay there by the thousands as far as my eye could see" (Levene *et al.,* 1976). These were adults returning from the ocean to their natal river, the Garcia, to prepare for their upstream migration to spawn and die. Other rivers are remembered for their size of coho salmon runs such as the Navarro, the Noyo, the Big, the Russian, and the San Lorenzo. These runs "were once a mainstay of California's sport and commercial fisheries" (Moyle *et al.,* 2008). This species, which had survived millennia of predators, droughts, fluctuating ocean conditions, and other natural hazards, was considered "inexhaustible" just fifty years ago (Janssen 2008). But it would barely survive the 20th century. By 1991 another lifelong resident of the Garcia River, Lando Franci, reported that "the (c)oho are gone" (Monschke *et al.*, 1992).

Cool, Moist, and Coastal

The distribution of CCC coho salmon at the time of European settlement included most coastal streams from the Santa Cruz County portion of the Pajaro River north to Usal Creek in Mendocino County. Watersheds draining into San Francisco Bay with similar conditions (*e.g.* ample cool water and conifer forests), also supported them. The first scientific specimens of CCC coho salmon in California were collected from a San Francisco Bay stream, San Mateo Creek in San Mateo County, by Alexander Agassiz in 1860. Historical presence of coho is confirmed for Corte Madera Creek and Arroyo Corte Madera del Presidio in Marin County. Less definitive evidence suggests coho presence in streams further east to include the Napa River, Walnut Creek, San Leandro Creek, Coyote Creek, and the Guadalupe River. A longtime Berkeley resident reported in 1939 that Strawberry Creek, "the one which runs through the University of California Campus . . . [once] supported a run of silver salmon" (Leidy 2007). This observation is supported by archeological evidence predating Spanish settlement (Gobalet *et al*., 2004). While up to a quarter of Bay watersheds may have supported coho, conditions may not have been ideal. The persistence of coho in the Bay probably depended on "immigration from coastal populations" (Bjorkstedt *et al*., 2005). Drier and hotter inland areas probably saw them intermittently, with coho runs possibly not surviving drought years. In the Russian River, in Sonoma and Mendocino Counties, there was a similar pattern; coho were abundant in the lower watershed, in the cool fog belt near the ocean. Its middle section, which, historically experienced dry reaches in the summer (Levene *et al.,* 1976), does not

appear to have had coho. In the upper Russian River, where it was wetter and cooler, "occasional migrants were likely present for short periods of time." But in the long run it was "too warm or dry to allow coho to complete their life cycles" (Bjorkstedt *et al*., 2005). A similar situation existed along the coast south of the Pajaro River, where the presence of coho to at least the Big Sur River (Monterey County) has been hypothesized, but not documented (Anderson 1995). Recently uncovered archeological evidence confirmed coho at least as far south as Elkhorn Slough in Monterey County (Gobalet 2008). Evidence suggests that the CCC coho population was likely concentrated near the coast where habitat conditions were ideal. At the edges and interiors of their range, coho were probably found occasionally, and likely disappeared as conditions became too warm and dry.

Photo Courtesy: Juvenile coho salmon, *Oncorhynchus kisutch*, collected in San Mateo Creek, a tributary of San Francisco Bay, in 1860. Image provided by the Harvard Museum of Comparative Zoology. Specimen 68471.

"En Especial Salmon"

Salmon, because they represented a significant seasonal food source, have always attracted humans. This was reflected in the placement of many native villages, and held true when the Spanish began to arrive in California in the late 18th century. Place names like *Pescadero* ("fishing place") illustrate the importance of fish as a food source. At the Carmel Mission, "Father Serra had a lagoon created . . . and they diverted the Rio Carmelo and raised salmon/steelhead in it" (Lydon 2008). Decades later, during the founding of the last California mission, Father Altimira recorded the observation of a native guide, who told him that Sonoma Creek had plenty of fish, "*en especial salmon"* (Altimira 1823). While Spanish and Mexican settlers caught, ate and even raised salmon, it seems unlikely they had much effect on coho salmon populations. The number of settlers was small, the fish abundant, and their habitats relatively unimpaired.

A Changing Landscape

As the Mission era drew to a close in the 1830s, ownership of land shifted from the church to private individuals. Land grants of thousands of acres were given out. The mature forests and ample water that coho salmon require attracted the attention of the new landowners, and the relationship between people and salmon began to change. The population of American settlers in Mexican California was slowly increasing, and so was the

Photo Courtesy: Early logging operation, Sonoma County c. 1880. Sonoma County Museum Collection

demand for lumber. From the earliest mission days, redwoods and other trees had been cut and milled by hand. Two men working a sawpit could produce about 100 board feet of lumber a day (Carranco and Labbe 1975). It could take a year or more to reduce a medium-sized redwood to boards. Several coho streams still bear Spanish names which point to early timber harvesting in these watersheds, including Corte Madera Creek, and Arroyo Corte Madera del Presidio. A "*Corte Madera*" is a place to "cut lumber."

California's first water-powered sawmill was built in 1834 on a coho stream—Mark West Creek, a tributary of the Russian River. It could process about 500 board feet a day (Carranco and Labbe 1975). A flood washed the mill away before the decade was out, but others were soon in operation. General Vallejo built a mill on Sonoma Valley's Asbury Creek in 1839 (Dawson 1998). The Santa Cruz area developed its first mill in 1841, with another built in 1845. By 1857, there were ten sawmills in the county and by 1864 the number had increased to twenty-eight. This exponential growth of sawmills was not driven by local need, but paralleled the exponential population growth associated with the Gold Rush and developing San Francisco (Figure 1). Santa Cruz became "one of the major suppliers for the builders" of San Francisco (Lehmann 2000). North of the Golden Gate, mills appeared along the Sonoma coast in the 1840s, and by 1852 on the Big River in Mendocino County (Downie *et al*., 2006). Again, demand from San Francisco drove these mill operations; Mendocino County's population was so small that its affairs were administered by Sonoma County until 1859.

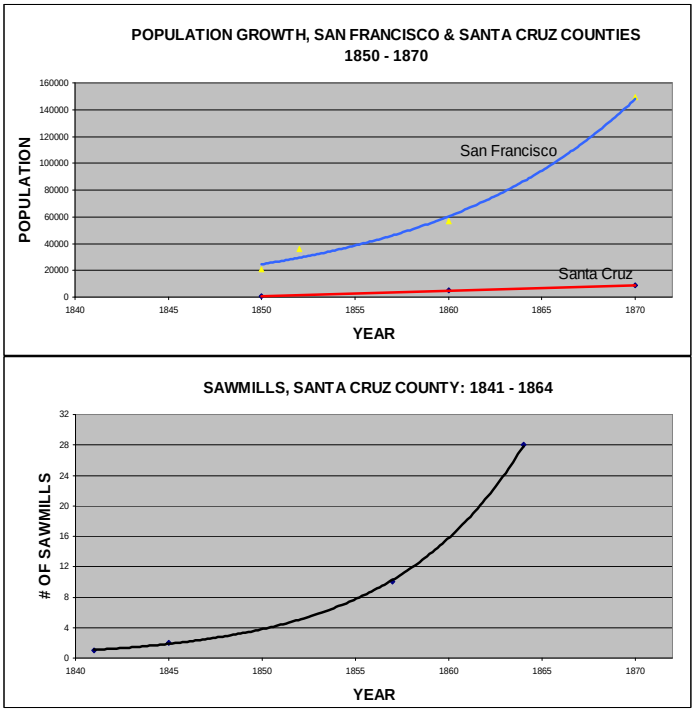

Figure 1: Exponential growth of sawmills and human population

Coho habitat was at the center of this logging boom. Many coho streams were named after their mills or mill owners: Mill Creek in Marin County; Mark West in Sonoma County; and Waddell in Santa Cruz. Usal Creek in Mendocino, is said to be named for the initials of the "United States of America Lumber" Company. Likewise, Duncan's Mill gave its name to the small town on the Russian River where it once stood. How did this first wave of logging affect the coho? On Mendocino's Big River, and probably elsewhere, early logging was done next to the river, so that the logs could be floated downstream to the mill (Downie *et al.*, 2006). As trees shading the pools where coho reared during summer were cut, water temperatures increased, making the habitat less suitable. Debris in the water created barriers for coho migration to and from the sea. South of the Golden Gate, streams did not have the volume of water to carry logs, so they "had to be skidded down using oxen, or processed where they fell. The best the lumbermen could do was fell the redwoods . . . and split them on site, carrying the posts, pickets, or shakes out . . . on mules or wagons." Coho spawning beds and rearing pools were directly and indirectly

altered, as "roads were laid out in stream bottoms or drainage swales, and no attempts were made to control the resulting erosion. Gullies from these early operations are still visible… Landslides and slumps were often precipitated by these logging practices… Many of today's mapped landslide deposits probably date from this period" (County of Santa Cruz 1976).

A host of products were produced from forests of California's central coast—lumber, shingles, fencing, as well as tan oak bark for tanning leather, a major industry at the time. Redwood was, "the best wood known for railroad ties . . . Sonoma and Mendocino Counties provided ties for the Central Pacific Railroad [the first trans-continental railway]. Every eastern train that crosses the Sierra rolls over the product of the forests of Sonoma . . . ties from this county synchronized to "maximize the flow." To avoid jams, men cleared the channels in the drier months of "all obstructions and debris." Log drives had severe consequences for coho salmon: they flushed away gravel spawning beds; deposited huge amounts of fine sediment in the estuary; destroyed rearing pools by eroding streambeds, in some cases to bedrock; and created jams which may have acted as migration barriers. Splash damming continued into the early 1930s and more than 70 years later, the devastating effects of these log drives are still apparent. The Big River watershed was recently described as being "beat up the worst" of any river on the central coast, due to this practice (Downie *et al*., 2006). Splash dams were also used on the Garcia and Navarro Rivers and perhaps other parts of the Mendocino Coast.

"A Moving Mass of Turgid Filth"

By twentieth century standards, the pace of early logging was modest. About a thousand acres a year were being harvested in Sonoma County during the 1870s (Thompson 1877), a rate that may have been nearly sustainable for both trees and salmon. However, downstream the operations of the mills themselves caused other problems. Sawmills produced tremendous quantities of sawdust. A common practice in the 19th century was to dump the waste into the same stream that powered the mill. As early as 1867, the *Santa Cruz Sentinel* reported that, "the sawmills on the Pescadero have . . . injured the fishing, from the sawdust running down the creek." Four years later, an article in the same newspaper described how the "impact of sawmills on trout fishing was always a matter of contention in the communities along the streams flowing out of the redwood-covered canyons of the Santa Cruz Mountains". For years it had been the practice of lumber companies to remove sawdust from the various mills by sluicing it into the running streams. This system had become universal . . . "until our pure limpid streams were discolored, and the water became, in some instances, as black as tar,--a moving mass of turgid filth" (Sentinel 1871).

The problem was not limited to sawmills. Creeks were seen as handy disposal systems. In Santa Cruz, "Bausch Beer Gardens lost business on days a nearby winery dumped pungent tailings in the creek and the [San Lorenzo] river ran red when Kron's tannery emptied a tanbark vat" (Gibson 1994). Some of the earliest environmental protection laws in California were passed during this era. In Santa Cruz "local laws curbed mill dumping of sawdust." North of the Golden Gate, the Big River Mill, near the town of Mendocino, was temporarily shut down in 1889 to instigate a new sawdust disposal system required by the County Fish Commissioner (Downie *et al*., 2006), and the following year, the *Point Arena Record* reported the mill at Gualala was "constructing a large furnace . . . to burn their sawdust instead of dumping it into the river" (Mendocino-Beacon 1890).

Creeks were also used for other purposes besides log transport and waste disposal. In 1873 it was reported that "every dairyman along the many streams which drain the western slope of the Santa Cruz

range," was preparing to tap these creeks for irrigation and domestic use. These included waterways like San Vicente Creek (where coho are still found), and most "…streams along the coast south of Waddell's creek, to the Pajaro." Water which flowed into the ocean rather than put to human uses was considered "waste water" (Sentinel 1873).

Hooks, Nets, Pitchforks, and Dynamite

It was only a few years before these impacts began to have a noticeable effect on the numbers of trout and salmon. In 1878, A.J. LaMotte, who arrived in Sonoma Valley in the early 1860s, lamented, "(s)ome years back great numbers of trout could be taken, but as fishermen increased, the fish rapidly decreased in number" (Munro-Fraser 1880). The same story was true in at least one tributary of the Russian River. In the 1870s the local newspaper reported that Santa Rosa Creek, "once a splendid stream for trout" had gotten so bad that "now no one thinks of trying to fish there" (The-Sonoma-Democrat 1876). Besides steelhead, Santa Rosa Creek also supported coho (Merritt-Smith-Consulting 1996). In addition to sport fishing, coho were being commercially harvested in at least a few places during the 1860s, including Pescadero and San Gregorio Creeks, Santa Cruz County (Gobalet *et al*., 2004). Two decades later, over 183,000 pounds of salmon were canned near Duncan's Mills on the Russian River in 1888. The size of the fish, 8-20 pounds, makes it appear that many were coho salmon. Coincidentally or not, declining numbers of salmon were first noted in the Russian River that same year (Steiner Environmental Consulting 1996).

Photo Courtesy: Kelley House, Post Cards, Noyo River 1930's

Salmon Spear, Kelley House Museum

It is impossible to know exactly how much effect commercial and recreational fishing by itself had on salmon populations in that era. The popularity of fishing is evidenced by this account: "(w)hen the railroad reached Santa Cruz in 1876, it was the river as much as the beach that drew tourists. Santa Cruz promoted itself as a 'sportsmen's paradise,' with most hotels only two blocks from the river. Hotels and downtown campgrounds saw a business boom each year at the start of fishing season" (Gibson 1994).

There were no limits or fishing regulations in those days. Fish were caught with hooks, nets, pitchforks, fish wheels, even dynamite: In the San Lorenzo River, "railroad workers . . . while building the South Pacific Coast Railroad in the late 1870s, often used explosives to 'fish.'" (Lydon 2008). Though no longer legal, the same technique was used by at least one individual in Sonoma Valley as late as the 1930s (Dawson 1998). Most historical sources lump several species under the term "salmon," so one can only guess at what impact 19th century fishing had on the coho population. Hard to catch with hook and line (Janssen 2008), spawning runs would have been vulnerable to nets, pitchforks, fish wheels, and dynamite. Coho's life cycle makes them especially sensitive to human impact, suggesting that their population followed the general decline of California "salmon" and "trout" recorded during the mid-19th century, perhaps more steeply than other species.

Photo Courtesy: "Fishing Fleet at Noyo, Mendocino County, California, circa 1930. H. H. Wonacott, photographer. Collection of the Mendocino County Museum

Declining numbers of salmon and trout prompted action. As mentioned, the dumping of waste into streams was prohibited. The California Fish Commission was created in the 1870s, and established early fishing regulations. The state's first fish hatchery was built on a tributary of the Sacramento in 1872. Hatcheries soon proliferated, built with both public and private funding (including railroads hoping to attract tourists). While early hatcheries raised steelhead and Chinook, "propagation of coho dates back to at least the 1890s" (DFG 2002). Beginning around 1906, the San Lorenzo River was stocked with coho and steelhead (Becker and Reining 2007). It was common practice in those days to plant fry (fish a few months old or less), which have a much lower rate of survival than larger, year-old smolts. Hatcheries also used eggs from watersheds as far away as Oregon and Washington, so the young fish were not genetically adapted to the waters into which they were released (Bjorkstedt *et al.*, 2005). Over 100,000 fry were planted in Waddell Creek between 1913 and 1933. Scott Creek was also heavily stocked during this time (Anderson 1995). However, in general, coho planting was "infrequent before 1929" (Bjorkstedt *et al*., 2005). For many reasons, planting hatchery fish probably had little to no effect on wild coho before the mid-twentieth century.

Bales of Smoked Coho

Initially, the center of California's salmon industry was the Sacramento River, with its abundant runs of Chinook salmon. As that fishery declined, "commercial trollers began harvesting salmon

offshore. By 1904, some 175 sail-powered fishing boats were operating out of Monterey Bay" (Lufkin 1991). Coho that had survived more than a year in freshwater *and* migration out to sea, faced a new challenge. Human activity was now affecting coho at every life stage. In Mendocino County, commercial fishing began near Fort Bragg, on the Noyo River in the 1890s with "a few men using dories or rowboats on the river," who "netted or seined silver salmon in the winter" (Stebbins 1986). Elmer Walker, who was born on the Garcia River in 1889, recalled how his father sent fish to San Francisco:

> "They had what they called a card. [It] had timbers that would float, with slots in there so that the fish couldn't get out. But they'd put them right in there and keep them alive . . . everything was shipped by boat at that time. They towed the cards. From where it was located it wasn't too far down to the mouth of the river . . . and then they had a dip net that they dipped them out with when they got ready to ship them. They were shipped in wooden crates and nailed up and sent to San Francisco. They knocked 'em in the head. Salmon and steelhead: there was no designation as far as marketable fish"

Roy Bishop, who also grew up on the Garcia River, remembered seeing "bales of smoked coho" that his grandfather sold. This was around 1925 (Levene *et al.*, 1976).

By the 1920s, California's salmon and steelhead streams had earned worldwide acclaim, and the "economic value of the sport fishery exceeded commercial fishing by two-to-one" (Lufkin 1991). Special trains brought anglers from the Bay Area to fish for adult coho in Lagunitas Creek (Brown and Moyle 1991). By one account, "the San Lorenzo River became the number 1 fishing river in northern California, and remained so for half a century." At the same time, the advent of the automobile granted fishermen ready access to once remote streams. Soon after, the Great Depression saw a resurgence of subsistence fishing as people fell on hard times. Vernon Piver recalled:

> "Times were really tough. My mother told me, to this day, she don't have a taste for smoked salmon, because they netted fish on the Garcia River and my grandfather smoked salmon and sold them for revenue, to pick up a few nickels and dimes. One of their main staples was that smoked fish" (Russell and Levene 1991).

Coho salmon. "Mouth of Garcia, Oct. 1932. This is what we caught." Sheppard Album, Kelley House Museum, Mendocino, California

While diminished to some degree from their numbers a century before, CCC coho salmon continued to occupy most of their original range. To some extent the land was recovering from the 19th century logging. By 1942, the Big River basin, whose channels had been so badly "beaten up" by the use of splash dams, had "some of the finest redwood second growth in the state"(Downie *et al.*, 2006). World War II may have granted coho a temporary reprieve from fishing and planting, because industry focused on building weapons to fight the war. But ultimately, the

war had repercussions that reached to the heart of the coho's domain.

From War Tanks to Bulldozers: Building A Moonscape

In the late 1940s, "the technologies of World War II . . . spun off the highly mobile track-driven bulldozer," which delivered the large trees of the central coast "for conversion to two-by-fours for a national building boom driven by the affluence of the returning soldiers" (House 1998). In essence, the industrial capacity used to build tanks was retooled into building bulldozers. Transient "gypsy loggers and sawmillers invaded the region with Gold Rush zeal"(Lufkin 1991). The combination of heavy equipment and the way it was used caused significant erosion and sediment delivery to streams. The equipment's size required the use of wide skid roads. Water breaks to curb erosion were rarely installed. To brake going downhill, tractor drivers scraped the ground with their blades. The construction of logging roads on unstable ground was common practice. Even worse, a 1962 Fish and Game survey of the Garcia River noted that "numerous roads were constructed in the stream channels," themselves, "oftentimes moving the stream out of its natural channel" (Monschke *et al.*, 1992). Trees were harvested "practically to the bottom of small gullies"(Downie *et al.*, 2006). Individual "layouts" were created, up to 300 feet long and 20 feet wide, to prevent falling trees from shattering on impact. By the end of 1956 it was estimated over 1000 miles of California streams had been damaged. The 1962 survey of the Garcia found more than 85 percent, of the channels had suffered some damage, and more than a third was "severely damaged" (measured by length). A person who saw it from the air in the late 1960s described the upper Garcia as "…a moonscape. Blue-line creeks were skid roads" (Monschke *et al.*, 1992). The intensity of the timber harvest was summed up by a resident of the Butano/Pescadero watershed: "They built a road to every tree they cut down" (Environmental Science Associates, Pacific Watershed Associates *et al*., 2004). By the 1970s, "more than 80 percent of the virgin forests had been cut, milled, and shipped," in most watersheds along the central coast (Lufkin 1991).

Even in an average year, such conditions caused serious problems for coho: "These hills are prone to erosion in the first place, so if you build roads and take out the trees, it's going to cause sedimentation" (Craig Bell quoted in (Monschke *et al.*, 1992) . In an unfortunate coincidence, two of the region's biggest floods on record happened in 1955 and 1964. Several residents of the Butano Creek basin reported that "the cause of the first damaging flood in the watershed . . . was due to logging undertaken by the Santa Cruz Lumber Company . . . beginning in 1955." Trout fishermen saw fishing decline rapidly: "(t)he creek silted up so bad . . . that the pool at the bottom of the 'Falls' was completely silted in." A resident who flew over the area at the time reported "hundreds and possibly thousands of landslides in the upper Butano" (Environmental Science Associates, Pacific Watershed Associates et al., 2004). Silt from landslides clogged spawning gravel and filled rearing pools, and landslides themselves directly blocked streams, creating migration barriers for coho.

Attempts at flood control were made in response to these events. On the lower San Lorenzo River in the City of Santa Cruz, "all riverside forests were stripped and the river was straightened by the Army Corps of Engineers," which also built flood control levees. These "transformed the river from a tree-lined and very scenic part of town, to a sterile drainage ditch. The siltation of the channel and the lack of deep water pools of water, coupled with low summer flows and a lack of shade . . . decimated fish populations." Where before, "trout and salmon had been routinely caught in the city," now "the river was barren of most wildlife," and "the fish populations declined" (McMahon 1997).

The Baby Boom

The postwar building boom increased the demand for other building materials besides lumber. In the early part of the twentieth century, gravel mining was done by hand in local streams. Elders in Sonoma Valley remember people driving small trucks down to the creek. "A number three scoop [shovel] and a strong back, that was how you did it" (Dawson 2002). Local gravel went to construct nearby buildings, bridges, and roads. The Garcia River saw its first commercial gravel operation in the 1930s *(Monschke, et al.,* 1992), but it was not until after the war that such operations increased to the point where they were making a significant impact to rivers and streams (Dawson 2002).

Population growth was the engine that drove the postwar boom. The number of people living in the Russian River basin increased 400 percent in the second half of the 20th century. More people brought a corresponding increase in demand for water. Dams of every size were constructed on coho streams throughout the region. Two large dams were built on the Russian River; Coyote Dam was completed in 1959, and Warm Springs Dam in 1982. While these dams pose a barrier to other salmonids this was probably not significant for coho, which never spawned in large numbers in the middle or upper Russian. Downstream, however, these dams altered the dynamics of the river, reducing peak flows, prolonging high winter flows, reducing replenishment of spawning gravel, and increasing summer flows to 15 to 20 times above historical levels (Steiner Environmental Consulting 1996). This last effect may be the most significant. During the warm months, coho rely on the cooler water at the bottom of deep pools. Higher summer flows raise the temperature of this cooler layer by mixing it with warmer surface waters. Medium-sized dams were built in smaller coho watersheds, such as Lagunitas and Nicasio Creeks in Marin County. Nevertheless, the small dams may have had the greatest cumulative effect. Five hundred small dams were counted on tributaries of the Russian River in 1996 (Steiner Environmental Consulting 1996). Besides acting as migration barriers on the lower Russian's coho streams, these dams also reduce spawning gravel and summer water supply downstream.

Photo Courtesy: Hal Janssen with two coho salmon caught in the San Lorenzo River, 1964. Alameda Creek Alliance

An Amazing Time to Live

As the second half of the twentieth century progressed, coho faced ever-increasing pressures at every stage of their life history: they were cut off from much of their prime habitat, they laid their eggs in clogged spawning beds, they had lost cool summer refuges at the bottom of deep pools, and they faced increasing commercial fishing at sea. It is really no surprise their numbers declined; however, it did not happen all at once. During the 1960s and 1970s, commercial and sport fishermen were still seeing and catching them. In places, coho were still abundant.

Photo Courtesy: Central California Coast Coho. Hal Janssen collection.

Hal Janssen, who grew up on Alameda Creek on San Francisco Bay in the 1950s, has spent a lifetime on the central coast, fishing "300 days a year . . . for thirty-five, forty years." Hal called the 'fifties "an amazing time to live." Speaking of coho, he recalls, "We would have huge schools and schools of them in California in the 'fifties and 'sixties in the San Lorenzo River and Pescadero." As fishing declined on the San Lorenzo in the early 1960s, he moved north, to the Russian and then up into Mendocino. One September a friend called him up and said, "Come to the Garcia; you can't believe it. It's loaded with silvers (coho); they're jumping everywhere!" Sure enough, when he arrived on the Garcia, coho salmon "were everywhere." Speaking of the Navarro, he said, "(t)he tidewater used to be absolutely packed with salmon. Packed! You'd go down there in September, it was more packed than the Garcia was." He also mentioned the Big River and Ten Mile River.

Being out so much of the time, Hal witnessed first-hand the decline of coho and other salmonids. Of the Navarro, he said, "Now there is none! They're gone!" He attributes the decline to a number of things, including: poachers, who take advantage of the lack of game wardens in the field; the flood of 1955, and predation by marine mammals (Janssen 2008) .

Computers, Accidental Anglers and Millions of Fry

Coho numbers are estimated to have plummeted statewide from as many as 500,000 in the 1940s, to as few as 13,000 by 2002 (DFG 2002) (CCC coho would have represented a fraction of this number). Moreover, while most coho in the 1940s were native to their streams, as few as 500 purely native fish remained. The gene pool of the rest has been diluted by out-of-basin plantings. A troubling development is the disappearance of coho from many parts of their range, the general pattern being from south to north. In Santa Cruz County, the Pajaro River and Soquel Creek lost their native runs around 1968, followed by Aptos Creek in 1973. In 1957, the San Lorenzo River was called "the most important steelhead and salmon fishery " south of the Bay area (Becker and Reining 2007). Just twenty-seven years later, its coho run was gone. Many San Mateo County streams lost their runs in the late 1970s and early 1980s, due to the drought of 1976 -1977 coupled with land and water development. By 1995, only Waddell and Scott Creeks were believed to maintain sustained natural runs of coho south of San Francisco (Anderson 1995).

Urbanization is a prominent factor in the decline of coho, particularly in San Francisco Bay. As late as 1965, runs of coho salmon were reported in Marin's Corte Madera Creek. The following year, California Fish and Game reported that coho in the Napa River (Napa County) "had been eliminated." Coho and other salmonids became rare in the Walnut Creek watershed in the late 1960s, and were last reported in the south Bay's Guadalupe River (Santa Clara County) in the 1970s (Leidy 2007). Similar urban pressures were occurring in the San Lorenzo River watershed. The growth of Silicon Valley fueled a sharp rise in development in the upper watershed that peaked in the 1970s (County of Santa Cruz 2001). One likely effect of all this building boom was a huge increase in siltation first noted in the 1960s (Becker

and Reining 2007). Unlike logging impacts, where the impacts from past practices are slowly healing over time, the impact of urbanization is profound and permanent. Of all 78 watersheds that historically had a coho population, all of those with significant amounts of urban development, have lost their coho run save one, Lagunitas Creek[1].

In Lagunitas Creek, the 2007/2008 coho run was probably the smallest run observed since annual surveys began in 1995. There was a 70 percent decline in the number of redds (gravel "nests" where eggs are laid) compared the parent generation, which hatched three years earlier. Similar or greater declines were seen in other coastal watersheds in Marin. This is consistent with a 73 percent decline in counts for returning CCC coho throughout their range. The decline has been attributed to reduced populations and influences of "poor ocean conditions and food supply when these coho migrated to the ocean as smolts in 2006" (Ettlinger, Childress *et al*., 2008). Remarkably, as bad as the 2007/2008 spawning run was the 2008/2009 spawning run was worse, with only 40 fish returning from the ocean.

On the Russian River, the number of coho smolts entering to the ocean is estimated to have declined 85 percent in just the sixteen years between 1975 and 1991. By the winter of 2007/2008, Joe Pecharich, a coho researcher who worked at the Warm Springs Dam Fish Hatchery and now works for NMFS, said, "…we know of only two coho that came back. The year before that we know of only two. The year before that were five." And in the current winter of 2008/2009, the only known coho female to return was caught and, inadvertently, killed by an angler (Norberg 2009).

Along the Mendocino coast, the pattern was more varied, in some cases being the opposite of that seen in the southern portion of the species coastal range. On the Big River, which had seen intensive logging, only two coho were reported in 1955. Yet by 1978 its coho run was estimated at 2000. Stocking of coho began there in 1956, and a hatchery was built in the early 1960s (Stebbins 1986). A half million eggs and fry were planted in the Big River between 1956 and 1978 (Downie *et al*., 2006). As with past stocking efforts using fry, the effectiveness of the plants was probably minimal. Current run size is unknown, but juveniles have been consistently found in many tributaries, showing that some adults are still spawning on the Big River. On the Garcia, Lando Franci recalled that "(s)almon were already starting to dwindle" by the 1940s. Craig Bell remembers seeing "(s)ilvers and Kings . . . rolling in the tidewater" in October 1979. But "by about '(19)85 it was history" (Monschke *et al.*, 1992). The fish were gone.

As on the Big River, declining numbers of coho inspired vigorous hatchery and planting programs. Unfortunately there was still no effort to plant native streams with native stock. In all, over 11.5 million out-of-basin fry and fingerlings were released in central coast streams, mostly from the 1950s through the mid-1990s (Bjorkstedt *et al.*, 2005). Despite all the planting, commercial catch of coho declined sharply in the late 1970s, believed to be the result of poor conditions in both the ocean and the coho's freshwater

[1] Lagunitas Creek coho are persisting due in large part the dedication and organization of local citizens and the common vision of local agencies and political bodies to implement restoration actions and policies necessary to save this fish.

habitat. By the early 1990s, ocean stocks of coho were so low that commercial and sport fishing were closed (DFG 2002) and have remained closed ever since.

Rays of Hope

By the winter 2006/2007, native coho were estimated to have declined more than 99 percent in less than seventy years. Most spawning populations are reduced to less than fifty fish (Moyle *et al.*, 2008). California's once abundant central coast coho are now nearly extinct. Only a sustained and vigorous effort by the public, landowners, and decision-makers at every level, will bring them back. While their survival hangs in the balance, a handful of places have seen modest increases in coho in recent years. On a tributary of the Garcia River where coho had not been seen for at least twenty years, schools of juveniles were discovered at ten locations in 2008. One researcher believes that the sustainable forestry now being practiced there, "might be the best way left to preserve woodland ecosystems, watersheds and fish" (Fimrite 2008). Additionally, gravel mines have closed or improved their activities to be more compatible with habitat needs, such as Homer and Steve Canelis from Austin Creek Aggregates, and extensive restoration efforts on agricultural and forested landscapes have been ongoing for 15 years and are resulting in substantial improvements in habitat quality.

Large wood is being placed into streams to promote gravel sorting and pool development for improved spawning and rearing habitats. One such project on the South Fork Ten Mile River facilitated the restoration of 9.4 miles with 245 logs and 65 rootwads placed across 138 sites. Coho salmon were observed in the South Fork Ten Mile for the first time in a decade. Similar projects are being proposed for the North Fork Ten Mile; projects that are a very high priority for preventing extinction and ensuring survival of coho salmon.

In Santa Cruz County, San Vicente Creek had apparently lost its coho run by the early 1980s. Yet, in the fall of 2002, several hundred coho were discovered in an agricultural off-channel pond on the Coast Dairies Property by NOAA's Office of Law Enforcement (The Trust for Public Land 2004). Researchers believe the cool, deep water in this pond, which is connected to the creek by an inlet and outlet channel, mimics natural "off channel" conditions preferred by coho for rearing. Recently, when water flow into this pond became disconnected, numerous agencies and concerned citizens joined together and completed a complex restoration effort in record time, solely for the purpose of saving this important southern coho salmon population.

California's redwood forests are now the last areas where coho salmon persist in some abundance. Unlike other landuses such as agriculture or urbanization, timberland management in California is regulated by Forest Practice Rules. These Rules have standards for road construction and maintenance to reduce sediment to streams, riparian canopy retention along fish-bearing and non-fishbearing watercourses and mechanisms for forest growth and regeneration. Watershed processes that provide for salmon spawning, rearing and sheltering are relatively intact in forestlands. The future and fate of salmon is inextricable to the future and fate of California's redwood forests.

If people can come together to prevent the extinction of the condor or raise and fly whooping cranes across country in an ultralight to teach them migration; we can bring salmon back in California. The news of preventing extinctions of species is growing and offers a ray of hope that the story of CCC coho salmon will continue. The purpose of this plan is to build upon these successes and educate our children so that the spawning runs witnessed on the Garcia River in the 1930's as well as healthy spawning runs throughout the Central Coast, will be a part of our future.

Photo Courtesy: Bob Coey, NMFS