State of California
The Resources Agency

DEPARTMENT OF FISH AND GAME

REPORT TO THE FISH AND GAME COMMISSION:

A STATUS REVIEW OF THE COHO SALMON (ONCORHYNCHUS KISUTCH) IN CALIFORNIA SOUTH OF SAN FRANCISCO BAY

Prepared by

Keith R. Anderson
Senior Fisheries Biologist
Region 3, Monterey

Approved by

Alexander Petrovich Jr., Deputy Director
California Department of Fish and Game

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REPORT TO THE FISH AND GAME COMMISSION

A STATUS REVIEW OF THE COHO SALMON (ONCORHYNCHUS KISUTCH) IN CALIFORNIA SOUTH OF SAN FRANCISCO BAY

EXECUTIVE SUMMARY

This status report was prepared in response to a petition received by the Fish and Game Commission from the Santa Cruz County Fish and Game Advisory Commission to list the coho salmon (Oncorhynchus kisutch) south of San Francisco Bay as a Threatened Species pursuant to the California Endangered Species Act (Fish and Game Code Sections 2050 et seq.).

On April 7, 1994, pursuant to Section 2074.2 of the Fish and Game Code, the Commission determined that the petition contained sufficient information to indicate that the petitioned action may be warranted. Pursuant to Section 2074.6 of the Fish and Game Code, the Department of Fish and Game (Department) undertook a review of this petition. Based on the best scientific information available on the coho salmon south of San Francisco Bay, the Department has evaluated whether, in fact, the petitioned action should be taken. Information and comments on the petitioned action and the species in question were solicited from interested parties, management agencies, and the scientific community.

This report presents the results of our review and analysis

Findings

Coho salmon stocks south of San Francisco Bay constitute the southern portion of the species range in California and, as such, appear to be adaptive to the marginal environments associated with the fringe of a species distribution. Historically found in as many as 50 coastal drainages in San Mateo and Santa Cruz counties, spawning runs were limited to 11 stream systems by the 1960's, and are currently restricted to only one remnant

population in Waddell Creek, one small naturalized (hatchery-influenced) population in Scott Creek and a small hatchery-maintained, non-native run in the San Lorenzo River, Santa Cruz County. The combined average annual spawning population of native and naturalized coho salmon in Waddell and Scott Creeks is estimated at only 50-60 adults, comprising only 1.5% of the estimated abundance of coho salmon south of San Francisco Bay in the early 1960's. As a consequence of the loss of two of the three brood year lineages of Waddell and Scott Creek coho salmon, sustained spawning runs occur only every third year.

Coho salmon south of San Francisco Bay are considered the most restricted, remnant and sensitive stocks of coho salmon in California because of the cumulative deleterious influences of past and present habitat loss, habitat degradation, catastrophic floods and droughts, loss of genetic and population viability, predation, unfavorable oceanic conditions, overexploitation, disease and interaction with hatchery fish. These southern populations could become functionally extinct as self-sustaining stocks from the consequences of a single catastrophic event.

Conclusions

The Department concludes that the coho salmon south of San Francisco Bay is in serious danger of extinction because these southern stocks have declined by over 98% from historical levels; consist of only two native or naturalized remnant populations isolated in two small, adjacent coastal streams (Waddell and Scott Creeks) and one small hatchery-maintained, non-native run in San Lorenzo River, Santa Cruz County; continue to be endangered by numerous deleterious factors; and, in our best professional judgment, seem highly likely to decline to the point of extinction in the near future. The petitioner has requested that the coho salmon south of San Francisco Bay be listed as Threatened. The Department's status review indicates that uplisting the requested action from Threatened to Endangered is warranted, and based on the best available scientific information regarding the distribution, abundance, biology and threats to coho salmon south of San Francisco Bay, the Department finds that listing as Endangered is the appropriate action. This finding is based on the following:

1. Coho salmon depend on specific components in their essential habitat at various freshwater life history stages, and the destruction and degradation of this habitat have been extensive since historical times.

2. The fixed 3-year maternal broodyear lineages characteristic of southern coho salmon make them particularly vulnerable to natural catastrophic events, such as floods and droughts.

3. Predation by marine mammals adversely affects remnant coho salmon populations when fish are concentrated in lagoons and in the ocean at the mouths of streams waiting for suitable attraction flows to gain access into streams, and when fish are swimming over shallow sandbars at stream mouths during periods of low streamflow.

4. Due to the small numbers of adult coho salmon remaining in southern stocks, the adverse consequences from BKD disease are a continuing threat to perpetuation of the population.

5. The take and incidental mortality of any southern coho salmon in the ocean fisheries is adverse to the species survival due to the very small numbers of returning spawners in these stocks.

6. An oceanic environment that is becoming less favorable for coho salmon smolt and adult survival does not bode well for the long-term survival of southern stocks that have been reduced to remnant levels with sustained runs only every third year.

7. Past and present hatchery practices and plantings have caused the interbreeding of native wild southern coho salmon stocks with non-native and imported stocks, and subjected native stocks to artificial selection and spawning. These activities have combined to adversely influence the genetic viability of remaining stocks.

8. Current low numbers of adult fish, combined with increasing geographic and genetic isolation, place the remaining two stocks of southern coho salmon at risk of extinction due to biological and genetic factors associated with small population size. These factors seriously threaten the viability of southern coho salmon to produce self-sustaining populations.

9. Human-related activities pose a serious threat to the continued existence of the remaining two stocks because of the vulnerability of stocks that now produce sustained spawning runs only every third year.

10. The loss of two of the three brood year lineages that comprise a southern coho salmon population, combined with the low number of spawners in the surviving 1993-1996 lineage below the threshold necessary for sustaining population viability, depicts failing stocks on both Waddell and Scott Creeks.

Recommendations

Listing:

1. The Commission should find that the petitioned action should be uplisted from State Threatened to State Endangered.

2. The Commission should find that the uplisted petitioned action is warranted for the listing of coho salmon south of San Francisco Bay as State Endangered.

3. The Commission should publish notice of its intend to amend Section 670.5, Title 14, CCR to add the coho salmon south of San Francisco Bay (*Oncorhynchus kisutch*) to its list of Endangered Species.

Recovery Objectives:

1. The Department shall immediately begin to develop a recovery plan that will:

   a protect existing populations and habitat;

   b) restore habitat and populations; and

   c) monitor the populations and implementation of the recovery plan.

2. The Department shall seek funding for development and implementation of the recovery plan through the State budgetary process.

3 The Department shall immediately implement all the protections of sections 2050-2097 of the Fish and Game Code.

Public Responses

During the 12-month review period, the Department contacted a number of affected and interested parties, invited comment on the petition, and requested any additional scientific information that may be available. A copy of the Public Notice and a list of parties contacted are contained in Appendix B-1. Copies of comments received are provided in Appendix B-3.

REPORT TO THE FISH AND GAME COMMISSION

A STATUS REVIEW OF THE
COHO SALMON (ONCORHYNCHUS KISUTCH)
IN CALIFORNIA SOUTH OF SAN FRANCISCO BAY

INTRODUCTION

Petition History

On February 24, 1993, the California Fish and Game Commission (Commission) received a petition from the Santa Cruz County Fish and Game Advisory Commission (County) requesting State listing of the coho salmon (Oncorhynchus kisutch) of Scott and Waddell Creeks as an Endangered Species. The Department reviewed the petition and recommended to the Commission that the petition be rejected. This recommendation was based on the conclusion that the Scott and Waddell Creek runs are probably not reproductively isolated from runs in neighboring streams and, therefore, are not distinct stocks of coho salmon. The Department believed it was inappropriate to limit the listing action to only two populations of a species experiencing severe decline over a large portion of its range.

At its August 5, 1993, meeting, the Commission requesting that the County prepare a draft recovery plan to be submitted at the October 7, 1993 Commission meeting. Action on the petition was put over until the October 1993 meeting.

At the October 7, 1993, Commission meeting, the Department stated conditional support for the County's draft recovery plan, but again recommended the Commission reject the petition on the basis that listing the species only in Scott and Waddell Creeks would not improve the recovery of coho salmon south of San Francisco. The County officially withdrew the petition with the stated intent of submitting a new petition covering all streams south of San Francisco Bay.

On December 16, 1993, the Commission received an expanded petition from the County requesting State listing of the coho salmon south of San Francisco Bay as a Threatened Species (Appendix A). The Department reviewed the petition and recommended to the Commission that they accept it as complete pursuant to Sections 2072.3 and 2073.5 of the California Endangered Species Act (Fish and Game Code Sections 2050 et seq.) and that the petitioned action may be warranted. On April 7, 1994, the Commission accepted the Department's recommendation and designated the coho salmon south of San Francisco Bay as a Candidate Species as provided for in Section 2074.2 of the California Endangered Species Act (CESA). That action initiated a 12-month review period, pursuant to Section 2074.6 of CESA, in which the Department must review the best scientific evidence available on coho salmon south of San Francisco Bay and provide a

written status report to the Commission. This report presents the results of the Department's status review and a recommendation to the Commission, based on the best scientific information available, of whether or not the petitioned action is warranted.

Department Review

During the 12-month review period, the Department contacted affected and interested parties, invited comment on the petition, and requested any additional scientific information that may be available, as required pursuant to Section 2074.4 of CESA. A copy of the Public Notice and a list of parties contacted are contained in Appendix B-1. A list of the newspapers which published the legal notice is contained in Appendix B-2. Copies of comments received are provided in Appendix B-3. The Department convened an informal Ad-Hoc Coho Salmon Advisory Committee of four individuals with special knowledge on coho salmon south of San Francisco Bay to provide advice and comment to the Department regarding action on the petition. The Committee met on October 13, 1994 and January 4, 1995 in its advisory role. A list of Committee members is contained in Appendix B-4. The Department also sponsored a public meeting on March 24, 1994 in Felton, Santa Cruz County, to seek public input on coho salmon restoration and recovery in Santa Cruz County streams with emphasis on Scott and Waddell Creeks. A copy of the meeting announcement and a summary of public comments are presented in Appendix B-5.

Federal Listing Review

In March 1993, the Santa Cruz County Fish and Game Advisory Commission (County) filed a petition (the same petition submitted to the Commission on February 24, 1993) with the National Marine Fisheries Service (NMFS) to list the coho salmon of Scott and Waddell Creeks as a Federal Endangered Species. In their April 1994 status review (Bryant 1994), NMFS determined that "the Scott and Waddell Creeks coho salmon populations do not represent a "species" under the FESA [Federal Endangered Species Act], and, therefore, a proposal to list these populations under the FESA is not warranted at this time."

The status review further stated:

> "However, these populations may be part of a larger ESU [Evolutionarily Significant Unit] whose extent has not yet been determined. Whether this larger ESU merits protection under the ESA cannot be determined at this time. NMFS will attempt to identify the larger ESU that contains the Scott and Waddell Creeks coho salmon populations as part of the ongoing status review that is addressing all coastal coho salmon populations in California, Oregon, Washington, and Idaho."

In October 1993, the Pacific Rivers Council and 20 other petitioners, filed a petition with the NMFS to list the coho salmon throughout its range in Washington, Oregon, Idaho and California as a Federal Threatened or Endangered Species. On October 27, 1993, the NMFS initiated a status review for coastwide stocks of coho salmon. Findings of the status review and decisions on whether to propose listing this species or any distinct population segments (ESUs) as Threatened or Endangered was due on October 20, 1994. To date, the findings and decisions have not been published in the Federal Register.

FINDINGS

Life History

Description

Coho are medium to large salmon, with spawning adults typically 40 to 70 cm (15.8 to 27.6 inches) forklength (FL) and weighing 3 to 6 kg (6.6 to 13.2 lbs.). Coho as large as 80 cm (31.5 inches) and 10 kg (22 lbs.) have been caught in California. They have 9-12 major dorsal fin rays, 12-17 anal fin rays, 13-16 pectoral fin rays, 9-11 pelvic fin rays (with an obvious axillary process at fin base), a small fleshy adipose fin, and a slightly indented caudal fin. The scales are small and cycloid. Lateral line is complete and almost straight with 121-148 pored scales. Pyloric caeca number 45-83. There are 11-15 branchiostegal rays on either side of the jaw. Gill rakers are rough and widely spaced, with 12-16 on the lower limb (half) and 6-9 on the upper limb (half) of the first gill arch.

Spawning adults are generally dark and drab. The head and back are dark, dirty blue-green; the sides are a dull maroon to brown; and the belly is gray to black. Females are paler than males. Spawning males are characterized by a bright red lateral stripe, hooked jaw, enlarged and more exposed teeth, slightly humped back and a more compressed head and body. The snout is less deformed than in other salmon species. Both sexes have small black spots on the back, dorsal fin, and upper lobe of the caudal fin. The adipose fin is finely speckled, imparting a grey color. Except for the caudal, the other fins lack spots and are tinted orange. The gums of the lower jaw are grey, except the upper area at the base of the teeth through which the teeth project, which is generally whitish.

Adult coho salmon in the ocean are steel-blue to slightly greenish on the back, silvery on the sides, and white on the belly. They have numerous small, irregular black spots on the back, upper sides above the lateral line, base of the dorsal fin and upper lobe of the caudal fin.

Juvenile coho in inland waters are blue-green on the back, with silvery sides and 8-12 narrow and widely spaced parr marks centered along the lateral line. The pale interspace between parr marks is wider than the width of a parr mark. The adipose fin is uniformly pigmented grey or dusky color. The other fins lack spots and are usually orange tinted; however, the intensity of the orange tint varies greatly. The anal fin is pigmented between the rays, often producing a black and orange banding pattern. The anal fin is large, with the first rays elongated and white with black behind. This characteristic distinguishes juvenile coho from the juveniles of other Pacific salmon species.

Taxonomy

The coho salmon is one of seven species of Pacific salmon belonging to the genus Oncorhynchus, and one of five such species found in California. It occurs naturally only in the north Pacific Ocean and tributary drainages. It presently ranges in freshwater drainages from Hokkaido, Japan and the Russian Far East, around the Bering Sea and Aleutian Islands to mainland Alaska, and south along the North American coast to Monterey Bay, California. Coho salmon have been successfully introduced into more non-endemic lakes and streams than any other Pacific salmon species, including all of the Great Lakes. It is a member of the Family Salmonidae (Salmon, Trout and Char) of the Order Salmoniformes (Salmon-like Fishes) in the Class Osteichthyes (Bony Fishes). The coho salmon was first described as a species, Salmo kisutch, by Walbaum in 1792, from specimens taken from the rivers and lakes of the Kamchatka Peninsula, Russia. It was eventually redescribed as Oncorhynchus kisutch by Jordan and Evermann in 1896-1900. Oncorhynchus means "hooked snout", and kisutch is Walbaum's interpretation of the local name for this species used in Kamchatka. Coho salmon is the accepted name as adopted by the American Fisheries Society and Federal and State agencies. The name "coho" comes from an American Indian name for this salmon. Other common names include: silver salmon, blueback, and sea trout.

Genetic Relationships

Coho salmon exhibit a trait common to many species in being most abundant in the central portion of their range and less common in the northern and southern fringes of their natural distribution. Populations in California are the southernmost for the species, with the populations in Waddell and Scott Creeks being the present southern end of the spawning range on the North American coast. These southernmost populations experience and respond to the unfavorable, adverse environmental conditions associated with the fringe of any distribution. In such areas, environmental conditions can become marginal, harsh or extreme for coho survival and, presumably, these southernmost populations have adapted to the less-than-optimal environments. Genetic

assessments can assist in determining if southern stocks have developed unique characteristics and are genetically differentiated from more northern stocks.

In the recent NMFS status review of coho populations in Scott and Waddell Creeks, Bryant (1994) reviewed coho genetic assessments to date and concluded that:

> "The results from the limited number of allozyme studies conducted on coho salmon populations in California were similar to those obtained for coho populations in Oregon, Washington, and British Columbia. However, little pattern in the distribution of variant alleles or genetic variation was observed, and only weak associations between genetic identity and geographic location were found. The estimated average number of individuals exchanging genes among the California populations of coho salmon studied was > 1.0 fish per generation, which is large enough to prevent the tendency for fixation of different alleles in different populations. Overall, the genetic data compiled for this status review failed to demonstrate that the Scott and Waddell Creeks coho salmon populations as a group are distinct from other coastal coho salmon populations."

California populations of coho do not appear to have the genetically distinct, temporally segregated runs that characterize the more abundant chinook salmon and steelhead trout in California or the coho stocks of the Columbia River Basin. California coho are predominately found in small to medium size coastal streams and rivers and do not use long river systems that would require extensive long-run migrations as found in the Columbia River Basin. Because California coho are basically short-run fish in smaller coastal systems, the potential for reproductive isolation and genetic differentiation between long-run and short-run stocks as found in Washington and Oregon does not appear to exist in California.

However, given the homing capabilities of coho salmon, it is reasonable to expect that at least some coho along the California coast have adapted for local environmental conditions with regard to run-timing and other life history characteristics. A recent study of allozyme variation in California coho salmon by Bartley et al. (1992) showed that most variant alleles occurred at three or fewer localities, although the distribution of those alleles did not follow any particular pattern. These authors concluded that gene flow among California populations was high from an evolutionary perspective, but low in terms of the actual number of individuals (1.4 per generation) being exchanged between populations. Further population genetic studies using mitochondrial DNA are needed. Bartley et al. (1992) believe there is some indication from allozyme data that California

stocks may be somewhat genetically differentiated from stocks in more northern areas.

Although NMFS concluded that the two remaining reproducing coho populations south of San Francisco Bay (Scott and Waddell Creeks) are not distinct from other coastal coho populations, NMFS has tentatively concluded that these two stocks are part of a larger, distinct coho population segment, identified as an Evolutionarily Significant Unit (ESU), that extends from Monterey Bay north to the vicinity of Punta Gorda-Cape Mendocino on the California north coast (G. Bryant, NMFS, Pers. Comm.). This tentative ESU identification is based on review of genetic, morphological, life history and environmental data and will be reported in the NMFS status review for coastwide stocks of coho salmon.

Biology

The general biology of coho salmon is described in detail in the extensive technical information provided in Shapovalov and Taft (1954), McPhail and Lindsey (1970), Scott and Crossman (1973), McMahon (1983), Hassler (1987) and Sandercock (1991).

General Life History Cycle

The following summary of the coho salmon life history cycle is excerpted from the *Petition To The Board of Forestry To List Coho Salmon (Oncorhynchus kisutch) As A Sensitive Species*, prepared by the California Department of Fish and Game (CDFG) and presented to the California Board of Forestry (BOF) on January 4, 1994:

"The life history of the coho salmon in California has been well documented by Shapovalov and Taft (1954) and Hassler (1987). Coho salmon generally return to their natal streams to spawn after spending two years in the ocean except some males called "jacks" may return after one growing season in the ocean. The spawning migrations begin after heavy late-fall or winter rains breach the sand bars at the mouths of coastal streams, allowing the fish to move into them. However, migration typically occurs when stream flows are either rising or falling, not necessarily when streams are in full flood. The timing of their return varies considerably, but in general they return earlier in the season in more northern areas and in the larger river systems (Baker and Reynolds 1986). In the Klamath River, the coho run between September and late-December, peaking in October-November. Spawning itself occurs mainly in November and December (USFWS 1979). The early part of the run is dominated by males, with females returning in greater numbers during the latter part of the run. Baker and Reynolds (1986) found the coho run in the Eel River occurs 4-6 weeks later than that in the Klamath River;

arrival in the upper reaches of the Eel River peaks in November-December.

In the short, coastal streams of California, most coho return during mid-November through mid-January (Baker and Reynolds 1986). For example, in Waddell Creek, spawning migrations often do not occur until November or December (Shapovalov and Taft 1954). In Oregon streams, Sandercock (1991) found spawning can occur as late as March if drought conditions delay rains or runoff. Coho salmon migrate up and spawn mainly in streams that flow directly into the ocean or in tributaries of large rivers. Generally, coho spawn in smaller streams than used by chinooks.

Females choose the spawning sites (redds) usually near the head of a riffle, just below a pool, where the water changes from a laminar to a turbulent flow and there is a medium to small gravel substrate. The flow characteristics of the location of the redd usually ensure good aeration of eggs and embryos, and flushing of waste products. The water circulation in these areas facilitates fry emergence from the gravel. Each female builds a series of redds, moving upstream as she does so, and deposits a few hundred eggs in each. Thus, spawning may take about a week to complete and a female can lay between 1,400-7,000 eggs. There is a positive correlation between fecundity and size of females. Hassler (1987) noted a dominant male accompanies a female during spawning, but one or more subordinate males also may engage in spawning. He also found both males and female die after spawning, although the female may guard a nest for up to two weeks.

Embryos hatch after 8-12 weeks of incubation, the time being inversely related to water temperature. Hatchlings remain in the gravel until their yolk sacs have been absorbed, 4-10 weeks after hatching. According to Baker and Reynolds (1986), under optimum conditions, mortality during this period can be as low as 10 percent; under adverse conditions of high scouring flows or heavy siltation, mortality may be close to 100 percent. Upon emerging, they seek out shallow water, usually along stream margins. Initially they form schools, but as they grow bigger the schools break up and the juveniles (parr) set up individual territories. Chapman and Bjornn (1969) determine the larger parr tend to occupy the heads of pools; the smaller parr are found further down the pools. As the fish continue to grow, they move into deeper water and expand their territories until, by July and August, they are in deep pools. Optimal habitat seems to be in deep pools created by large, woody debris and boulders in heavily shaded sections of stream.

As water temperatures decrease into the fall and winter months, fish stop or reduce feeding due to lack of food or in response to the colder water and growth rates slow down. During

December-February, winter rains result in increased stream flows and by March, following peak flows, fish again feed heavily on insects and crustaceans and grow rapidly. Toward the end of March and the beginning of April they begin to migrate downstream and into the ocean. Outmigration in California streams typically peaks in mid-April and to mid-May, if conditions are favorable. Migratory behavior is related to rising or falling water levels, size of fish, day length, water temperature, food densities, and dissolved oxygen levels. At this point, the outmigrants are about one year old and 10-13 cm in length. The fish migrate in small schools of about 10-50 individuals. Parr marks are still prominent in the early migrants, but the later migrants are silvery, having transformed into smolts.

After entering the ocean, the immature salmon initially remain in inshore waters close to their parent stream. They gradually move northward, staying over the continental shelf. Coho salmon can range widely in the north Pacific, but the movements of California fish and poorly known. Most coho caught off California in ocean fisheries were reared in the Columbia River or in coastal Oregon streams either naturally or in hatcheries. In 1990, for instance, 112,600 coho were caught in commercial and recreational ocean fisheries, which greatly exceeds the present production capability of California populations alone (A. Baracco, pers. comm.). Oceanic coho tend to school together. Although it is not known if the schools are mixed, consisting of fish from a number of different streams, fish from different regions are found in the same general areas. Adult coho salmon are primarily piscivores, but shrimp, crabs, and other pelagic invertebrates can be important food in some areas."

Distinctive Traits

An identification of distinctive life history traits, if any, attributable to coho salmon south of San Francisco Bay is limited by available information to the review of studies and observations on Scott and Waddell Creeks. The documentation for coho in other streams south of San Francisco Bay consists of observations about distribution, presence or absence of fish, relative abundance, and a few point-in-time samplings of juvenile populations.

Detailed descriptive information on Scott and Waddell Creek coho populations can be found in the definitive study of the 1934-1941 period by Shapovalov and Taft (1954); observations, surveys and fish trapping activities over the past 15 years on Scott Creek by volunteers of the Monterey Bay Salmon and Trout Project (MBSTP), a cooperative salmonid rearing program (MBSTP Annual Reports); studies and observations on both streams during the 1988-1994 period by Dr. J. Smith of San Jose State University

(Smith 1990, et seq.); and studies on Scott Creek during 1992-94 by the Department (Marston 1992; Nelson 1993; Nelson 1994).

In Waddell Creek during the 1930's and 1940's, Shapovalov and Taft (1954) found that coho spawning runs peaked in December and January, coincident with and apparently governed by the period of greatest storm runoff and high stream flows. Trapping revealed 33 percent of the adult coho were entering the stream in the one week period of December 31 to January 6; 81 percent entering in the six week period of December 10 to January 20; and 96 percent entering in the nine week period of December 10 through February 10. Most spawning occurred between January 15 and February 15. Females averaged about 2,790 eggs per fish. Eggs hatched in 35-50 days at Waddell Creek prevailing water temperatures and fry emerged from the gravels within three weeks of hatching. After 9-11 months of stream rearing, schools of smolt would outmigrate to the ocean primarily in March and April. Outmigrant smolt averaged 10.3-11.7 cm (4-4.6 inches) FL. Most coho spent two growing seasons in the ocean before returning to the stream as three year old mature adults, comprising 84 percent of the run with males averaging 64.7 cm (25.5 inches) FL and females averaging 63.9 cm (25.2 inches) FL. Some precocious males, called "jacks", matured early and returned to the stream after only one season in the ocean (6-9 months), comprising 16 percent of the run and averaging 40.6 cm (16 inches) FL.

The observations of Smith (1990; et seq.), Monterey Bay Salmon and Trout Project (MBSTP), and Nelson (1993; 1994) suggest that the timing of the peak spawning migration in Scott and Waddell Creeks has shifted about two weeks later in the season compared to the 1930's and 1940's. Bryant (1994) in the NMFS status review concluded that "Spawning migrations in most California coastal streams and rivers have shifted to later in the spawning season, possibly due to degraded conditions within the watersheds, rivers, and estuaries."

Scott and Waddell Creek coho spawn in a wide variety of substrate conditions. Much spawning habitat is limited to less than optimal small gravels with high sand and silt content and moderate to high embeddedness. These streams are characterized by large quantities of highly mobile sediment bedload. Fingerlings must seek and survive in pools that exhibit elevated summer and fall water temperatures at the margin of acceptability. The ability of coho to successfully use marginal spawning and rearing habitats is an expression of their relatively wide range of tolerance. Coho appear to be the least particular of all Pacific salmon in choice of spawning sites and are opportunistic in the use of a wide range of spawning substrates (Sandercock 1991). Although juveniles prefer cold water, they have tolerance for diurnal temperature peaks that can reach the low 20's°C (70's° F), providing nocturnal temperatures drop back into the 15-19°C (60-66°F), range or less.

The NMFS assessed information on possible distinctive differences in habitat use, behavior and life history traits between the Scott and Waddell Creeks coho and other West Coast coho populations (as well as the effects of past stocking and hatchery influence on these populations) and concluded that "many of the distinctive habitat characteristics and life history traits exhibited by coho salmon in Scott and Waddell Creeks are not unique, but are shared with most coho salmon populations in California and Oregon." (Bryant 1994).

Brood Year Lineage

The distinct, independent character of southern coho salmon maternal brood year lineages is a life history trait of significant influence on overall population viability, management and recovery. Essentially all California wild female coho spawn as 3-year old's, and this apparently is absolute for southern stocks (Shapovalov and Taft 1954; Smith 1990, et seq.; MBSTP Annual Reports; Nelson, CDFG, Pers. Comm.). As a consequence of all Scott and Waddell Creek wild female coho being 3-years old at spawning, there are three distinct, separate maternal brood year lineages on each stream. For example, all coho salmon-male and female-produced in 1994 were the progeny of females produced three years earlier in 1991, which in turn were the progeny of females produced three years earlier in 1988, which were the progeny of females produced in 1985, etc. The three maternal brood year lineages are:

Lineage:	I:	1985,	1988,	1991,	1994,	1997,	2000..
Lineage:	II:	1986,	1989,	1992,	1995,	1998,	2001..
Lineage:	III:	1987,	1990,	1993,	1996,	1999,	2002..

Although there is genetic exchange between year classes of a particular stream when 2-year old precocious males (jacks) of one year class spawn with 3-year old females of the prior year class, there is no corresponding exchange between the three maternal brood year lineages due to the fixed 3-year old age trait of spawning southern coho females. These stocks do not contain female spawners maturing at different ages and do not have overlapping maternal generations.

This circumstance places year classes and brood year lineages at high, long-term risk from the adverse effects of stochastic events (such as floods, droughts, hazardous substance spills and dewaterings due to water diversion). This jeopardy is especially high for small, remnant populations. For example, a flood may flush away most of the eggs and fry from a spawning season, thus depressing or even eliminating that year class of production. However, this loss also adversely impacts the brood year lineage in that few or no female coho are produced to spawn three years later, eliminating or causing a very weak year class to occur three years in the future. This detrimental consequence

can be repeated on a three-year cycle (due to the maternal brood year lineage) for generations, until the lineage is extirpated or external factors, such as straying or hatchery programs, provide the missing female segment of the brood year lineage.

Associated Species of Concern

The following species of concern are associated with coho salmon populations on Scott and Waddell Creeks, and also would be present on many of the other streams south of San Francisco Bay that potentially would be identified for coho salmon recovery program reintroductions. The historic ranges of these species of concern overlap with that of the southern coho salmon in San Mateo and Santa Cruz counties. Presumably, suitable habitat restoration, preservation and population expansion for coho salmon would also benefit these species of concern.

California red-legged frog (*Rana aurora draytonii*)
Federally proposed for listing as Endangered
California Species of Special Concern

San Francisco garter snake (*Thamnophis sirtalis tetrataenia*)
Federally listed as Endangered
State listed as Endangered

Southwestern pond turtle (*Clammys marmorata pallida*)
Federal Category 2 Candidate for listing
California Species of Special Concern

Tidewater goby (*Eucyclogobius newberryi*)
Federally listed as Endangered
California Species of Special Concern

Steelhead trout (*Oncorhynchus mykiss*)
In coastwide status review by NMFS in response to a petition filed February 14, 1994 to list as Federal Threatened or Endangered
California Species of Special Concern (Southern Steelhead)

DISTRIBUTION AND ABUNDANCE

Coho salmon occur naturally in the north Pacific Ocean and presently range in freshwater drainages from Hokkaido, Japan and the Russian Far East, around the Bering Sea and Aleutian Islands to mainland Alaska, and south along the North American coast to Monterey Bay, California. South of San Francisco Bay, coho salmon are typically associated with small to moderately-sized coastal streams characterized by heavily forested watersheds; perennially-flowing reaches of cool, high-quality water; dense riparian canopy; deep pools with abundant overhead cover; instream cover consisting of large, stable woody debris and undercut banks; and gravel or cobble substrates. The

destruction, degradation or alteration of this essential habitat has contributed to the disappearance of natural spawning coho salmon populations from all but two streams of its historic range south of San Francisco Bay.

Historic Distribution

Berger et al. (1982) reported that at the beginning of the century, coho salmon may have ranged as far south as the Santa Ynez River in Santa Barbara County, using the accessible coastal streams from there northward. There is much conjecture and inference on the subject, but no supportive evidence has been found documenting coho salmon spawning populations south of the Pajaro River, Santa Cruz County. An extensive search of files, literature and museum collections failed to find any authenticated records of wild coho salmon from the Carmel River and streams to the south, including the Big Sur River (Swift 1993; J. Nelson, CDFG, Pers. Comm.), although it is frequently expounded that coho salmon once occurred in both streams.

Historically, coho salmon probably used all or most of the accessible coastal streams along the San Mateo and Santa Cruz coastlines that provided essential habitat, possibly as many as 50 streams. By the 1960's, coho salmon populations were known from, but limited to four streams or stream systems in San Mateo County--San Gregorio Creek System, Pescadero Creek System, Butano Creek and Gazos Creek; and seven streams or stream systems in Santa Cruz County -- Waddell Creek, Scott Creek, San Vicente Creek, San Lorenzo River System, Soquel Creek, Aptos Creek and the lower Pajaro River System (Figure 1) (Hassler et al. 1991, Brown et al. 1994, Hope 1993, J. Smith, Pers. Comm., D. Streig, MBSTP, Pers, Comm., J. Nelson, CDFG, Pers. Comm.).

As reported by Hope (1993), the Pajaro River lost its coho salmon run by about 1968, when coho disappeared from the two principal coho producing tributaries -- Pescadero and Corralitos Creeks. The last native run of coho salmon in Soquel Creek occurred in 1968, and were last reported from Aptos Creek in 1973. The San Lorenzo River lost its native coho salmon runs by 1978 as an apparent consequence of the severe 1976-77 drought and the influence of a state planting program from the 1950's through mid-1970's that introduced non-native coho stocks. A few juvenile coho salmon of unknown genetic origin were collected from the San Lorenzo River tributaries of Fall and Bean Creeks in 1981, but were not present when the same streams were sampled again in 1983 (J. Smith, Pers. Comm.). San Vicente Creek apparently lost its coho salmon runs by about 1982. The San Mateo coastal streams of San Gregorio, Pescadero, Butano and Gazos Creeks lost their coho salmon populations by the late 1970's and early 1980's as a consequence of the severe 1976-77 drought, which exacerbated existing poor habitat conditions, and

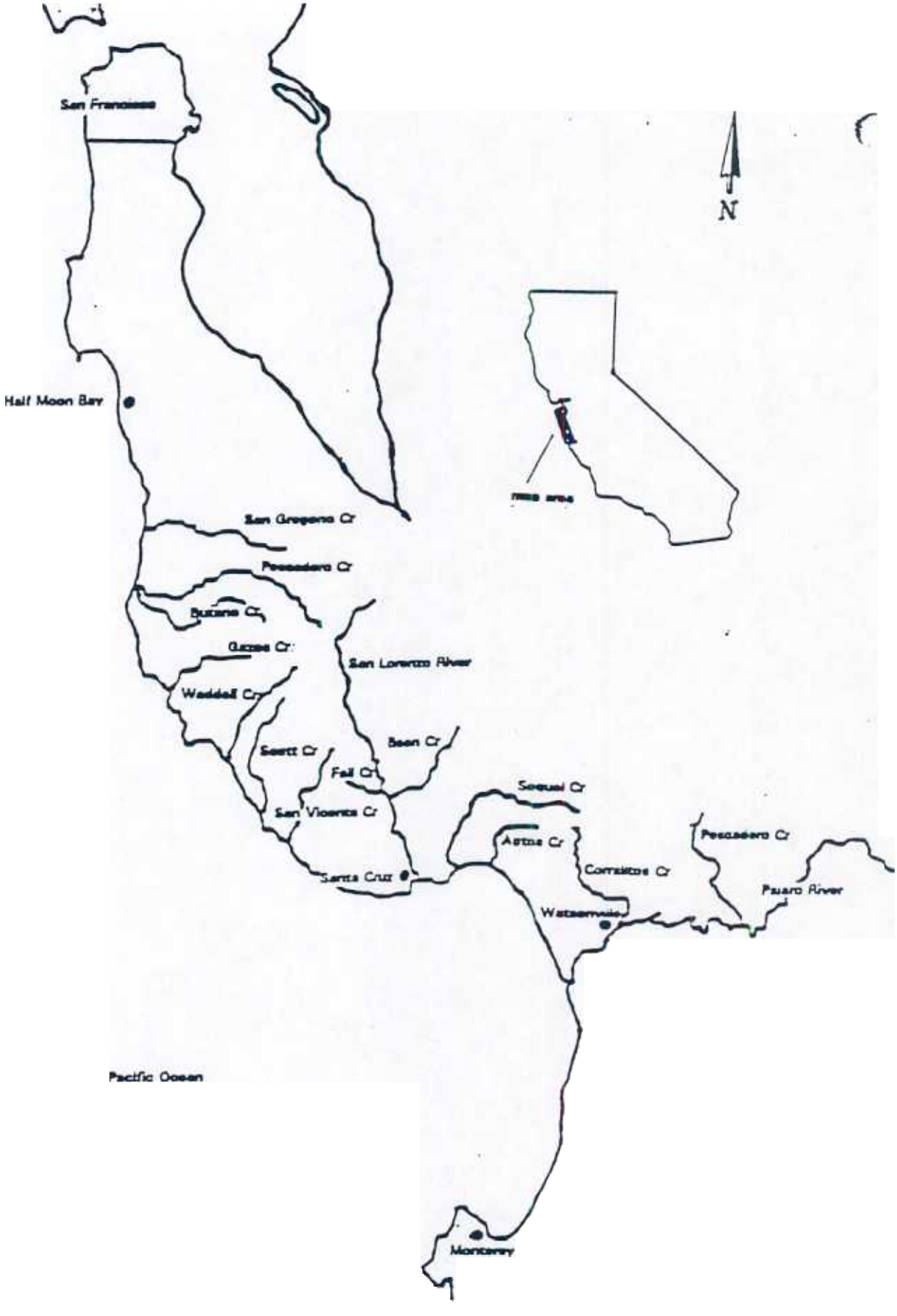

Figure 1. Historical distribution of coho salmon south of San Francisco Bay, California, as of 1960.

concurrent expansion of land and water development activities in these watersheds.

Current Distribution

Natural, sustained runs of coho salmon south of San Francisco Bay are currently only found in Waddell and Scott Creeks in northern Santa Cruz County (Figure 2). A small, hatchery-maintained non-native run occurs in some years in the San Lorenzo River as a result of the Monterey Bay Salmon and Trout Project hatchery program. Due to habitat loss and degradation and the use of non-native coho stocks, there is no naturally-spawned coho salmon production in the San Lorenzo River. Adult coho salmon, probably straying from Waddell or Scott Creeks, may infrequently enter Gazos and Pescadero Creeks to the north in San Mateo County.

Historic Abundance

A comprehensive review of estimates of historic abundance, decline and present status of coho salmon in California is provided by Brown et al. (1994). In the 1940's, the coho salmon spawning population in California was estimated between 200,000-500,000 fish, which declined to 100,000 by the 1960's. Brown et al. (1994) estimated that the California coho salmon spawning population had declined to about 31,000 fish by 1991, of which 57 percent were hatchery populations and 43 percent, or only 13,240 fish, were natural spawners, which included native, wild fish and naturalized (hatchery-influenced) fish. Brown et al. (1994) cautioned that this estimate could be overstated by 50 percent or more. They further concluded that, of the 13,240 natural spawners, only about 5,000 were native, wild coho without hatchery influence, and many of these fish were in individual stream populations of less than 100 fish each (Brown et al. 1994).

There is little definitive data on historical coho salmon abundance in streams south of San Francisco Bay. Estimates of historical abundance are essentially educated guesses and speculations by fishery biologists and managers based on limited samplings, surveys and personal observations. The Department (1991) estimated that the streams south of San Francisco Bay contributed approximately 2 percent of the historic total California coho salmon spawning population, or approximately 4,000 to 10,000 fish in the 1940's.

There is a long, complex, and poorly documented history of hatchery operations and coho salmon (and steelhead trout) plantings in Santa Cruz County streams since at least 1905, involving both local and imported coho stocks. Bryant (1994) prepared a "History of Hatchery Stocks and Outplantings" on this

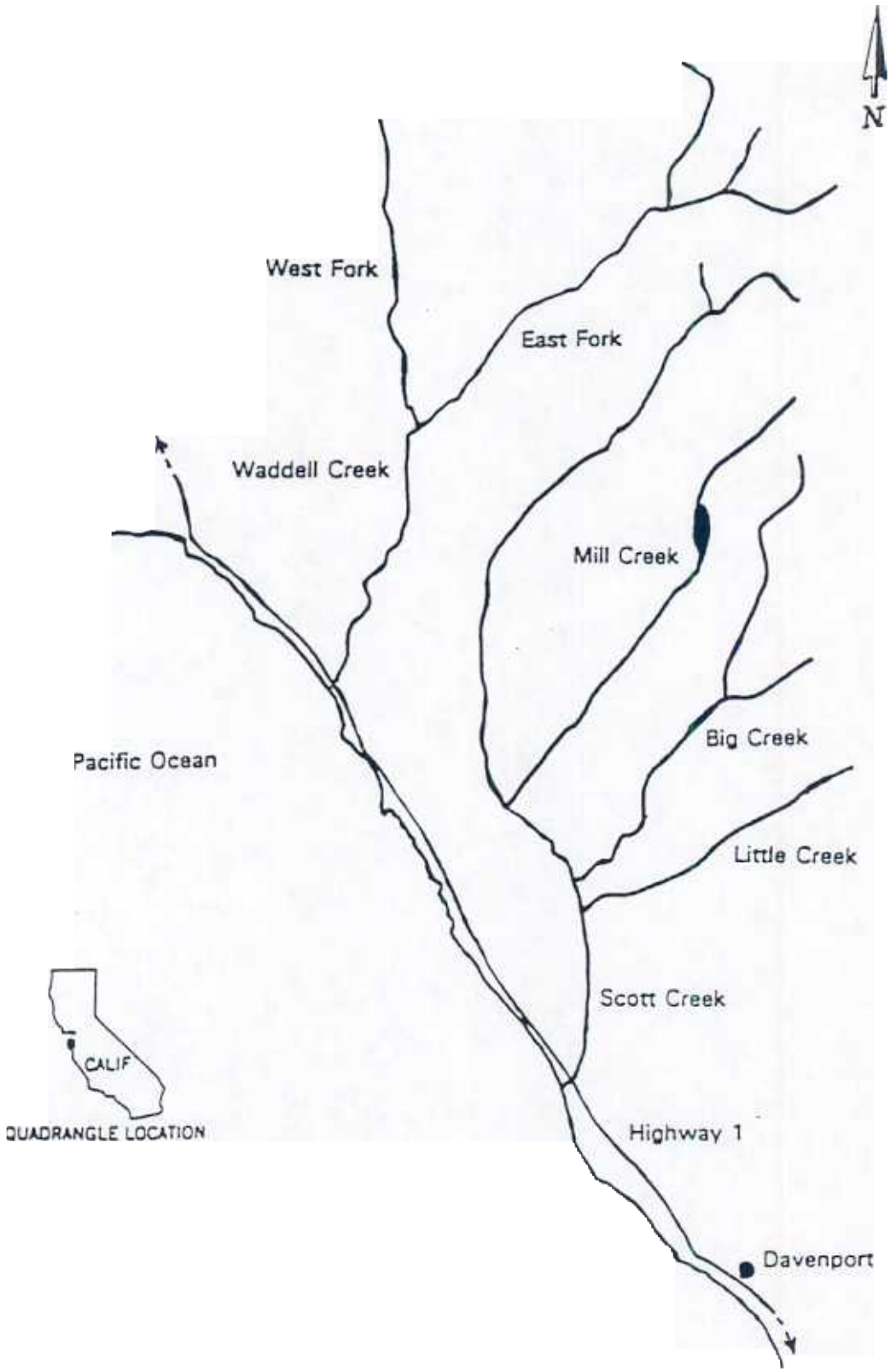

Figure 2. Scott and Waddell Creeks, Santa Cruz County. Current distribution of native coho salmon south of San Francisco Bay.

subject for the NMFS status review, which is included as Appendix C.

On Waddell Creek between 1934-1942, the annual coho salmon spawning population fluctuated without a definite trend between 120 - 633 spawners, with an average annual run of 313 adults (Shapovalov and Taft 1954). It should be noted that at least 116,000 coho salmon fry/fingerlings of various sources were planted in Waddell Creek during the period of 1913-1933 prior to this study. The annual number of juvenile coho salmon captured in the outmigrant trap during the nine year study fluctuated between 152 - 4,911 fish, with an average annual outmigration of 2,040 juvenile coho salmon (Shapovalov and Taft 1954).

In the early 1970's, marked coho salmon from Washington State and other imported stocks were introduced into Waddell Creek in association with a commercial anadromous fish ocean farming operation (Taylor 1991, Brown et al. 1994, CDFG unpubl. file data). Returning marked coho salmon were captured at a recovery facility on lower Waddell Creek, where they were removed for commercial and broodstock purposes. Soon after operations began, the recapture facility was damaged by flood. The experimental aquaculture enterprise later reopened on Davenport Landing Creek to the south (Appendix C).

On Scott Creek, Shapovalov and Taft (1954) estimated the average annual coho salmon spawning population was 350 adults for the 1934-42 study period, with an average annual run of 522 adults in the 1936-1939 period. However, it is important to note that Scott Creek was heavily stocked with coho salmon fry/fingerlings in 1913, 1915, 1929, 1930, and 1932-39, potentially influencing the size of spawning runs during this period.

Streig (1991) examined Scott Creek coho salmon egg production records from the Big Creek Hatchery - Scott Creek Trap Operation for 1908 to 1940, when the hatchery and trap were destroyed by flood. He estimated the minimum coho salmon run size that would have been necessary to produce the recorded egg production by calculating that Scott Creek coho average 2,700 eggs per female and have a 1:1 male/female ratio as reported by Shapovalov and Taft (1954). Streig's (1991) calculations (Table 1) only represent a conservative estimate of the number of adult coho salmon needed for the egg taking operations, and do not represent complete annual run estimates nor population trend data.

Table 1. Estimates of number of coho salmon needed to produce recorded egg production on Scott Creek from 1909 to 1939 (Streig 1991).

Year	Number of Green Eggs Taken	Estimated No. Females	Estimated Total Run
1909	1,400,000	518	1,036
1929	298,000	111	222
1930	134,000	50	100
1934	124,000	46	92
1936	64,000	24	48
1937	148,000	55	110
1938	97,000	36	72
1939	207,000	77	154

Coho salmon were abundant and supported a significant sport fishery on the San Lorenzo River into the 1960's, when a severe population decline occurred. Johnson (1964, cited in Bryant 1994) estimated the annual river sport catch at 200 - 1,500 adult coho salmon. The Department (1965) estimated the average annual coho salmon run for the 1959-63 period as 1,600 adult coho salmon. By the early 1970's the river sport catch had declined to 383 adults in 1970-71, 370 adults in 1971-72 and 342 adults in 1972-73, with angler-caught coho salmon averaging 66.7 cm (26.3 inches) FL in 1971-72 and 51.3 cm (20.2 inches) FL in 1972-73 (Johansen 1975).

The decline in the San Lorenzo River coho salmon sport catch in the 1970's reflected a corresponding drastic decline in the annual coho salmon spawning runs. A fish trap at the City of Santa Cruz Felton Diversion Dam on the San Lorenzo River (stream mile 10.0) began operation in the winter of 1976-77 (coincident with a severe drought). Only 174 adult coho salmon were counted at the trap that winter and 182 adults counted the following year (San Lorenzo River Watershed Management Plan 1979, cited in Bryant 1994). In 1980-81, only 16 adult coho salmon were counted at the trap (Scott 1981, cited in Bryant 1994). Lang (1966, 1972, cited in Bryant 1994) reported that fine sediments within the San Lorenzo River streambed increased from 8 percent in 1966 to 65 percent in 1972, confirming an observed dramatic increase in sediments during the 1960's - 1970's, concurrent with the decline of the coho salmon spawning population.

The Department estimated that the streams of Santa Cruz County exclusive of the San Lorenzo River (i.e. Waddell, Scott, San Vicente, Soquel, Aptos Creeks) supported a combined average annual run of about 1,500 adult coho salmon for the 1959-1963 period; and the streams of San Mateo County (i.e. San Gregorio, Pescadero, Butano and Gazos Creeks) supported a combined average

annual run of about 1,000 adult coho salmon for the same period (CDFG 1965).

Current Abundance

Brown et al. (1994) estimated that by 1991, the average annual spawning population of native, wild coho salmon in California was less than 5,000 adults, with many individual stream populations numbering less than 100 fish each. They also concluded that the California coho salmon spawning population had declined more than 94 percent since the 1940's, with the greatest decline occurring since the 1960's (Brown et al. 1994).

Based on the following information, average annual runs of coho salmon south of San Francisco Bay declined from an estimated 4,100 adults in 1959-63, to 125-185 adults by 1991-93; a 95-97 percent decline. Subtracting the non-native, hatchery-maintained San Lorenzo River run reveals a decline of about 98.5 percent since the early 1960's.

Waddell Creek

In 1988, Smith (1994c) collected only 19 juvenile coho salmon at 5 of 8 sampling sites on Waddell Creek; this compared to the capture of 781 juvenile steelhead in the same effort. These results suggest a very weak 1988 year class (1988-1991 brood year lineage).

During the winter of 1991-92, Smith (1992a) periodically operated an upmigrant trap on Waddell Creek between high streamflow events and captured 31 adult coho salmon, of which only 3 were 3-year olds representing the returning 1989 year class (2 females and 1 male). The remainder (28) were 2-year old precocious males (jacks), with possibly 9 of the jacks being strays from the MBSTP Big Creek Hatchery Program on Scott Creek (Smith 1992a). Based on recovery of tagged carcasses, Smith (1992a) estimated the 1991-92 run at 50 jacks and only 15 3-year old coho of the returning 1989 year class.

No juvenile coho salmon were captured in stream sampling efforts in February and April 1992, lagoon samplings of December 1991, January and May 1992, nor outmigrant trapping in the spring of 1992 (Smith 1992a). Although the outmigrant trap was operated only part of the migration season, the complete absence of coho salmon smolt in a trapping effort that captured 788 juvenile steelhead suggests very poor or no coho production of the 1991 year class, which would be the smolt collected in 1992 (Smith 1992a). Smith (1994) believes the 1991 year class (1991-1994 brood year lineage) has been lost from Waddell Creek.

In the summer and fall of 1992, Smith (1992b) collected juvenile coho salmon at 6 of 13 sampling sites in Waddell Creek,

but only 19 juveniles were collected compared to 1,505 juvenile steelhead. These results suggest a very weak 1992 year class (1992-1995 brood year lineage).

Smith (1993) attempted to operate an upmigrant trap in Waddell Creek in the winter of 1992-93 and captured only 1 adult coho salmon, but this reflected high streamflows and very poor trapping conditions. No coho salmon were observed in Waddell Creek during spawning surveys and carcass counts conducted in the 1992-93 spawning season (J. Nelson, CDFG, Pers. Comm.). An outmigrant trap was operated in the last half of the spring 1993 outmigration season and captured 119 coho salmon smolt (Smith 1993). With only 19 juvenile coho collected in the summer of 1992 and 119 coho smolt trapped the following spring, Smith (1993) concluded that the 1992 year class (1992-1995 brood year lineage) was extremely weak, and total production probably was 200-500 coho smolt, and "such production is likely to produce only 10-25 returning adults, even with a high (5%) ocean survival rate."

Smith and Davis (1993) resampled Waddell Creek in 1993 and captured 44 juvenile coho salmon in July and August and 58 juvenile coho in October and December. The 58 coho captured in the fall 1993 was three times the 19 juvenile coho captured in 1992. Smith and Davis (1993) estimate the total fall 1993 juvenile coho salmon population at 1,140 fish, higher than the 200-500 fish estimate for 1992, but still considered a low number for the amount of available rearing habitat on Waddell Creek. They further conclude that "If 3 percent of the 1993 coho are able to return as adults, that would only produce a spawning population of approximate 34 fish."

In March 1994, 5,700 fin-clipped coho salmon smolt of the Scott Creek 1993 year class were stocked into upper Waddell Creek. These fish came from the MBSTP Big Creek Hatchery Program (MBSTP Annual Reports). This supplementation planting was an emergency coho salmon recovery action sponsored by the Department to augment the depressed Waddell Creek 1993 year class (1993-1996 brood year lineage) in response to concerns that: 1. the 1991 year class (1991-1994 lineage) appears to be lost; 2. the 1992 year class (1992-1995 lineage) appears to be very weak and at extreme risk of extirpation; and 3. the 1993 year class (1993-1996 lineage) appears to be weak, with a projected adult return in 1996 of only 34 spawning fish (possibly only 16 females or less) (J. Nelson, CDFG, Pers. Comm.). Also, Smith and Davis (1993) concluded in reference to the estimate of only 34 adults potentially returning from the 1993 year class, that adverse environmental factors, such as poor access or floods, lowering the "spawning success from such a small population could jeopardize the one remaining sustaining year class [1993 year class]."

In July 1994, Smith (1994) resampled 12 sites on Waddell Creek to document the status of 1994 year class production and found no wild juvenile coho salmon, despite concentrating sampling effort in preferred coho habitats. A single holdover hatchery-origin yearling coho from the March supplementation plant was captured from the lowermost site. This absence of wild juvenile coho salmon in 1994 supports the conclusion based on 1992 sampling data that the 1991 year class (1991-1994 lineage) has been lost from Waddell Creek (Smith 1994).

On December 21, 1994, MBSTP volunteers surveyed lower Waddell Creek and observed one 3-year old male and one grilse coho salmon in the tidal reach, 2 grilse in the stream and collected for examination and release an additional 5 grilse and one 3-year old male coho (56.5 cm, 22.2 inches, FL), with at least 3 of the 5 grilse exhibiting obvious fin clip marks identifying them as returns from 1994 MBSTP supplementation plants of Scott Creek stock coho salmon (M. McCaslin, MBSTP, Pers. Comm.). Smith began operating an upmigrant trap on Waddell Creek on November 19, 1994, and reported that 13 coho salmon had been trapped by January 1, 1995, of which 11 were fin-clip marked fish of Scott Creek stock and only 2 (15 percent) were native Waddell Creek fish, both males (J. Smith, Pers. Comm.). These survey and trapping results confirm additional observations that grilse coho salmon were returning to Waddell Creek from the March 1994 smolt plant (and possibly straying from Scott Creek), and that Waddell Creek native coho salmon were nearly absent in 1994-95, supporting the conclusion that the 1992 year class (1992-1995 brood year lineage) is failing and approaching extinction (J. Nelson, CDFG, Pers. Comm.; J. Smith, Pers. Comm.).

In summary, the Waddell Creek 1991 year class (1991-1994 lineage) is <u>extinct</u>; the 1992 year class (1992-1995 lineage) is at extreme risk of extirpation, <u>estimated at 10-25 returning adults, or 5-12 females or less</u>; and the 1993 year class (1993-1996 lineage) is very weak, <u>estimated at only 34 returning adults, or 17 females or less</u>, prior to the supplementation planting. The supplementation planting should significantly augment the Waddell Creek 1993 year class. A 3 percent return of the 5,700 smolt released could yield 170 spawners returning in some unknown combination of 2-year old jacks (in 1995) and 3-year old fish in 1996, with an expected moderate straying to Scott Creek (natal stream). Projected return estimates for the three year classes that constitute the Waddell Creek wild coho salmon spawning population (1991-0; 1992-25; 1993-34) average <u>20</u> adult coho salmon per year, a decline of 94 percent from the average annual spawning population of the 1934-42 period.

Scott Creek

Scott Creek contains a naturalized (hatchery-influenced) coho salmon population associated with the Monterey Bay Salmon

and Trout Project (MBSTP) Big Creek Hatchery Program, a coho salmon and steelhead trout population augmentation effort. The Big Creek Hatchery is located on a tributary to Scott Creek. This facility was owned and operated by the Department between 1927-1940, but was abandoned and never rebuilt after being destroyed by flood in 1940. The hatchery was restored in 1982 by a local community cooperative effort and is operated by MBSTP, a cooperative salmonid rearing project under permit from the Department (See Appendix C for fish planting history). Coho salmon production, utilizing Scott Creek fish, began in the 1984 spawning season (winter of 1983-84) and hatchery spawning has been sporadic since then, dependent on the availability of broodstock in the returning Scott Creek runs.

The numbers of Scott Creek adult coho salmon captured and spawned by MBSTP each year for the 1984 through 1995 seasons are summarized in the Table 2 (MBSTP Annual Reports). For the 12 years of record, the average number of adult coho salmon captured has been 9 males and 7 females. It is significant that in 7 of the 12 seasons, no adult female coho salmon could be recovered from the Scott Creek drainage. The fish capture data in Table 2, especially the data for female coho captures, has significant index value in documenting the relative abundance and trend of the Scott Creek coho salmon spawning population for the 12 year period, in that MBSTP volunteers annually invest considerable effort in searching for and capturing adult coho salmon from the drainage for the hatchery spawning program (snorkeling, netting and trapping activities) (M. McCaslin, MBSTP, Pers. Comm., J. Nelson, CDFG, Pers, Comm.) The population index data in Table 2 (particularly female captures) characterizes the Scott Creek naturalized coho spawning population as exhibiting very low numbers of returning adult spawners with a sustained run occurring only every third year, most recently in 1993 with the return of the 1990 year class (1993-1996 lineage). This is the same brood year lineage (1993-1996) that is still surviving in Waddell Creek. Brown et al. (1994) estimated the average annual Scott Creek coho salmon spawning population at only 30-40 adults.

Table 2. Number of Scott Creek coho salmon captured and spawned by Monterey Bay Salmon and Trout Project from 1983 to 1995 (Data from MBSTP Annual Reports and D. Streig, MBSTP, Pers. Comm.).

Year	Number Captured			Number Spawned	
	Male	Female	Grilse	Male	Female
1994-95	1	0	75	14*	6*
1993-94	0	0	12	0	0
1992-93	11	17	0	11	17
1991-92	9	1**	23	15	1**
1990-91	2	0	0	0	0
1989-90	63	35	0	28	13
1988-89	0	0	10	0	0
1987-88	4	6	0	3	4
1986-87	11	22	0	6	10
1985-86	0	0	8	0	0
1984-85	4	0	0	0	0
1983-84	1	3	0	1	1

*Six females and 13 males spawned were grilse from 1994 hatchery releases.

**Marked Scott Creek coho salmon female captured in San Lorenzo River.

Scott Creek stock coho salmon production from the MBSTP Big Creek Hatchery Program is summarized in Table 3 (MBSTP Annual Reports). Over the 11 year period of record, coho salmon smolt supplementation plants have been made into Scott Creek in 7 years, and "contingency" plants have been made into the San Lorenzo River in 3 years. Plants are made into the San Lorenzo River as a contingency measure for potential broodstock use in the event drought conditions prevent coho access into Scott Creek two years hence--the San Lorenzo River lagoon breaches in drought yearsdue to the much larger drainage of the River, while the Scott Creek lagoon may not. In such a circumstance, marked adult Scott Creek stock coho captured from the River could be used to continue the Scott Creek stock coho salmon supplementation planting program.

The Department considers the Scott Creek coho salmon population to be a naturalized (hatchery-influenced) population as a result of the ongoing MBSTP program. Limited natural spawning still occurs in the drainage by returning adults from the hatchery releases, naturalized fish of hatchery program ancestry, and possibly some native, wild fish. The natural spawning Scott Creek coho salmon population is small with a sustained run occurring only every third year (1993-1996 brood year lineage), as documented by Smith (1992b, 1994b, 1994c); Marston (1992), and Nelson (1993, 1994).

In 1988, Smith (1994c) found a total of 384 juvenile coho salmon at 12 of 14 sampling sites on Scott Creek. In the spring of 1992, the Department operated an outmigrant trap for 9 weeks on lower Scott Creek and captured only 10 juvenile coho salmon compared to 318 juvenile wild steelhead and 314 hatchery smolt steelhead (Nelson 1993).

In June and July 1992, Marston (1992) quantitatively sampled the fish population of the lower 0.7 mile of Scott Creek and estimated the juvenile coho salmon population at 18 fish, compared to 3,685 juvenile steelhead.

Smith (1992b) found only 42 juvenile coho salmon at 6 of 13 sampling sites on Scott Creek in 1992, compared to 1,266 juvenile steelhead captured at the same sites, and estimated that the total juvenile coho salmon production in 1992 was less than 1,000 fish, equivalent to a potential return of less than 30 adults.

An upmigrant trap was operated on lower Scott Creek in January-May 1993 by the Department, but was functional only for the end of the coho salmon spawning migration, and captured 10 adults (4 male and 6 female) between January 29 and February 8 (Nelson 1994). The Department operated an outmigrant trap for 11 weeks during spring, 1993, and trapped 114 juvenile coho salmon (60 wild smolt, 46 hatchery smolt and 8 young-of-year) along with 1,073 juvenile steelhead (Nelson 1994).

Table 3. Number of Scott Creek Stock Coho Salmon Smolt Planted by MBSTP into Scott Creek and San Lorenzo River, 1985 through 1995 (Data from MBSTP Annual Reports).

Year of Release	Number of Smolt Planted	
River	Scott Creek	San Lorenzo
1985	428	0
1986	0	0
1987	0	0
1988	2,450	5,997
1989	2,756	0
1990	6,552(1)	0
1991	5,460	5,040
1992	0	0
1993	1,860(2)	0
1994(3	18,312	6,052
1995	0	0

(1. Progeny of cross between Scott Creek stock males and San Lorenzo River (Noyo) Stock females, due to absence of Scott Creek females.

(2.) Progeny of one Scott Creek stock female stray captured from San Lorenzo River and crossed with Scott Creek stock males.

(3.) An additional 5,698 smolts were stocked in Waddell Creek in March 1994.

In July-August 1993, Nelson (1994) resampled the fish population in the lower 0.7 mile reach of Scott Creek (sampled by Marston (1992) in 1992) and, based on quantified samplings, estimated the juvenile coho salmon population at only 11 fish, compared to 1,762 juvenile steelhead.

In January 1994, Smith (1994b) collected juvenile coho salmon at all 11 sites sampled on Scott Creek, capturing 376 juvenile coho compared to 673 juvenile steelhead, documenting a good 1993 year class production. Smith (1994b) estimated the 1993 year class production at 6,900 juvenile coho salmon for the Scott Creek drainage, potentially yielding as many as 138 returning adults in 1996.

Smith (1994) again sampled Scott Creek in August 1994 and found only 17 juvenile coho salmon at 6 of 13 sampling sites, suggesting an extremely weak 1994 year class (1991-1994 lineage) Based on the low densities and the distribution of the captured fish, Smith (1994) speculated that at least two pairs of coho

salmon successfully spawned in Scott Creek during the 1994 season. During this same season (1993-94 winter) MBSTP volunteers could not locate a single adult female coho salmon during their extensive survey and capture efforts (MBSTP Annual Reports; M. McCaslin, MBSTP, Pers. Comm.).

In order to collect adult coho salmon for the 1995 spawning program, MBSTP surveyed (by snorkeling) the Scott Creek drainage seven times from November 1994 through January 1995. During these surveys, 76 coho salmon were collected for examination and an additional 33 coho were seen but not collected. Of the 76 coho salmon collected, 6 were females and 70 were males. Unfortunately, with the exception of a single 3-year old male, all other coho captured were grilse as identified by fin clips (52 coho) or length (23 coho) (McCaslin, MBSTP, Pers. Comm.). These survey results document the near extinction of the 1992 year class (1992-1995 lineage), and significant grilse returns from the unusually large (18,312) 1993 year class coho smolt release of March 1994.

In summary, Scott Creek coho salmon are considered a naturalized (hatchery-influenced) population, with the 1991 and 1994 year classes (1991-1994 lineage) near extinction, the 1992 year class (1992-1995 lineage) very weak or near extinction, and the 1993 year class (1993-1996 lineage) representing the only sustained spawning run. This situation mirrors the status of coho salmon year classes on Waddell Creek. The average annual Scott Creek coho salmon spawning population is estimated at 30-40 adults (Brown et al. 1994). Bryant (1994) calculated the Scott Creek average annual coho salmon spawning population has declined 93 percent from the early 1930's and early 1940's.

San Lorenzo River

The San Lorenzo River, the southernmost current distribution for coho salmon in California, has a small, non-native hatchery-maintained coho population estimated to be 75-125 adults per year (D. Streig, MBSTP, Pers. Comm. as cited in Bryant 1994). This River system no longer supports a natural-spawning coho salmon population, which was lost around 1978 (Brown et al. 1994). In an effort to reestablish coho runs for River recreational fishing, the MBSTP started a hatchery coho salmon smolt planting program in 1986 primarily using eggs from Noyo River and Prairie Creek stocks and, as returning runs developed, MBSTP began capturing adults (by seining the lagoon or operating the Felton Diversion Dam Trap) to artificially spawn and produce eggs and smolt from these non-native San Lorenzo River coho salmon to restock the River (MBSTP Annual Reports, Brown et al. 1994). Although small returning runs developed which generated some local interest in a winter sport fishery for sea-run salmon, these runs failed to produce a naturally-spawning population (due in part to lost and degraded habitat conditions and the non-

native ancestry of the San Lorenzo River coho salmon), and the resultant runs are entirely hatchery-maintained (Brown et al. 1994, Bryant 1994; J. Nelson, CDFG, Pers. Comm.). The number of San Lorenzo River adult coho salmon trapped and spawned by MBSTP is presented in Table 4. A history of coho salmon planting in the San Lorenzo River System is found in Appendix C.

Table 4. Number of San Lorenzo River coho salmon captured and spawned by Monterey Bay Salmon and Trout Project from 1985 to 1995 (Data from MBSTP Annual Reports and D. Streig, MBSTP, Pers. Comm.).

Year	Number Captured			Number Spawned	
	Male	Female	Grilse	Male	Female
1994-95	0	0	5	3	2
1993-94	0	0	0	0	0
1992-93	14	11	0	12	11
1991-92	17	13	16	11	8
1990-91	6	17	1	3	2
1989-90	115	68	0	17	14
1988-89	6	4	20	3	3
1987-88	19	36	0	10	10
1986-87	36	11	0	12	11
1985-86	0	0	0	0	0
1984-85*					
1983-84*					

* In 1983-84 and 1984-85, coho fingerlings from Noyo River and Prairie Creek stock were planted in the San Lorenzo River.

Limited fish surveys, samplings and observations in the San Lorenzo River System over the past 15 years have failed to document any significant coho salmon production (Marston, CDFG, Pers, Comm., P. Anderson, CDFG, Pers. Comm.). Don Alley (1995) conducted an extensive fish sampling survey in the drainage in 1994 (including 10 sampling sites on the mainstem River and 8

sites on 7 major tributaries known to be accessible to anadromous salmonids) and failed to find a single juvenile coho salmon. Comparing the current hatchery-maintained coho salmon run estimate of 75-125 adults per year with the average annual run estimate of 1,600 adults for the 1959-63 period (as previously discussed), the current hatchery run represents only 5-8 percent of the coho salmon population of the early 1960's, a decline of at least 92 percent.

Other Streams

Adult coho salmon may infrequently stray into other coastal San Mateo-Santa Cruz county streams and, under fortuitous circumstances, produce a successful spawn. One such example was documented by Smith (1994b) on Gazos Creek, San Mateo County, where no coho were collected in 1992, but 9 juveniles were collected in January 1994; confirming the successful spawn of at least one pair of coho in 1993 (1991 year class adults). A similar situation was documented on Pescadero Creek, San Mateo County, when Pescadero High School students trapped 5 coho salmon smolt in an outmigrant trap study during May 1994; confirming the successful spawn of at least one pair of coho in 1993 (1991 year class) in this drainage (J. Nelson, CDFG, pers. Comm.).

As previously stated, the San Mateo County streams lost their sustained coho salmon populations by the late 1970's-early 1980's, a 100 percent decline from the 1959-63 combined average annual run estimate of 1,000 spawners for these streams.

ESSENTIAL HABITAT

South of San Francisco Bay, coho salmon are typically associated with small to moderately-sized coastal streams characterized by heavily forested watersheds; perennially-flowing reaches of cool, high-quality water; dense riparian canopy; deep pools with abundant overhead cover; instream cover consisting of large, stable woody debris and undercut banks; and gravel or cobble substrates. Coho salmon essential habitat requirements have been well described by McMahon (1983), Hassler (1987) and Sandercock (1991) and are summarized from these reports.

Habitat requirements for coho salmon in freshwater vary with the age or life history phase of the fish and season of year. Sexually mature or maturing adults migrate from the ocean into natal streams to spawn in response to an increase in stream flows associated with fall and winter storm runoff. Preferred streamflow conditions for upstream migration include water temperatures of 4-14°C, minimum water depth of 18 cm, and maximum water velocity of 244 cm/sec.

Spawning habitat is typically located at the heads of riffles and tails of pools where the water changes from laminar

to a turbulent flow. Redds (egg nests) are formed in substrates composed of loose, small to medium sized gravels and cobble (1.3-12.7 cm diameter) with less than 20 percent fine silt or sand content, and nearby overhead and submerged cover for holding adults. Optimum water temperatures for spawning are 4-10°C, with optimum water depth of 10-54 cm and water velocity range of 20-80 cm/sec. Optimum water temperatures for egg incubation and fry emergence are 4-13°C, with dissolved oxygen levels above 8 mg/1.

Juvenile "parr" coho prefer well shaded pools at least 1m deep with dense overhead cover; abundant submerged cover composed of undercut banks, logs, roots and other woody debris; preferred water temperatures of 12-15°C, but not exceeding 22-25°C for extended time periods; dissolved oxygen levels of 4-9 mg/1; and water velocities of 9-24 cm/sec. in pools and 31-46 cm/sec. in riffles. A pool to riffle ratio of 1:1 is optimum for providing good food and cover conditions for parr. Preferred rearing habitat has little or no turbidity and high sustained invertebrate forage production. Juvenile coho forage over a wide range of substrates.

In late winter and spring, parr coho salmon undergo a physiological transformation (smoltification) that prepares them for saltwater adaptation and, as "smolt", migrate downstream to the ocean. McMahan (1983) concludes that "The radical physiological and behavioral changes that occur during smoltification make this stage particularly sensitive to environmental stress factors." Water temperatures during smoltification and seaward migration are preferably less than 12°C.

NATURE AND DEGREE OF THREAT

Habitat Destruction and Degradation

A major cause of decline for coho salmon has been the unnatural destruction and degradation of stream essential habitat within its historic range as documented and summarized by Hassler (1987), Nehlson et al. (1991), Hope (1993), Bryant (1994), Brown et al. (1994), and CDFG (1994). The remnant natural-spawning coho salmon populations of Waddell and Scott Creeks depend upon the essential stream habitat for survival and perpetuation, as would reestablished populations on other streams pursuant to any recovery program.

Most stream habitat loss and degradation has resulted from watershed disturbances caused by or associated with human activities, such as cropland agriculture, logging, urban development and run-off, agricultural and domestic water diversion, highway and road construction and maintenance, livestock grazing, erosion and flood control projects, gravel

mining, dairy and other confined animal operations, and the construction of water diversion and impoundment dams.

The loss and degradation of stream habitat has been a cumulative consequence of human activities at least over the past century, with particular intensity on these coastal drainages since the 1940's. Most habitat degradation is associated with the loss of essential habitat components necessary for high coho salmon survival and recruitment, especially loss of woody debris and sedimentation impacts (Brown et al. 1994). Coho salmon are particularly vulnerable to loss or degradation of spawning, summer rearing and winter holding habitat components (Pearcy et al. 1992 as cited in CDFG 1994).

Although stream habitat destruction and degradation is generally identified as the prime cause of decline of coho salmon populations in California and in most of the historic coho salmon streams south of San Francisco Bay, it is not the generative factor for declines in Scott and Waddell Creeks. There is some habitat loss and degradation in these two streams associated with various past and present human activities; however, overall the two streams are relatively stable, second-growth forested watersheds, providing high quality (but low volume) streamflows and ample amounts of coho salmon parr essential habitat, which is significantly underutilized (Smith 1992b, 1994b, 1994c; Marston 1992; Smith and Davis 1993, Nelson 1994). Coho salmon declines in Scott and Waddell Creeks appear to be caused by the cumulative influence of multiple factors determining the number and success of spawners, not a limitation on the amount or quality of parr habitat.

Natural Catastrophic Events

Coho salmon have been adversely impacted by catastrophic natural events over their evolutionary history in California and have survived to recolonize streams and reestablish populations. Unfortunately, their resiliency as a species to rebound in time from floods, droughts, landslides and other natural stochastic events, is now negated by the pervasive destruction and degradation of their essential stream habitats and reduction in population size below the numbers necessary to ensure their present survival against natural environmental disasters (Brown et al. 1994).

Major landslides can deposit huge sediment loads over long periods into stream channels that can take decades or centuries to recover, with concomitant long-term detriment to salmon habitats. Floods can destroy or alter stream and lagoon habitats, accelerate erosion and sedimentation, and decimate eggs, fry and juvenile salmon populations, thus reducing or eliminating year classes. Natural recovery can occur very slowly. Droughts desiccate coho rearing and holding habitats,

eliminate fish populations and prevent or delay the opening of stream mouths and lagoons, thus preventing access into the streams by spawning adults. The severe drought conditions of 1976-77, exacerbated by existing reduced and degraded habitat, apparently was the cause of much decline and extirpation of coho salmon runs south of San Francisco Bay (Smith 1994b, Brown et al 1994, Bryant 1994, Marston, CDFG, Pers. Comm.). Low rainfall during the fall and early winter months coincident with the coho salmon spawning migration season can prevent adult coho access into streams, leading to failed year classes (even if later storms occur). Drought during spring months can landlock outmigrant smolt coho, preventing entry to the ocean and consequently depressing or eliminating year class recruitment.

The inflexible 3-year maternal brood year lineage and early winter spawning traits of coho salmon south of San Francisco Bay place these stocks in high jeopardy from drought or flood events. Such events have cumulative and catastrophic consequences for the long-term viability of southern coho salmon, and can result in the extirpation of year classes and broodstock lineages, as has occurred with the 1991-1994 lineage on Waddell and Scott Creeks and the near elimination of the companion 1992-1995 lineage on both streams (Smith 1994b, 1994c, Brown et al. 1994, Bryant 1994, J. Nelson, CDFG, Pers. Comm., MPSTP Annual Reports). As discussed by Smith (1994b), the functionally extinct 1991-1994 brood year lineage was severely impacted by drought (D) or flood (F) events in 1976 (D), 1977 (D on smolt), 1982 (F), and 1991 (D); and the very weak 1992-1995 lineage was severely impacted in 1977 (D), 1983 (F), 1986 (F), and 1992 (F). The 1993-1996 lineage, the only sustained lineage remaining, has not experienced such extreme natural stochastic events for over two decades (Smith 1994b).

Predation

Numerous species of native fish, mammals and birds prey on coho salmon at various stages of their life cycle. These species include sculpin and squawfish, marine mammals such as sea lions and harbor seals, and various bird species such as cormorant, loon, merganser, gulls, heron, egret, and kingfisher. Coho salmon evolved along with the host of predators that prey upon them. When salmon populations are healthy and robust, they can easily withstand a large degree of predation without ill effects at the population or individual stock level. However, when salmon populations become severely depressed as coho salmon are today, predation may retard recovery.

There are numerous reports and concerns expressed about marine mammals taking salmon adults and juveniles from lagoons and in the ocean at the mouths of Waddell and Scott Creeks and the San Lorenzo River. This predation is exacerbated during fall/winter low streamflow and drought conditions that cause the

accumulation of adult coho in lagoons or in the ocean at the mouths of streams awaiting an opportunity to enter streams and complete their spawning migration. Recent observations suggest an alarming scenario of heavy marine mammal predation on salmon from the fishing lines of wharf and ocean commercial and recreational fishermen and on salmon and steelhead attempting to access streams by swimming over shallow sandbars at the mouths of the San Lorenzo River and Scott and Waddell Creeks (Lease 1994, D. Murphy, MBSTP, Pers. Comm.). Examination of returning adult coho salmon in the 1991-92 spawning season revealed that the portion of a spawning run exhibiting marine mammal attach marks can vary from 10 percent of the fish trapped on Waddell Creek to 80 percent of those captured on Scott Creek. (J. Smith, Pers. Comm., D. Streig, MBSTP, Pers. Comm.).

Introduced non-native fish species, such as black bass, green sunfish and brown trout, can establish resident populations in salmon streams (particularly as the habitat degrades and becomes less favorable for sustaining coho salmon), and become effective predators or fry and juvenile coho salmon.

Disease

Generally, diseases and parasites do not cause significant mortality in native coho salmon stocks in natural habitats (Bryant 1994). This was the case on Waddell Creek during the 1930's-1940's (Shapovalov and Taft 1954). The transmission of diseases from hatchery to native coho salmon stocks is a potential threat, but the degree of risk and seriousness of such a problem are little known (Brown et al. 1994).

The introduction of disease into wild stocks is becoming an increasing concern, however, with regard to bacterial kidney disease (BKD). The disease BKD is a chronic, slow developing disease caused by a pathogen (Renibacterium salmoninarum) and has been a major contributor to mortality of salmonids in some hatcheries. Iron Gate, Trinity River, Mad River and Warm Springs hatcheries and Noyo River, Scott Creek and San Lorenzo River coho stocks used for providing eggs for artificial propagation are known to harbor BKD. A detailed description of the effects of this disease on coho salmon and the various treatment programs being undertaken by the Department to deal with this chronic disease can be found in CDFG (1994).

Overexploitation

There is considerable disagreement as to the role that commercial and recreational ocean fishing has played in the long-term decline of coho salmon populations. This disagreement continues even though there are few historical or recent records to indicate that curtailment of fishing has increased coho salmon spawner abundance. As an example, curtailment of fishing seasons

has been thought to have reduced harvest related mortality rates on Oregon coastal coho salmon populations substantially during the past decade; however, there has been no evidence of a corresponding increase in coho spawner escapement during this period.

While over-fishing in the ocean fisheries may not be the primary cause of decline of coho salmon stocks as a whole, harvest may contribute to the continued decline and eventual extirpation of native and naturalized coho stocks now reduced to extremely small numbers, such as those of Waddell and Scott Creeks. Consequently, problems can arise in "mixed stock" fisheries such as the ocean commercial and sport fisheries, where hatchery salmon stocks, which can sustain higher harvest rates, are harvested together with wild salmon stocks, which can sustain much lower harvest rate, if any harvest at all. Where habitat conditions remain poor for native coho salmon stocks, as they are in many streams, they may be even less able to sustain harvest. As a general rule, when habitat conditions are favorable, depressed salmon populations have the potential to rebound quickly. When habitat conditions are poor, they cannot survive in sufficiently large enough numbers to rebound quickly and, consequently, fishing may become more of an impediment to population recovery.

Coho salmon stocks south of San Francisco Bay are especially vulnerable to overexploitation by both ocean fishing and inland sport fishing because the rigid 3-year brood year lineage character of these southern stocks precludes the ability to rebound from overharvest exhibited by other salmon stocks that contain significant numbers of female spawners maturing at different ages; Brown et al. (1994) concluded that for the Waddell and Scott Creek coho salmon stocks that have been reduced to a remnant sustained run every third year, "decimation of the spawning stock by overharvest during a single year could extirpate either or both of these populations."

Oceanic Conditions

Recent assessments of changes in oceanic conditions along the North American Pacific Coast and biological consequences have been made by Brown et al. (1994), CDFG (1994), Barry, et al. (1995) and Roemmich and McGowan (1995). Major changes in oceanic conditions along the North American Pacific Coast over the past 60 years may be significantly contributing to the decline of California coho salmon populations. A warming trend in sea temperatures along the coast is causing dramatic declines in zooplankton abundance, corresponding declines in fish species that forage on zooplankton, changes in ocean current and upwelling patterns, a northward shift in many marine species population ranges, an overall decline in ocean productivity, and an oceanic environment becoming far less favorable for coho

salmon survival. Brown et al. (1994) summarize evidence suggesting that major ocean mortality of smolt and adult coho salmon has been occurring at least over the past 20 years.

It is interesting to note that a general ocean warming trend along the Washington-California coastline during 1976-1983 coincided with the severe 1976-77 drought and the late 1970's-early 1980's period of sharp decline or extirpation of coho salmon spawning populations south of San Francisco Bay.

An oceanic environment that is becoming less favorable for salmon survival does not bode well for the long-term perpetuation of the two remnant coho salmon stocks south of San Francisco Bay representing the southern end of the species range in California. In Monterey Bay, a rise in annual mean shoreline sea temperature of 1°C, an increase in the mean summer maximum sea temperature by 2.2°C, and a northward shift of marine species populations over the past 60 years may portend poor ocean survival and a continuing decline in number of adult coho salmon returning to spawn in these southern streams.

A scenario of reduced ocean survival (and consequent decline in returning coho salmon spawners to southern streams) for an unknown period into the future emphasizes the importance and urgency of improving freshwater habitats and maximizing coho smolt survival and recruitment in streams as a measure to partially mitigate the mortality associated with changing oceanic conditions.

Interaction with Hatchery Fish

Following an extensive literative review, Brown et al. (1994) concluded that California native coho salmon populations do not appear to be strongly genetically differentiated, but observation of numerous traits suggests there are genetic differences between stocks from widely different geographical areas; however, overall levels of genetic variability are low compared to other Pacific salmon and anadromous trout species.

There is a long, complex and poorly documented history of coho salmon plantings and transfers in Santa Cruz County streams (Appendix C). Native San Lorenzo River and Scott Creek stocks were widely used in supplementation plantings from 1905 through 1941. These transfers mixed stocks that probably had a high rate of natural exchange (straying) due to their abundance and proximity, and may have been segments of a larger spawning population. In this regard, the potential adverse impacts of such transfers were more likely those associated with artificial selection and spawning rather than interbreeding with non-native stocks. The latter concern takes priority regarding the Department use of non-native California stocks and imported coho stocks in local planting programs from 1950's through mid-1980's:

Noyo River, Prairie Creek, Russian River and Alesa River Oregon stocks were introduced into the San Lorenzo River; and Prairie Creek, Noyo River, and Trinity River stocks are known to have been introduced into Scott and Waddell Creeks (Bryant 1994). Brown et al. (1994) identify possible effects of interbreeding between non-native and native, wild stocks as including "disruption of locally adapted gene complexes, swamping and homogenization of native gene pools, and transmittal of nonadaptive traits from hatchery stocks to wild (native) stocks. Indirect genetic changes in wild fish are also possible, resulting from the altered environment or from processes, such as genetic drift and inbreeding, that accompany reduced population sizes caused by the presence of hatchery fish."

It is strongly suggested that persistent planting of non-native stocks on wild populations can infuse maladaptive genes into the hybrids leading to genetic extinction of native coho salmon populations (CDFG 1994, Brown et al. 1994). The planting of non-native coho stocks in California has failed to establish self-sustaining populations, and has contributed to the loss of native, wild populations (CDFG 1994), such as the loss of the native coho runs in the San Lorenzo River between the 1950's and 1978. Bryant (1994) concludes that the planting of non-native smolt coho salmon into Scott and Waddell Creeks in 1950's - 1970's "probably contributed to the decline in returning numbers of coho salmon and to the current genetic makeup of coho salmon populations within these streams." Bartley et al. (1992) found that Waddell Creek coho had the highest level of heterozygosity (0.05) of 27 populations sampled, which Brown et al. (1994) presumed was a consequence of interbreeding with imported stocks (note that Waddell Creek was the initial site of coho importations for the experimental ocean farming operation).

Because of the above problems encountered with historical transfers of non-native stocks and strong Legislative direction to protect, maintain and manage California's native fish and wildlife populations, the Department's "Salmon and Steelhead Stock Management Policy" was developed. This internal policy, which seeks to minimize the interactions between hatchery and natural populations, can be summarized as follows:

> "It is the policy of the DFG to maintain the genetic integrity of all identifiable stocks of salmon and steelhead in California. To protect the genetic integrity of California salmon and steelhead stocks, each salmon or steelhead stream shall be evaluated by the DFG and the stocks classified according to their probable genetic source and degree of integrity. Management and restoration efforts will be guided by this classification system, and policies relating to artificial production must also be compatible with this classification system."

This policy is a strong statement for the conservation of natural coho salmon population viability in California.

There are increasing concerns about the possible deleterious effects of supplementation planting programs that use native stocks and eventually create "naturalized" (Hatchery-influenced) populations, such as the current MBSTP program on Scott Creek. Such concerns center around the detrimental consequences of artificial selection and spawning that produce fish with lower overall survivability; reduced environmental adaptiveness; that compete with and/or displace wild fish; and dilute wild stocks with maladaptive genes through hybridization (Hard et al. 1992, Bryant 1994, CDFG 1994). Nielsen has concluded that the planting of hatchery coho can adversely influence wild coho stocks by disrupting social and foraging behavior and lowering the reproductive potential of wild fish (Nielsen, Pers. Comm.). McGennis (1994) concluded that "the values attributable to wild salmon and hatchery salmon are incompatible. Hatcheries have not been proven to sustain wild populations within their native range, and they exacerbate the several problems wild salmon face.... The relationship between the two salmons is irreconcilable. Hatchery production of salmon masks the decline of wild salmon, contributes to the genetic dilution and loss of wild salmon, and increases competition for limited freshwater and ocean resources wild salmon depend on."

Thus, the future survival of Scott and Waddell Creek coho salmon stocks is inextricably linked with the complex and pernicious consequences of past interbreeding with non-native fish and past and present artificial selection and spawning associated with supplementation planting activities.

Population Viability

Possibly the most serious threat to the perpetuation of southern coho salmon is the failing viability of the two remaining, remnant spawning populations. On both Waddell and Scott Creeks, only 1 of the 3 brood year lineages (the 1993-1996 lineage) produces a measurable spawning run, the other two lineages are either functionally extinct or at great risk of extinction. Thus, sustained spawning runs occur only every third year. For the 1991-1994 period, the estimated 'best-case' average annual run calculation for Waddell Creek is 20 adults (10 or less females) and for Scott Creek is 30-40 adults (15-20 or less females).

Brown et al. (1994) concluded that coho salmon spawning populations of less than 100 fish (such as on Waddell and Scott Creeks) are "probably lower than the population size necessary to preserve genetic integrity of the stock and to ensure its survival against random environmental disasters." Nehlsen et al. (1991) believe that a minimum population of at least 100 adults

is necessary to minimize the risks of inbreeding and random environmental disasters. They also warn that a declining stock may reach a threshold size below which it can no longer perpetuate itself due to feedback loops, or "extinction vortices," that increase the certainty that cumulative deleterious factors and random events will cause a population failure (Nehlsen et al. 1991). Nelson and Soule (1987) summarize the genetic concerns and consequences of reduced population size. In their assessment of anadromous salmonid stocks, Nehlsen et al. (1991) concluded that coho salmon stocks in coastal streams south of San Francisco are at high risk of extinction.

The loss of two of the three brood year lineages that comprise a population, combined with the low numbers of adults in the surviving 1993 year class, depicts a failing population viability for both the Waddell Creek and Scott Creek coho salmon stocks.

Due to the extirpation of coho salmon from San Mateo coastal drainages and declining low absolute numbers of wild coho spawners in California, the Waddell and Scott Creek coho populations are becoming ever more isolated - both geographically and reproductively isolated - from the nearest northern stocks in Marin and Sonoma counties (it is about 160 km (100 miles) from Waddell Creek to Redwood Creek, the nearest coho salmon stream in Marin County). Moderate to high exchange (straying) between Waddell and Scott Creek coho populations was documented by Shapovalov and Taft (1954), and more recently by J. Smith (Pers. Comm.) and M. McCaslin (MBSTP, Pers. Comm.). These streams are about 7 km (4.3 miles) apart. Adjacent populations continually exchange individuals, which helps minimize or prevent inbreeding depression or speciation, promotes a dynamic population structure, and is important in ensuring the future of the species and its role in the ecosystem. However, the probability of reproductive isolation from northern stocks must be increasing as the absolute numbers of adult coho spawners in both southern and northern stocks continue to decline to extremely low levels.

Coho salmon stocks consist of a highly organized network of dynamically connected populations adapted to local stream conditions. Occasional interchange of genes between these genetically linked populations is beneficial to the species overall by providing greater diversity and thus greater ability to better adapt to ecological changes. Each coho salmon population is geographically, evolutionarily and ecologically important. Therefore, the depletion or extirpation of populations, or the fragmentation and severing of natural linkages (sources of genetic interchange) between populations, can cause rapid extinction of the species across large portions of its range. Given the number and location of streams that historically supported them, it appears California coho salmon populations have been individually and cumulatively depleted or

extirpated and the natural linkages between them have been fragmented or severed. Unless this is reversed, the Department believes the long-term health of California's remaining coho salmon populations may be at significant risk. Maintenance of a broad distributional range and an expansive network of connected populations is critical for the long-term survival of the species as a whole. Large-scale fragmentation and collapse of the coho salmon's range indicate that the California population structure and function is breaking down catastrophically, and that remaining isolated populations, such on Waddell and Scott Creeks, face greatly increased risk of extirpation (CDFG 1994).

CURRENT MANAGEMENT

There are currently no official or mandated Department management programs specifically directed to the preservation or recovery of coho salmon south of San Francisco Bay. Mostly, this is because the species is not yet listed by either the State nor Federal governments as Threatened or Endangered. As a State Candidate Species, the coho salmon south of San Francisco Bay is protected from direct take under CESA, but biological consultation is not mandated in advance of any project development unless the species is actually listed. Thus, mitigation measures or project alternatives are not mandated, but are left to the discretion of the decision-making body. In such cases, the decision is often based on local economic considerations rather than overall welfare for a particular species.

The Department's Inland Fisheries Division has designated the coho salmon in California as a "Fish Species of Special Concern" since 1992. In 1994, the Department petitioned the BOF to list coho salmon statewide as a sensitive species pursuant to Forest Practices Rules. Also, coastwide stocks of coho salmon are presently under status review by NMFS.

The Monterey Bay Salmon and Trout Project (MBSTP) Big Creek Hatchery Program is a cooperative salmonid rearing program operating under permit from the Department pursuant to Fish and Game Code Sections 1200-1206. The explicit objectives of the MBSTP coho salmon programs on Scott Creek and the San Lorenzo River are to provide additional salmon fishing resources and to augment natural stocks. The San Lorenzo River effort sustains a small, hatchery-maintained run that provides some local inland sport fishing interest; however, the program does not utilize nor promote natural coho salmon stocks. The Scott Creek supplementation planting effort has been unsuccessful in preventing the continued decline of the spawning population nor preventing the functional extinction of the 1991-1994 and 1992-1995 brood year lineage segments of this population. Due to alarmingly low numbers of returning adult coho, Scott Creek (as well as Waddell Creek) was closed to salmon fishing in 1991; thus

MBSTP is not currently providing additional inland salmon fishing resources on this stream.

Current inland sport fishing regulations close Scott and Waddell Creeks to salmon fishing. The San Lorenzo River is open to a winter fishery for sea-run coho salmon and steelhead trout with a 2-fish limit of trout and/or salmon in combination.

The Department's Inland Fisheries Division administers a Fishery Restoration Grants Program, which has provided partial funding to MBSTP for their cooperative salmonid rearing program, and to various local project sponsors in San Mateo and Santa Cruz counties for anadromous salmonid stream habitat restoration and fish passage improvement projects, primarily focused on steelhead trout restoration.

Department implementation and action pursuant to the following policies and laws are aimed at preserving and improving coho salmon statewide and, therefore by inference, would benefit coho salmon south of San Francisco Bay:

1. The Salmon, Steelhead Trout, and Andromous Fisheries Program Act of 1988 (Fish and Game Code Section 6900 et seq.).

2. California Fish and Game Commission policy on "Cooperatively Operated Rearing Programs for Salmon and Steelhead."

3. California Fish and Game Commission policy on "Salmon"

4 Department of Fish and Game "Salmon and Steelhead Stock Management Policy".

Since the passage of the Magneson Fishery Conservation and Management Act in 1976, both commercial and recreational ocean salmon fishing has been coordinated among the states of Washington, Oregon and California through the Pacific Fisheries Management Council (PFMC). This management process sets regulations within 200 miles of the shoreline, which is the principle area used by salmon, and establishes spawning escapement goals for salmon stocks. A general framework has been developed for managing coho salmon stocks south of Cape Falcon, in northern Oregon, as a stock aggregate. This stock aggregate, called the Oregon Coastal Natural Group, includes California populations.

Annual catch of coho salmon in California's commercial troll fishery ranged from 100,000 to more than 650,000 fish in the early 1960's to early 1970's.

During the period 1980-1990, annual commercial coho landings in California ports averaged 54,300 fish and annual recreational ocean fishing produced an average of 29,300 fish. Aside from this harvest of coho salmon, which includes a mixture of hatchery and wild fish, there is incidental coho mortality during the chinook salmon season. The extent to which this additional mortality may be affecting specific coho stocks or coho populations in general in unknown. Spawning escapement of wild coho salmon populations in California is not well monitored and thus is not directly considered in PFMC harvest decisions.

Total number of commercial and recreational landings of coho salmon in San Francisco Bay and Monterey Bay ports are presented in Table 5 (Bryant 1994).

Table 5. Total Number of Commercial and Recreational Landings of Coho Salmon in San Francisco Bay and Monterey Bay Ports California. (Bryant 1994).

	San Francisco Bay		Monterey Bay	
Year	Commercial	Recreational	Commercial	Recreational
1952	928	No Data	158	No Data
1953	5,031	No Data	651	No Data
1954	1,322	No Data	461	No Data
1955	2,041	No Data	648	No Data
1956	1,626	No Data	251	No Data
1957	9,235	No Data	4,139	No Data
1958	3,564	No Data	324	No Data
1959	5,874	No Data	95	No Data
1960	4,503	No Data	178	No Data
1961	8,847	No Data	413	No Data
1962	1,503	41	255	0
1663	23,680	1,335	2,389	163
1964	47,912	8,322	12,492	6,225
1965	14,494	2,961	2,692	1,024
1966-1975	No Data			
1976-80	20,800	3,600	9,400	100
1981-85	7,700	1,100	1,400	100
1986	5,100	400	1,300	< 50
1987	1,200	100	100	< 50
1988	6,700	300	400	< 50
1989	6,500	900	500	< 50
1990	27,400	5,800	5,700	1,200
1991	53,000	7,700	21,400	2,900
1992	300	1,600	1,900	200

RECOVERY CONSIDERATIONS

The Department's objective is the protection and expansion of the existing two natural populations of coho salmon south of San Francisco Bay and reestablishment of a sufficient number of additional, viable native coho salmon populations in restored and protected watersheds to insure their long-term survival within their native habitat and range south of San Francisco Bay. In order to achieve recovery, the remaining two natural populations and any reintroduced populations must be protected, monitored, and proven to be self-sustaining to the satisfaction of the Department and the Commission. The Department will develop appropriate downlisting or delisting criteria, and periodically reexamine the status of the coho salmon south of San Francisco Bay. When, in the Department's judgment, recovery goals and downlisting or delisting criteria have been met, it will make recommendations to the Commission regarding changing the status of this species.

Recovery of viable coho population in streams south of San Francisco will require vigorous efforts by the DFG, other government agencies and the private sector to reverse the present trend of coho habitat debilitation. Watershed and water flow and quality conditions must be substantially improved to provide the necessary spawning and rearing habitat to allow the natural coho population to survive and increase to levels sufficient to withstand droughts and other uncontrollable natural perturbation.

Reintroduction and expansion of naturally reproducing populations will require limited artificial production of smolt-sized coho using fish from the two remaining populations in Scott and Waddell creeks. These activities would be conducted under DFG authority in cooperation with local private interests. A successful coho production facility, Monterey Bay Salmon and Trout Project, is in operation on Big Creek and, additionally, a program employing DFG facilities may also prove necessary. Cooperative restoration efforts are underway with Santa Cruz County and programs would be initiated with all county governments where historically viable coho population occurred. The Department of Forestry and Fire Protection would necessarily be an active partner in stabilization and restoration of coho habitat within wildland areas through their authority for timberland management and wildland and rural fire control. Other appropriate federal, state, and local governmental units would be incorporated in efforts to restore and maintain stream and riparian habitats including water flow and quality. The success of the restoration efforts will largely hinge on the cooperation and participation of the local community and landowners.

ALTERNATIVES TO THE PETITIONED ACTION

If the Commission should choose not to list the coho salmon south of San Francisco Bay, it is the Department's opinion that this fish would be deprived of protection provided through recognition and formal consultation available to a listed species. When a species is listed as Threatened or Endangered, a higher degree of urgency is mandated, and protection and recovery receives more attention and funding from the Department and other agencies than for nonlisted species. The species also would receive protection from unauthorized take pursuant to CESA.

In the absence of listing, it would be possible to devise a management plan for this species after further study. However, this departmental status review indicates that the future existence of this species is already in serious jeopardy. Despite good intentions on the part of the Department and Commission, promises of management and protection for unlisted species do not have the weight of law behind them, thus seldom receive high priority in the eyes of other agencies in especially in these times of limited funding. Without the benefits of listing and the cooperation of other agencies in preservation and recovery actions, coho salmon south of San Francisco Bay could decline further until their population is no longer viable, and they will no longer be able to exist in perpetuity. Eventually, extinction would occur.

The petitioner has requested listing the coho salmon south of San Francisco Bay as Threatened. The Department's status review indicates that the continued existence of the coho salmon south of San Francisco Bay is seriously endangered, that uplisting the requested action from Threatened to Endangered is warranted, and that listing as Endangered is appropriate. When listed as State Endangered, the coho salmon south of San Francisco Bay would receive special considerations and protection under CESA and the California Environmental Quality Act (CEQA) that are not available to unlisted species.

PROTECTIONS RESULTING FROM LISTING

If listed, the coho salmon south of San Francisco Bay will receive protection from take during development activities subject to CEQA, receive protection from unauthorized take pursuant to CESA, and be subject to formal consultation requirements under CESA. They will also be eligible for the allocation of resources by government agencies to provide protection and recovery. During the CEQA environmental review process, listed species receive special consideration, and protection and mitigation measures can be implemented as terms of project approval. Species that are not listed do not readily receive protection. The status of listing provides a species with recognition by lead agencies and the public, and

significantly greater consideration is given to the Department's recommendations resulting from project environmental review.

Listing this species increases the likelihood that State and federal land and resource management agencies will allocate funds towards protection and recovery actions that benefit coho salmon south of San Francisco Bay. With limited funding and a growing list of Threatened and Endangered species, priority has been and will continue to be given to species that are listed. Those that are not listed, although considered to be of concern, are rarely given serious consideration under these circumstances.

ECONOMIC CONSIDERATIONS

Designation of the coho salmon south of San Francisco Bay as Endangered will formally subject it to the protective aspects of CESA and CEQA. These acts would prohibit its taking and possession except as may be permitted by the Commission, and subject it to formal consultation procedures.

If coho salmon are listed as Endangered, the economic impacts on further water development for agriculture, land development, or municipal use could be significant. Additional diversion of water during summer and fall months from streams with coho salmon could severely reduce existing coho populations and deleteriously impact recovery efforts and, therefore, would be prohibited.

Listed status may also have a financial impact on current agriculture industry and other water users (ie. municipal and domestic users). Extensive water diversion for agriculture occurs during the summer and fall months which either dewaters streams completely or reduces flows to such a low level that water quality is compromised. If these streams are to be restored for use by coho salmon, then alternative water diversion regimes or reductions in appropriations will need to be addressed with potential high costs.

All watersheds with coho salmon south of San Francisco Bay have some degree of logging activity. Clear-cutting is not practiced and current logging practices are relatively conservative so the economic impact to this industry should be minimal if existing Forest Practice Rules are effectively protecting instream habitats. Costs may be substantial in some watersheds where the effects of past logging practices are still seen and where proposed operations may lead to further habitat degradation or delay recovery.

There will be an unknown economic impact on landowners living within watersheds that have coho salmon. Any landowner who may need to modify current land use practices to reduce silt loads to the streams or improve water quality will be affected.

Modifications associated with agricultural practices (ie. cultivating practices and disposal of animal wastes), road construction and maintenance (private, county and state entities), and riparian use (private homeowners) may have an unknown economic impact. In conjunction with the costs to landowners for implementing Best Management Practices, there may also be a cost share with the State for riparian conservation easements if they are deemed necessary.

There could be a substantial economic impact if the current closure on coastwide coho salmon commercial ocean fishing is continued and the present recreational ocean fishery is closed due to listing or if it impacts the chinook commercial and recreational ocean fisheries. The impact would not only affect the fisherman, but all other industry associated with fishing (ie. party boat operators, local bait and tackle shops, fishing gear manufacturers, and local hotel and restaurant industries).

Today, coho salmon south of San Francisco Bay play a minor role in ocean recreational and commercial fisheries, however recovery of these populations would have a positive economic benefit to local communities. The same economic benefit would be seen with enhanced stream sport fisheries.

CONCLUSIONS

The Santa Cruz County Fish and Game Advisory Commission petitioned the State Fish and Game Commission to list the coho salmon south of San Francisco Bay as a State Threatened Species

The Fish and Game Commission is guided by the California Endangered Species Act (CESA) and the Guidelines promulgated under this Act in determining whether a species may be properly listed as endangered or threatened. Section 670.1(b) of Title 14 of the California Code of Regulations sets forth the listing criteria. Under this section, the Commission may list a species if it finds that its continued existence is in serious danger, or is threatened by any of the following factors:

- Present or threatened modification or destruction of its habitat;
- overexploitation;
- predation;
- competition;
- disease; or
- other natural occurrences or human-related activities.

To meet the California Endangered Species Act's definition of "endangered", a species must be:

> a native species or subspecies;
>
> a bird, mammal, fish, amphibian, reptile or plant;
>
> in serious danger of becoming extinct throughout all, or a significant portion, of its range;
>
> affected by loss of habitat, change in habitat, overexploitation, predation, competition, or disease (Cal. Fish and Game Code Sec. 2062).

A "threatened" species is a species which is "likely to become an endangered species in the foreseeable future" in the absence of the special protection provided by the Act. (Sec. 2067). The Fish and Game Code (Sec. 2072.3) lists additional factors relevant to a determination that a species is threatened or endangered:

- population trend;
- range;
- distribution;
- abundance;
- life history;
- ability to survive and reproduce;
- degree and immediacy of threat
- existing management effort;
- type of habitat.

Based on this status review of available scientific information, we conclude that the coho salmon south of San Francisco Bay is seriously endangered through its historic range due to loss of habitat, degradation of habitat, catastrophic floods and droughts, loss of genetic viability, predation, unfavorable oceanic conditions, overexploitation, disease, and loss of population viability. The species has declined as a result of extensive alteration and degradation of stream habitats and appropriation of streamflows in the coastal watersheds from San Francisco Bay south to Monterey Bay concomitant with deleterious cumulative influences of catastrophic floods and droughts, past hatchery planting practices, increasing predation by marine mammals, continued overexploitation in the ocean catch,

BKD disease, and an increasingly more unfavorable, changing oceanic environment. Coho salmon south of San Francisco Bay constitute the southern portion of the species population and range in California and represent a genetically, evolutionarily and environmentally significant portion of the species range in California.

Coho salmon numbers south of San Francisco Bay have declined over 98 percent since the early 1960's and currently are restricted to one remnant population in Waddell Creek, one small naturalized (hatchery-influenced) population in Scott Creek, and a small hatchery-maintained, non-native run in the San Lorenzo River, Santa Cruz County. There is minimal possibility of successful natural expansion of the remnant Waddell and Scott Creek populations to neighboring drainages due to the functional extinction of two of the three brood year lineages, inadequate numbers of adult coho to naturally produce the necessary founder populations for successful recolonization of streams, loss of genetic and population viability, and general lack of secure adjacent suitable habitat. The two populations are highly vulnerable to imminent extinction. The small number of adult fish remaining combined with the loss of 2 of the 3 brood year lineages lowers the genetic and population viability of the Waddell and Scott Creek coho populations below self-perpetuation thresholds, and under these conditions they cannot be expected to survive over the longterm.

The Department's status review indicates that uplisting the requested petitioned action from Threatened to Endangered is warranted, and based on the best available scientific information regarding the distribution, abundance, biology and nature of threats to coho salmon south of San Francisco Bay, the Department finds that listing as Endangered is an appropriate action. In our professional judgment, the coho salmon south of San Francisco Bay qualifies for listing as Endangered under the California Endangered Species Act.

RECOMMENDATIONS

Petitioned Action

1. The Commission should find that the petitioned action should be uplisted from State Threatened to State Endangered.

2. The Commission should find that the uplisted petitioned action is warranted for the listing of coho salmon south of San Francisco Bay as State Endangered.

3. The Commission should publish notice of its intent to amend Section 670.5, Title 14, CCR to add the coho salmon south of San Francisco Bay (Oncorhynchus kisutch) to its list of Endangered Species.

Recovery Actions

In order to achieve recovery of coho south of San Francisco Bay, the following actions will be taken:

1. The Department will immediately assign a biologist as the lead person to develop and implement a recovery plan.

2. The lead person will assemble a multi-disciplinary team made up of representatives from the public and private sector to guide development of the recovery plan.

3. The Department will seek funding for development and implementation of the recovery plan through the State budgetary process.

4. The recovery plan will include elements for:
   (a) protection of existing populations and habitat;
   (b) restoration of degraded habitat;
   (c) supplementation of existing populations;
   (d) reintroduction of coho into historic habitat;
   (e) monitoring the status of coho and the success of the implementation of the recovery plan; and
   (f) goals for delisting the species.

5. The Department will provide additional expertise and, subject to availability of funds, monetary support to the MBSTP hatchery to function as a integral part of the recovery effort.

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APPENDIX A

APPENDIX B

STATE OF CALIFORNIA . THE RESOURCES AGENCY

PETE WILSON, Governor

DEPARTMENT OF FISH AND GAME
POST OFFICE BOX 47
YOUNTVILLE, CALIFORNIA 94599
(707) 944-5500

August 2, 1994

PUBLIC NOTICE

TO WHOM IT MAY CONCERN

Pursuant to Section 2074.4 of the California Fish and Game Code (FGC), NOTICE IS HEREBY GIVEN that on April 7, 1994 the California Fish and Game Commission accepted a petition from the Santa Cruz Fish and Game Advisory Commission to amend the official State list of endangered and threatened species (Sections 670.2 and 670.5, Title 14, California Code of Regulations) as follows:

Species	Proposal
Coho Salmon South of San Francisco Bay (*Oncorhynchus kisutch*)	List as Threatened

The California Endangered Species Act (Section 2050 et seq., Chapter 1.5, FGC) requires that the Department of Fish and Game (Department) notify affected and interested parties that the Commission has accepted the petition for the purpose of receiving information and comments that will aid in evaluating the petition and determining whether or not the above proposal should be adopted by the Commission. If the above proposal includes adding a species to the list as endangered or threatened, the Commission's action has resulted in this species receiving the interim designation of "candidate species." The Department will review the petition, evaluate the available information, and report back to the Commission whether the petitioned action is warranted (Section 2074.6, FGC). The Department's recommendation must be based on the best scientific information available to the Department.

NOTICE IS FURTHER GIVEN that anyone with data or comments on the taxonomic status, ecology, biology, life history, management recommendations, distribution, abundance, threats, habitat that may be essential for the species, or other factors related to the status of the above species, is hereby requested to provide such data or comments to:

Mr. Brian Hunter, Regional Manager
Region 3
Department of Fish and Game
P. O. Box 47
Yountville, CA 94599

Copies of the petition may be requested from the California Fish and Game Commission, Resources Building, 1416 Ninth Street, Sacramento, CA 95814.

Responses received by September 15, 1994 will be included in the Department's final report to the Commission. If the Department concludes that the petitioned action is warranted, it will recommend that the Commission adopt the above proposal. If the Department concludes that the petitioned action is not warranted, it will recommend that the Commission not adopt the proposal. (If the petitioned action is to list a species as endangered or threatened and the Commission accepts the Department's recommendation to not adopt the proposal, the species will lose its candidate status.) Following receipt of the Department's report, the Commission will allow a 45-day public comment period prior to taking any action on the Department's recommendation.

NOTICE IS FURTHER GIVEN that any species above, proposed to be added to the State list as endangered or threatened, is a "candidate species" pursuant to Section 2074.2, FGC, and pursuant to Section 2085, FGC, may not be taken or possessed except as provided by Section 2080, et seq., of the Fish and Game Code, or other applicable statutes.

APPENDIX

Section 2074.4 of the Fish and Game Code requires the Department of Fish and Game to notify affected and interested parties and landowners and to solicit data and comments on petitions accepted by the Fish and Game Commission. To fulfill this requirement, the Department sent notices and/or copies of the petition to the following persons and organizations. Legal notices were placed in the newspapers indicated below:

PERSON/ORGS. RECEIVING COHO SALMON SOUTH OF SAN FRANCISCO BAY PETITION AND/OR PUBLIC NOTICE

ROBERT O. BRIGGS
3610 PACIFIC COAST HIGHWAY
RANCHO DEL OSO
DAVENPORT, CA 95017

GEORGE GRAY
DEPARTMENT OF PARKS & RECREATION
101 MADELINE DRIVE
APTOS, CA 95003

MORROW WHITCOMB
MONTEREY BAY SALMON &
TROUT PROJECT
3784 WOODLEAF COURT
SAN JOSE, CA 95117

LINDA RADFORD
COOPERATIVE FISH REARING PROGRAM
INLAND FISHERIES DIVISION
P.O. BOX 595
CLOVERDALE, CA 95425

DR. JERRY SMITH
3047 BARONS COURT WAY
SAN JOSE, CA 95132

BUD MC CRARY
BIG CREEK LUMBER COMPANY
3564 HIGHWAY 1
DAVENPORT, CA 95017

SWANTON PACIFIC RANCH
299 SWANTEN ROAD
DAVENPORT, CA 95010

BEN WILSON
460 SWANTEN ROAD
DAVENPORT, CA 95017

LOCKHEED CORPORATION
16020 EMPIRE GRADE ROAD
SANTA CRUZ, CA 95060

ATTN: W.T. GRIZZELL

MS. CHARLENE B. ATACK
BOSSO, WILLIAMS, LEVIN, SACHS & BOOK
P.O. BOX 1822
SANTA CRUZ, CA 95061

MR. ERNEST MONA, SEA
COMPLAINT SECTION
STATE WATER RESOURCES CONTROL BOARD
DIVISION OF WATER RIGHTS
P.O. BOX 2000
SACRAMENTO, CA 95812-2000

MR. ERNEST BONTADELLI
P.O. BOX 879
SANTA CRUZ, CA 95061

MR. THOMAS GODDARD
SANTA CRUZ COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT
701 OCEAN STREET, ROOM 406B
SANTA CRUZ, CA 95060

MR. CRAIG FAANES, FIELD SUPERVISOR
U.S. FISH AND WILDLIFE SERVICE
2140 EASTMAN AVE., SUITE 100
VENTURA, CA 93003

MR. DAVE HOPE, RESOURCE PLANNER
COUNTY OF SANTA CRUZ
PLANNING DEPARTMENT
701 OCEAN STREET
SANTA CRUZ, CA 95060

LT. DENNIS BALDWIN
P.O. BOX 1506
CAPITOLA, CA 95010

MR. DENNIS MC EWAN
STEELHEAD TROUT SPECIALIST
INLAND FISHERIES DIVISION
DEPARTMENT OF FISH AND GAME
1416 NINTH STREET
SACRAMENTO, CA 95814

MR. KEN AASEN
SENIOR FISHERIES BIOLOGIST
REGION 3, NORTH DISTRICT
P.O. BOX 47
YOUNTVILLE, CA 94599

MR. KEITH R. ANDERSON
SENIOR FISHERIES BIOLOGIST
REGION 3, SOUTH DISTRICT
20 LOWER RAGSDALE DRIVE, SUITE 100
MONTEREY, CA 93940

MS. JENNIFER NELSON
FISHERIES BIOLOGIST
REGION 3 SALMON & STEELHEAD PROJECT
20 LOWER RAGSDALE DRIVE, SUITE 100
MONTEREY, CA 93940

MR. DAVE STREIG
HATCHERY MANAGER
MONTEREY BAY SALMON & TROUT PROJECT
825 BIG CREEK ROAD
DAVENPORT, CA 95017

JIM LOZAROTTI
2532 EMPIRE GRADE
SANTA CRUZ, CA 95060

MATT MC CASLIN
2524 PARKER STREET
SANTA CRUZ, CA 95065

WILLIAM COTTON AND ASSOCIATES
DAN EASTER
330 VILLAGE LANE
LOS GATOS, CA 95030

TERRY MANNING
SANTA CRUZ FLY FISHERMAN
PO BOX 2008
SANTA CRUZ, CA 95062

HARVEY RODGERS
SAN LORENZO RIVER
STEELHEADERS ASSOCIATION
2912 DRUBENBIAS #105
SOQUEL, CA 95073

TROUT UNLIMITED
CENTRAL COAST CHAPTER
PO BOX 486
REDWOOD ESTATES, CA 95044-0486

MAUREEN CHEROFF
800 RANCHO PRIETA ROAD
LOS GATOS, CA 95030

KEN MOORE
SEMPERVIRENS FUND
201 VALENCIA SCHOOL ROAD
APTOS, CA 95003

KATHY POWERS
49 SHADY OAKS DRIVE
WATSONVILLE, CA 95076-2509

NEIL S. LASSETTRE
1122 SUTHERLAND LANE #1
CAPITOLA, CA 95010

RUSS STEIN
STATE WATER RESOURCES
CONTROL BOARD
DIVISION OF WATER RIGHTS
PO BOX 2000
SACRAMENTO, CA 95812-2000

DAVE HOAGLAND
1925 46TH AVE, UNIT 85
CAPITOLA, CA 95010

ROBERT LA ROSA
THE NATURE SCHOOL
1000 LAUREL GLEN ROAD
SOQUEL, CA 95073

FRANK RODDY
STATE WATER RESOURCES
CONTROL BOARD
DIVISION OF WATER RIGHTS
PO BOX 2000
SACRAMENTO, CA 95812-2000

ROBERTA K. SMITH
SMITH-EVERNDEN ASSOCIATES
GEOLOGICAL CONSULTANTS
PO BOX 174
DAVENPORT, CA 95017

ERIC SCHMIDT
2805 SMITH GRADE
SANTA CRUZ, CA 95060

NADINE HITCHCOCK
CALIFORNIA STATE COASTAL
CONSERVANCY
1330 BROADWAY, SUITE 1100
OAKLAND, CA 94612

MR GREG BRYANT
NATIONAL MARINE FISHERIES
SERVICE
FEDERAL BUILDING
777 SONOMA AVENUE
SANTA ROSA, CA 95404

PATRICIA ANDERSON
AREA FISHERY BIOLOGIST
23845 SUMMIT ROAD, #1
LOS GATOS, CA 95030

FISH AND GAME COMMISSION
COUNTY OF SANTA CRUZ
701 OCEAN STREET, ROOM 406-B
SANTA CRUZ, CA 95060

FISH AND WILDLIFE ADVISORY COMMITTEE
COUNTY OF SAN MATEO
401 MARSHALL STREET
REDWOOD CITY, CA 94063

FISH AND GAME COMMISSION
COUNTY OF SANTA CLARA
COUNTY GOVERNMENT CENTER
70 WEST HEDDING STREET
SAN JOSE, CA 95110

U.S. ARMY CORPS OF ENGINEERS
SAN FRANCISCO DISTRICT
211 MAIN STREET
SAN FRANCISCO, CA 94105

CLAIRE DEDRICK, EXECUTIVE OFFICER
STATE LANDS COMMISSION
1807 13TH STREET
SACRAMENTO, CA 95814

HUSTON CARLYLE JR., DIRECTOR
OFFICE OF PLANNING AND RESEARCH
1400 10TH STREET
SACRAMENTO, CA 95814

DAVID N. KENNEDY, DIRECTOR
DEPARTMENT OF WATER RESOURCES
POST OFFICE BOX 942836
SACRAMENTO, CA 94236-0001

ROBERT NAZUM, PRESIDENT
CALIFORNIA ASSOCIATION RESOURCE
CONSERVATION DISTRICT
1072 JAUNITA DRIVE
WALNUT CREEK, CA 94595

EDWARD HASTEY, STATE DIRECTOR
U.S. BUREAU OF LAND MANAGEMENT
FEDERAL OFFICE BUILDING, ROOM E-2
SACRAMENTO, CA 95825

LAUREL MAYER, VICE PRESIDENT
THE NATURE CONSERVANCY WRO
785 MARKET STREET, 3RD FLOOR
SAN FRANCISCO, CA 94103

LAWRENCE DOWNING, PRESIDENT
SIERRA CLUB
730 POLK STREET
SAN FRANCISCO, CA 94109

MARVIN PLENERT, REGIONAL DIRECTOR
U.S. FISH AND WILDLIFE SERVICE
NORTHWEST REGIONAL OFFICE
911 NE 11TH AVENUE
PORTLAND, OR 97232-4181

DR. JOHN MC COSKER
CALIFORNIA ACADEMY OF SCIENCES
GOLDEN GATE PARK
SAN FRANCISCO, CA 94118

MARTIN SELDON
FEDERATION OF FLY FISHERMEN
POST OFFICE BOX 2393
SUNNYVALE, CA 94807-2393

DAN TAYLOR
NATIONAL AUDUBON SOCIETY
555 AUDUBON PLACE
SACRAMENTO, CA 95825

DR. PETER MOYLE
WILDLIFE AND FISHERIES BIOLOGY
UNIVERSITY OF CALIFORNIA, DAVIS
DAVIS, CA 95616

ROBERT BAIOCCHI, EXECUTIVE DIRECTOR
CALIFORNIA SPORTFISHING PROTECTION
P.O. BOX 357
QUINCY, CA 95971

THOMAS GRAFF
ENVIRONMENTAL DEFENSE FUND
5655 COLLEGE AVENUE, SUITE 304
OAKLAND, CA 94618

ASSOCIATION OF WATER AGENCIES
910 K STREET, SUITE 250
SACRAMENTO, CA 95814-3577

OFFICE OF ENDANGERED SPECIES
U.S. FISH AND WILDLIFE SERVICE
2800 COTTAGE WAY
SACRAMENTO, CA 95825

DR. DON ERMAN
DEPARTMENT OF FORESTRY AND
RESOURCE MANAGEMENT
21 MULFORD HALL
UNIVERSITY CALIFORNIA, BERKELEY
BERKELEY, CA 94720

MS. CARLA MARKMAN, CHAIR
CONSERVATION COMMITTEE
AMERICAN FISHERIES SOCIETY
C/O DEPARTMENT OF FISH AND GAME
1701 NIMBUS ROAD
RANCHO CORDOVA, CA 95670

August 2, 1994

Santa Cruz Sentinal
Post Office Box 638
Santa Cruz, California 95061

ATTENTION: LEGAL NOTICES

Please publish the enclosed Public Notice on any two days during the week of August 8, 1994. Send an invoice and proof of publication to:

Cindy Catalano
Regional Administrative Officer
Department of Fish and Game
Region 3
P. O. Box 47
Yountville, CA 94599

Thank you

Sincerely,

Cindy Catalano
Regional Administrative Officer
Region 3

KA/cw/dac

Enclosure: Public Notice

Mr. Robert Treanor
Fish and Game Commission w/Notice

Mr. Tim Farley
Inland Fisheries Division w/Notice

Letter also sent to: San Mateo Times, Half Moon Bay Review, Sacramento Bee, The Herald (Monterey), San Francisco Chronicle, San Jose Mercury News, San Luis Obispo County Telegram-Tribune

The Herald
Legal Notices
P.O. Box 271
Monterey, CA 93941

San Francisco Chronicle
Legal Notices
901 Mission Street
San Francisco, CA 94103

San Jose Mercury News
Legal Notices
750 Ridder Park Drive
San Jose, CA 95190

San Luis Obispo County
Telegram - Tribune
P.O. Box 112
San Luis Obispo, CA 93406

Santa Cruz Sentinel
Legal Notices
P.O. Box 638
Santa Cruz, CA 95061

San Mateo Times
Legal Notices
P.O. Box 5400
San Mateo, CA 94402

Half Moon Bay Review
Legal Notices
714 Kelley Ave.
Half Moon Bay, CA 94019

The Sacramento Bee
Legal Notices
P.O. Box 15779
Sacramento, CA 95852

MONTEREY BAY SALMON & TROUT PROJECT P.O. BOX 417 DAVENPORT, CA 95017

Mr. Brian Hunter, Regional Manager
Region 3
Department of Fish and Game
P. O. Box 47
Yountville, CA 94599

Sept. 10, 1994

Dear Mr. Hunter,

I appreciate the opportunity to comment on the status of the Coho Salmon south of San Francisco. I apologize for the length of this response, but I consider the subject to be of some importance.

DATA

- The Monterey Bay Salmon and Trout Project has provided the DF & G all records concerning our Coho production and planting, our observations of stream populations, and our observations of marine mammal bites on both Steelhead and Coho. Annual production reports were provided to the Department's Ponding Coordinator, and the rest of the data have been given to Region 3 South (K. Anderson & J. Nelson).

DISTRIBUTION AND ABUNDANCE

- To our knowledge, the Coho South of San Francisco live in only Scott and Waddell Cks. They seem to be extinct from all other creeks and rivers with the possible exception of Gazos Ck. ?
- Data exists showing regular straying of Cohos between Scott and Waddell Cks. This would indicate the genetic makeup of these Cohos to be the same.
- The rather large runs of large Coho that I remember in the 50's and 60's in the San Lorenzo River seem to be entirely gone. Attempts to reestablish these runs by MBS&TP plants (Noyo Riv. stocks, then Scott Ck stocks) have not been successful, probably due to siltation and habitat damage.
- The '93/'94 fall through spring run of Scott/Waddell Ck. Cohos (outmigration in spring of '95) is close to extirpated. The MBS&TP was unable to find any adult females in either Scott or Waddell Cks. last winter/spring. From summer evaluations of fry populations the Project would postulate perhaps two natural spawnings took place in Scott Ck. (small numbers of Coho fry are found in two widely separate locations). This year class shows the same low population levels as far back as our Project has records. It coincides with years when both serious droughts and severe floods have occurred. These conclusions

are in accord with observations of J. Smith & J. Nelson.

- The previous year class ('92/'93) is a peak year, the one prior to that ('91/'92) a kind of medium year. This also has held since the Project has records. From past experience we expect next year's run ('94/'95) to be of small to medium size. The peak year may contain as many 50 females, however it's probably considerably fewer than that.

BIOLOGY, GENETICS

- It is my opinion that the Coho South of San Francisco are not of purely native origin. Many hundreds of thousands of hatchery Coho were introduced into these streams prior to the 1940's, which must have led to outcrossing and contamination of the native gene pool. (I'm speaking of the fish introduced into Scott/Waddell Cks. Cohos of northern origin were introduced into the San Lorenzo River, but it's my guess they didn't stray into Scott/Waddell in enough numbers to impact the gene pool.)
- Even if not genetically 'pure' the Coho South of San Francisco are extremely valuable fish. They are a successful, wild race. They are the result of over 50 years of natural selection, yielding a very late running race of fish (the Project has observed Cohos running as late as February). Because of this late-running characteristic, these wild Coho are uniquely suited to the conditions on the Central Coast, where sandbars and late rains seem to be the rule. This stock of fish forms the core from which all of the central coast streams can be repopulated.

LIFE HISTORY

- Various sources (J. Smith, J. Nelson & others) indicate that the female Coho South of San Francisco are locked into a rigid three-year life cycle. This corresponds with the observations of the MBS&TP. Precocious males are seen with with regularity, which I would guess leads to regular year class genetic mixing.
- The rigid life cycle of the female Coho is a key difficulty in building up the population of missing and low year classes.

HABITAT

- Habitat in Scott Ck. is relatively unaffected by development, and is of relatively high quality. There are a few areas where bank stabilization would help, but the stream's Coho carrying capacity probably cannot be substantially increased.
- The major habitat concern in Scott Ck. is the annual dewatering of the lower section of the stream. The San Lorenzo River, Soquel Ck. and Scott Ck. were all dewatered again this fall. It is especially frustrating that the lower area of Scott Ck. was dried out again, despite laws and agreements to the contrary, and that this had to be brought to the

Department's attention by a citizen's complaint. The Department continues to demonstrate an inability to deal with this situation, although they have given public assurance that it would never happen again. I fully understand the Department's fiscal difficulties, however enforcement's priorities should emphasize countering situations like this where thousands of fish can be killed, and where the effect can be so devastating.

- The San Lorenzo River is apparently no longer habitable to Coho salmon. The major problem is siltation. Pollution, low summer flows, destruction of riparian habitat, and water diversions are interrelated major factors. I am pessimistic that this river will ever be habitable to Coho again. I don't think the money and the will can be found to repair it.

RECOMMENDATIONS

- Put lagoon breaching plans in place this fall for Scott Ck. The MBS&TP does not know what parameters (date, streamflow, lagoon height, etc.) are being considered for such a plan, but it is key that the Coho be assisted past the sandbar. The sandbar adversely effects Coho in two ways. First, by frequently preventing stream access until the fish die at sea without spawning. And second, by extending the period the fish are exposed to pinniped predation (see next item).
- Address the role of sea lion predation on the Cohos. I understand the sea lion issue is an incredibly hot and emotional one. But the Department must face this issue in relation to the local Coho and steelhead, because conclusive evidence exists as to their critical impact on the spawning runs. MBS&TP records show high levels of sea lion predation on steelhead and Coho in Scott Ck. (as well as the San Lorenzo River) even with the sandbar open. When the sandbar is closed, the Cohos are subjected to extended periods of sea lion predation from which few may survive. We feel that pinniped predation resulting from delayed stream access is a primary factor in the decrease of the Scott Ck. Coho.
- Implement a 'WATER MASTER' through the State Water Resources Board to control water diversions from Scott Ck, and to protect the stream habitat for Cohos.
- Aggressively enforce the maintenance of minimum flows on Scott Ck.
- Understand and define the role of artificial augmentation. Hatchery propagation is required to protect against man-made or natural disasters, to build the population to the point that Cohos can be reintroduced into other suitable local waters, and possibly to fill the missing year class in Scott Ck.
- Fund studies concerning the effectiveness of antibiotic therapy on BKD. The hatchery should continue the BKD/Erythromycin study with Wm. Cox of the Department.
- If results are positive, place a BKD eradication program in place for both Coho and steelhead in local streams.
- Prepare and fund a delayed growth experiment. Delayed growth experiments should be performed at the hatchery to see if four year old Coho females can be reared.

- If successful, fund a delayed growth program in the hatchery to attempt to fill the missing Coho year class.

MBS&TP COHO GOALS

- Continue/complete studies of antibiotic therapy on BKD in conjunction with Wm Cox of DF & G. Eradicate BKD from both Cohos and steelhead in local streams.
- Build up both peak and middle-sized Coho runs, to provide an excess of fish for establishing Coho runs in suitable streams south of San Francisco.
- Fill the missing Coho year class on Scott and Waddell Cks. Perform a delayed growth experiment on some of the fish from the high population year class to see if one could obtain two-year old outmigrants/four-year old spawners. If successful, fill the very low year class with holdovers from the high year class.

OTHER COMMENTS

- Sports fishing for winter steelhead should be allowed to continue in Scott Ck. with barbless hook and no-kill Coho restrictions. Admittedly, many cannot tell the difference between smaller Cohos and steelhead. An aggressive education program in Coho identification could be worked out with the MBS&TP and other local sportsman's groups.
- There is no evidence that MBS&TP's steelhead plants have in any way affected Coho populations, or Coho outmigrants. Statements claiming such are merely speculation, and are not based on scientific observations, studies, or factual information. The MBS&TP's observations are contrary to any such speculations and hearsay. The Project wishes to continue supplementation of natural steelhead production in Scott Ck.
- The MBS&TP raises approximately 20 to 30 thousand dollars and 10,000 volunteer man-hours for use in the restoration and conservation of the anadromous fishes in the greater Monterey Bay area, including Coho salmon. This is 50-60 thousand dollars less than its minimum requirements. MBS&TP has recently received a $52K appropriation which should ensure hatchery operation through spring of 1996. Without reliable future funding, the MBS&TP may be out of business and unable to assist in Coho restoration work past spring of 1996.

Sincerely,

Morrow Whitcomb, Chairman
Monterey Bay Salmon and Trout Project
H: (408) 248-3469 O: (415) 604-0379

9/27 deadline

FISH & GAME
SEP -7 1994
YOUNTVILLE

San Lorenzo River Steelheaders Association

BRIAN HUNTER, REGIONAL MANAGER
REGION 3
DEPARTMENT OF FISH & GAME
P.O. BIX 47
YOUNTVILLE, CALIFORNIA 94599

SEPTEMBER 2, 1994

DEAR MR. HUNTER,

I AM WRITING ON BEHALF OF THE SAN LORENZO STEELHEADERS ASSOCIATION.

WE WHOLE HEARTEDLY SUPPORT THE PETETION SUBMITTED BY OUR LOCAL SANTA CRUZ FISH AND GAME ADVISORY COMMISSION TO LIST THE COHO SALMON AS AN ENDANGERED AND THREATENED SPECIES IN ALL WATER AREAS SOUTH OF SAN FRANCISCO BAY.

COHO SALMON USED TO MIGRATE FROM THE SAN LORENZO RIVER, UP OUR BRANCIFORTE CREEK FISH TROUGH TO SPAWN AND MIGRATE BACK OUT TO THE OCEAN VIA SAN LORENZO RIVER.

BRANCIFORTE CREEK - FROM THE SAN LORENZO RIVER UPSTREAM FOR ABOUT A MILE HAS CONCRETE ENBANKMENTS/LEVEE ON ALL SIDE AND FLOOR, WITH A CONCRETE FISH TROUGH IN THE CENTER OF THAT 1st. MILE FOR FISH TO MIGRATE UPSTREAM.

THE MAINTENANCE OF THIS CREEK AND TROUGH HAS DETERIORATED OVER THE PAST 15 YEARS, WHERE NOW THE SALMON CAN NO LONGER GAIN ENTRY TO BRANCIFORTE CREEK. WHAT HAS HAPPENED, WHEN HIGH WATER IS DROPPED FROM THE RAINS, SILT IS DEPOSITED INTO THE ENTIRE BOTTOM OF THE CEMENT FISH TROUGH AND IS OVERGROWN WITH WILLOWS AND DEBRIS. THE SILT IS SO BUILT UP AT THE ENTRANCE FROM THE SAN LORENZO RIVER, THAT WHEN WATER SUDDENLY DROPS AFTER RAINS, FISH ARE STRANDED DUE TO SILT DEPOSITS IN THE TROUGH FOR OVER ONE MILE, PREVENTING SPAWNING AND MIGRATION. THE FISH FALL OVER THE SIDES OF THE SHALLOW TROUGH AND THE SEA GULLS COME DOWN AND PECK AT THEM, UNTIL THE FISH CANNOT SURVIVE.

FOR APPROXIMATELY 1 YEAR, I HAVE UNCSUCESSFULLY ATTEMPTED TO LAY OUT THE PROBLEM, WITH MAINTENANCE SOLUTIONS INVOLVING MUTUAL MEETINGS WITH THE CITY OF SANTA CRUZ PUBLIC WORKS MANAGER, RICHARD MCKINNEY AS WELL AS AREA FISHERY BIOLOGIST PATERCIA ANCERSON AND FISH AND GAME LT. BALDWIN.

LT. BALDWIN AND ANDERSON ADVISED ME THEY WERE GOING TO MEET WITH MR. MCKENNY OF SANTA CRUZ CITY ON THE"NEXT MONDAY" AND THEY WOULD CALL ME WITH RESULTS OF THAT MEETING, WHATEVER THE OUTCOME.....AND .....NEITHER HAS RESPONED ANYMORE. I HAVE LEFT SEVERAL VOICE MAIL MESSAGES, AND THEY HAVE NOT HAD THE COURTESY TO RESPOND TO ME.

BRUCE MORSE (408) 429-3658

San Lorenzo River Steelheaders Association

WHEN I HAVE TRIED to reach patricia anderson recently, in the MORNINGS, SHE DOES NOT RESPOND, AT ALL. IN THE LATE AFTERNOONS THE PHONE IS CONSISTENTLY BUSY.

IN OUR EARLY CONVERSATIONS, ... MY RAPPORT WIT LT. BALDWIN AND MS. ANDERSON WAS VERY BENEFICIAL AND CONSTRUCTIVE. LT. BALDWIN RECOMMEDED THE CITY GET STARTED WITH THE SAND BAR AT THE MOUTH OF THE SAN LORENZO, BEFORE THE MOUTH BACKS UP AND I AGREED.

AS TIME PROGRESSED NOTHING WAS DONE ABOUT BRANCI-FORTE CREEK (TO MY KNOWLEDGE WITH NO RESPONSE TO MY CALLS). I HAD LUNCH WITH SENATOR MELLO AND VOICED MY CONCERNS.

A MEETING WAS CALLED BY SENATOR MELLO'S OFFICE AND THE 4 OF US (PATRICIA ANDERSON AND RICHARD MCKINNY) MET TO DISCUSS SOLUTIONS TO THE SILT FILLED BRANCIFORTE CREEK.

AT THE END OF OUR MEETING , IT WAS AGREED THAT MR. MCKINNY AND MS. ANDERSON WOULD HAVE ANOTHER MEETING TO DISCUSS THE MAINTENANCE OF BRANCIFORTE CREEK. I EMPHASIZED AT THAT TIME, THAT MR. MCKINNY'S PROPOSAL TO SIMPLY PLOW A FURROW IN THE TROUGH, WOULD NOT WORK AND ALSO THAT TIME WAS RUNNING OUT WHAT WITH IMMINENTBACK-UP OF THE SAND BAR AT THE RIVER MOUTH. MS. ANDERSON INDICATED SHE WOULD INFORM ME IN WRITING OF THE MEETING RESULTS FOR THE MEMBERSHIP. SHE FAILED TO DO THIS.

I HAVE DOCUMENTATION FOR THE PAST 17YEARS FROM 1977 WHERE WE LOST OUR RUN OF SALMON AND STEELHEAD, PICTURES FROM THE BRANCIFORTE CREEK NEIGHBORHOOD. IN THE MEANTIME, WHERE WAS THE DEPARTMENT OF FISH AND GAME TO PROTECT OUR ENFIRNMENT FOR OUR FISHERIES..

THE PROTECTION OF THE COHO SALMON WILLNOT BE BENEFICIA TO SANTA CRUZ COUNTY UNLESS THE DEPARTMENT OF FISH AND GAME DOES ITS JOB TO ASSURE ADEQUATE SPAWNING AND MIGRATION HABITAT IN OUR STREAMS AND NOT BE INTIMIDATED BY THE SANTA CRUZ CITY PUBLIC WORKS DEPARTMENT.

ALL STREAMS IN SANTA CRUZ COUNTY HAVE LOST OUR SALMON AND STEELHEAD RUNS. ONLY WADELL AND SCOTTS CREEKS HAVE ANY MIGRATION AT ALL.

AGAIN, WE SUPPORT THIS PETITION TO LIST THE COHO SALMON AS ENDANGERED.

SINCERELY,

Bruce Morse

BRUCE MORSE
SAN LORENZO STELLHEADERS ASSOC.

✓ 314 Avalon Ave
S.C. 95060

PATRICIA ANDERSON
(408) 353-2275

RICHARD MCKINNEY
(408) 429-3658

CC: Senator Henry Mello

August 19, 1994

Mr. Brian Hunter, Regional Mgr.
Region 3
Dept. of Fish and Game

94 AUG 22 PM 3:51

Dear Mr. Hunter:

It becomes more apparent every year that listing the central coast Silver (Coho) Salmon as a threatened species is imperative to prevent losing the genetic strain unique to the streams south of the Golden Gate. The disastrous mid 1970's drought, helped along by uncaring landowners, all but eliminated both steelhead and salmon in Scott and Waddell Creeks. In the early 1980's remnant runs of steelhead and salmon began to slowly increase. But constant tampering with water flows, including dewatering, and unchecked manipulation of the watershed lands, such as road building, illegal grading, and timber operations have brought the salmon populations to near extinction.

The mass dumping of thousands of large hatchery steelhead smolts has has a deleterious on small wild salmonids Hatchery fish should be introduced gradually, near the ocean, not high in the streams where they devour everything smaller!

Finally, the Silver Salmon of the streams south of San Francisco constitute a very strong race of fish, able to

withstand water temperatures of up to 80°F and minimum flows that would kill most other salmon. These fish, once brought back to a viable population could be used for restocking a more northern stream, should a disaster strike there.

Sincerely

James A. Lazarotti

James A. Lazarotti
2532 Empire Grade
Santa Cruz, CA 95060

AD-HOC COHO SALMON ADVISORY COMMITTEE

The Department of Fish and Game Region 3 South District Senior Fisheries Biologist convened an informal Ad-Hoc Coho Salmon Advisory Committee to provide advice and recommendation to the Department regarding the status of coho salmon south of San Francisco Bay and possible actions on the petition. The Committee was composed of four individuals with unique knowledge about coho salmon:

Dr. Jennifer Nielsen
U.S. Forest Service
Hopkins Marine Station, Pacific Grove
Geneticist specializing in coho salmon and steelhead trout.

Dr. Jerry Smith
San Jose State University, San Jose
Professor and field researcher on the fishery resources of central coast streams for 20+ years.

Dr. Larry Brown
U.S. Geological Survey, Sacramento
Researcher and senior author of 1994 publication on "Historical Decline and Current Status of Coho Salmon in California"

Matt McCaslin
Santa Cruz
Local citizen with extensive empirical knowledge of coho salmon and steelhead trout resources of Scott and Waddell Creeks.

The first meeting was held at the Department of Fish and Game office in Monterey on October 13, 1994. Attendees included Dr. Jennifer Nielsen, Mr. Matt McCaslin, Dr. Jerry Smith, Mr. Keith Anderson (Senior Fishery Biologist), and Ms. Jennifer Nelson (Fishery Biologist).

The second meeting was held at San Jose State University on January 4, 1995 and attendees included Dr. Jennifer Nielsen, Mr. Matt McCaslin, Dr. Jerry Smith, Dr. Larry Brown, Mr. Keith Anderson (Senior Fishery Biologist), Ms. Jennifer Nelson (Fishery Biologist), and Ms. Patricia Anderson (Area Fishery Biologist).

Based upon the available information and the special knowledge of each committee member, the Committee voted unanimously at the end of the January 1995 meeting to recommend the coho salmon south of Punta Gorda (Humbolt County) be listed as State Endangered. The Committee strongly believed there is ample and compelling evidence that stocks south of Punta Gorda represent a definable population unit, such as the Evolutionarily Significant Unit (ESU) concept of NMFS, and that these stocks south of Punta Gorda qualify for State Endangered status.

STATE OF CALIFORNIA—THE RESOURCES AGENCY

PETE WILSON, Go

DEPARTMENT OF FISH AND GAME
20 LOWER RAGSDALE DRIVE, SUITE 100
MONTEREY, CA 93940
(408) 649-2870

February 25, 1994

Public Meeting Announcement

COHO SALMON RESTORATION IN SANTA CRUZ COUNTY

Felton

March 24, 1994 at 7:00 p.m.

The Department of Fish and Game is sponsoring a public meeting to discuss coho salmon restoration/recovery in Santa Cruz County streams with emphasis on Scott and Waddell Creeks. The Santa Cruz County Fish and Game Commission is advocating the listing of coho salmon south of San Francisco Bay as a threatened species pursuant to the California Endangered Species Act. In response, the County prepared a Draft Recovery Plan which focuses on restoration and recovery measures for coho salmon in Scott and Waddell Creeks.

The County Plan is a good starting point; however, the Department is taking the lead in expanding the plan and defining restoration and recovery of coho salmon south of San Francisco. For the Department to develop and implement a successful action plan, it is imperative that we have public input on the concerns and ideas for coho salmon recovery. We seek comments and suggestions from the public regarding factors which may be depressing the coho populations, potential restoration measures and concerns about the consequences of possible restoration actions.

This meeting will address coho salmon restoration/recovery for Santa Cruz County streams with emphasis on Scott and Waddell Creeks. Future meetings will address other coastal areas.

The public meeting will be held at:
Zayante Fire Station
California Department of Forestry
7700 East Zayante Road
Felton

Thursday, March 24, 1994 at 7:00 p.m.

For more information, please call Ms. Jennifer Nelson, Fishery Biologist, at (408) 649-7153.

On March 24, 1994, the Department of Fish and Game sponsored a public meeting in Felton to discuss coho salmon restoration/ recovery in Santa Cruz County streams. Approximately 30 people attended the meeting and had the following comments:

Scott Creek has approximately 20,000 acre feet of water appropriated per year, however it is unknown what riparian owners are using. Assistance was offered in sorting out water rights on Scott and Waddell Creeks.

Approximately 98% of Waddell Creek is within state park property with the west branch of Waddell Creek designated as wilderness area and the lagoon a natural reserve area. The State Park Commission will need to approve any fish habitat projects.

A prescribed burn to reduce the growth and perpetuation of "water sucking" trees was recommended for both creeks.

The sewage treatment plant on the East fork of Waddell Creek has undergone modification to upgrade system. Logging roads have been removed in a portion of the watershed (West fork) and the road adjacent to Waddell Creek is going to be modified which may reduce the amount of silt entering the creek.

A research component should be added to the recovery plan.

A brief synopsis of coho life history was given. Stochastic events, rigidity in the age of spawning females, and early timing of spawning were noted as factors which have led to the demise of coho salmon.

In 1981, five juvenile coho salmon were captured while electrofishing the lower portion of San Vicente Creek, Santa Cruz County.

Monterey Bay Salmon and Trout Project (MBSTP) is a valuable fishery tool and should be continued.

Research should be done as fish are coming over sandbar and on the marine mammal/coho salmon interactions.

Wild pigs in the tributaries are causing the water to be turbid and are having an impact on water quality.

A diversion from Waddell Creek to a site 4 miles north will be continued next year if the pipe can be replaced. Flow at the diversion point in Waddell Creek is 20% of what it was during the Shapavolov and Taft study. At that time, the area was clear cut and devastated by fire. A study should be conducted to determine stream flow vs. trees.

In Scott Creek, the coho salmon decline cannot be blamed on a degraded watershed.

Not many coho salmon in Big Creek because that stream is steeper than other streams in the watershed and not conducive to coho salmon spawning, however Mill Creek does provide habitat for coho spawing. Instream work is not needed on Scott Creek, but lagoon management and artificial breaching is needed. Since the construction of the Highway 1 bridge, the lagoon has not funtioned properly. Caltrans dumping sand onto the beach adds to the problem.

Predation by wildlife (marine mammals) is a problem based upon the scrape marks found on adult fish.

Bacterial kidney disease may be having a much greater impact than we realized.

Appendix C

"History of Hatchery Stocks and Outplantings" from April 1994 NMFS Status Review of Coho Salmon Populations in Scott and Waddell Creeks, Santa Cruz County, California.

APPENDIX C

HISTORY OF HATCHERY STOCKS AND OUTPLANTINGS

One of the major issues NMFS considered in determining whether a coho salmon ESU remains in Scott and Waddell Creeks, is the extent of hatchery programs in Santa Cruz County. NMFS considered three major issues: 1 history and numbers of hatchery releases, 2) composition of hatchery stocks used, and 3) geographic areas of hatchery releases. The following information is a chronological history of the egg taking and fish planting activities that occurred in Santa Cruz County, with an emphasis on Scott and Waddell Creeks compiled by the Monterey Bay Salmon and Trout Project (MBSTP) and NMFS from limited stocking and trapping records.

In 1904 the Brookdale Hatchery (San Lorenzo River and Scott Creek Egg Taking Station were built by the City of Santa Cruz and began operation in 1905 to produce one and a half million steelhead and coho fry per year. CDFG took over the operation through a lease from the County in 1912 for a steelhead egg source. During a drought in the 1920's a new site was selected for a hatchery on Big Creek (tributary to Scott Creek), and in 1926 Big Creek Hatchery was built and began operation in 1927. The three facilities operated until the flood of 1940 damaged both Big Creek Hatchery and Scott Creek Egg Taking Station which were subsequently shut down. The Brookdale Hatchery continued operation with surplus eggs from other northern CDFG hatcheries to produce salmonid fry for planting in local streams in July or

August; however, it could not produce sufficient numbers of yearlings and was shut down in 1953. After this closure, fish planted in Santa Cruz County streams came from various Fish and Game hatcheries in northern California.

Of the few remaining original fish planting records within Santa Cruz County, CDFG biennial report data indicate the total per county and occasionally watershed (Table 1). For 15 years, between 1909 to 1941, a total of 1,907,153 coho salmon from various Pacific Coast watersheds were known to have been planted in Santa Cruz County streams. These stocking reports indicated that between 1915-1939 Scott Creek was stocked with a total of 387,413 coho salmon fry and over 10,000 coho salmon juveniles between 1967-1968. Waddell Creek was stocked with approximate total of 116,000 coho salmon fry between 1913-1933, over 10,000 coho salmon juveniles from CDFG Darrah Springs Hatchery in 1966, and an unknown number of coho salmon in 1970 (Noyo River stock) and in 1972 (Trinity River stock) by CDFG. The San Lorenzo River was stocked with a total of 577,440 coho salmon fry between 1915-1941, and an unknown number of coho salmon juveniles and fry from 1957 to present.

When the Scott Creek egg taking station was established, the policy was to spawn every female steelhead and coho salmon to try and produce 3 million eggs/year for each species (Streig 1991). Streig (1991) tabulated and reported the fry production year fish spawned from the previous November through the end of the run that year), and the total number of green eggs taken.

Quantitative records of adult fish numbers returning to Scott Creek were not found. Using the average number of eggs per female (coho averaged 2,700 eggs and steelhead averaged 5,000 eggs) and the average sex ratio (1:1 male/female) reported by Shapovalov and Taft (1954), the approximate number of females spawned and the total number of adults spawned were estimated (Table 2)

In 1969 the Fish and Game Commission held a hearing and authorized the CDFG to issue an experimental commercial aquaculture permit to Pacific Marine Enterprises, now known as SilverKing Oceanic Farms (SKOF), to raise anadromous salmon and steelhead for release and later recapture in the lagoon of Waddell Creek (Reavis 1985). Soon after the operation began, a flood damaged the facility, and in 1979 SKOF began operation of a new facility on Davenport Landing Creek in Santa Cruz. They were unable to obtain any local California salmon stocks. Therefore, their egg sources came from other commercial or surplus from northern California and out of state stocks of Oregon, Washington, British Columbia, and Alaska (Reavis 1985, Streig 1991). Returning adult steelhead, coho, and chinook salmon to Davenport Landing Creek were hauled to a hatchery facility operated on Bean Creek near Scotts Valley in Santa Cruz (Reavis 1985). The fish were spawned at the Bean Creek facility and the smolts were returned to Davenport Landing Creek for release to the ocean. The fish traps were operated from August through June of the following year.

There were no records found for the number of fish captured, spawned, or juveniles released by SKOF during the 1970's in Waddell Creek. However, there were records found for the operations in Davenport Landing Creek during the 1980's using a variety of other river systems coho salmon stocks and are summerized in table 3 (Reavis 1985). From 1980-1984 spawning season, SKOF had a total return of 3,201 coho salmon with an average annual return of 640 coho salmon to the Davenport Landing Creek facility. During the 1980 through 1984 time period, SKOF released 949,768 coho salmon from their Davenport Landing Creek facility with an average annual stocking rate of 189,954 fish. From 1984-1988 spawning season, SKOF had a total return of 1,331 coho salmon with an average annual return of 333 coho salmon. During 1984 through 1988 time period, SKOF released 177,920 coho salmon from their Davenport Landing Creek facility, with an average annual release of 44,480 juvenile coho salmon. Approximately 85 percent of the coho salmon trapped by SKOF in their Davenport Landing Creek facility were caught in September and October each year, primaily due to artificial pumping of freshwater through Davenport Landing Creek (Reavis 1985).

In 1976 the Monterey Bay Salmon and Trout Project (MBSTP) was started, in joint venture with CDFG, to try and rebuild the declining salmonid populations in local streams. From 1976 through 1979 CDFG cage-reared salmonid stocks from their Mad River Fish Hatchery (Humboldt County) and Warm Springs Fish Hatchery (Sonoma County) near Moss Landing in Santa Cruz. The

Big Creek Hatchery was rebuilt in 1982 and started to use naturally returning stocks from Scott Creek and the San Lorenzo River.

The MBSTP and CDFG has reared and released over 1,150,000 juvenile coho salmon and steelhead in local watersheds from 1976 through 1992 (Streig 1993). From March through May of 1992, the MBSTP and CDFG released 1,870 juvenile coho and 123,000 juvenile steelhead throughout various local streams (Streig 1993). Locations of the salmon and steelhead plants include: the San Lorenzo River and tributaries Bear Creek, Boulder Creek, Branciforte Creek, Fall Creek, Newell Creek, and Zayante Creek; Aptos Creek; Arana Creek; Carmel River and tributaries; Corralitos Creek; Pajaro River and tributaries Little Arthur and Uvas Creeks; Salinas River and tributary Arroyo Seco; San Vicente Creek; Scott Creek and tributary Big Creek; Soquel Creek; Tar Creek; and Waddell Creek (Table 4).

As of June 1992, MBSTP was rearing a total of 214,085 fry which included: 16,540 coho salmon, 26,980 Carmel River steelhead, and 134,240 steelhead from an assortment of local creeks in California. Also, 32,365 chinook salmon from the Feather River, California, were reared at Moss Landing in Monterey Bay (Streig 1993).

When adult coho salmon return to Scott Creek and the San Lorenzo River, the MBSTP traps the entire run, spawns them artificially, and then releases the smolts to help augment

natural production. All released smolts are fin clipped and are not used as brood stock in subsequent years.

Table 1. History of Fish Plantings from 1909 through 1941 in Santa Cruz County, California. (individual hatcheries listed have their own history of stock transfers)

Year	Species	# Fish	Location of Plant	Origin[a]
1905-1908	No Data			
1909	Steelhead	862,000	Santa Cruz Co.	
	Coho	600,000	Santa Cruz Co.	
1910	Steelhead	753,500	Santa Cruz Co	
	Coho	No Data		
1911	No Data			
1912	Steelhead	803,500	Santa Cruz Co	
	Coho	No Data		
1913	Steelhead	121,000	Scott Creek	
		24,000	Waddell Creek	
		493,000	Santa Cruz Co.	
	Coho	15,000	Waddell Creek	Sisson
		25,000	Scott Creek	Sisson
	Chinook	294,600	San Lorenzo River	Sisson
1914	No Data			
1915	Steelhead	22,000	Waddell Creek	
		148,000	Scott Creek	
		485,000	Santa Cruz Co.	
	Coho	25,000	Scott Creek	Sisson
		18,000	Waddell Creek	Sisson
		28,000	San Lorenzo River	Sisson
1916	Steelhead	877,000	Santa Cruz Co.	
	Coho	No Data		
1917	Steelhead	500,000	Santa Cruz Co.	
	Coho	25,000	Santa Cruz Co.	Sisson
1918	Steelhead	710,000	Santa Cruz Co.	
	Coho	No Data		
	Chinook	135,000	San Lorenzo River	Mt. Shasta[b]
1919	Steelhead	535,000	Santa Cruz Co	
	Coho	No Data		
1920	No Data			

(Table 1. continued)

Year	Species	# Fish	Location of Plant	Origin[4]
1921	Steelhead	500,000	Santa Cruz	
	Coho	No Data		
1922-1923	No Data			
1924	Steelhead	500,000	Santa Cruz	
	Coho	No Data		
1925	Steelhead	1,295,000	Santa Cruz	
	Coho	No Data		
1926	Steelhead	903,000	Santa Cruz Co.	
	Coho	No Data		
1927	No Data			
1928	Steelhead	25,000	San Lorenzo River	
Furunculosis kills Big Creek Hatchery stock; 25,000 survived Brookdale Hatchery				
	Steelhead	152,000	Santa Cruz Co.	Mt. Shasta
	Coho	No Data		
1929	Steelhead	391,000	Santa Cruz Co.	
	Coho	25,000	Scott Creek	
		22,700	Waddell Creek	
		233,500	San Lorenzo River	
1930	Steelhead	506,000	Santa Cruz Co.	
	Coho	36,700	Scott Creek	
		30,000	Waddell Creek	
		27,625	Pajaro River	
		9,000	Soquel Creek	
		54,750	San Lorenzo River	
		50,000	San Lorenzo River	Ft. Seward
1931	No Data			
1932	Steelhead	630,000	Santa Cruz Co.	
	Coho	15,000	Scott Creek	Ft. Seward
		10,500	San Lorenzo River	Ft. Seward
		6,500	Soquel Creek	Ft. Seward
	Atlantic Salmon	1,500	Scott Creek	Mt. Shasta

(Table 1. continued)

Year	Species	# Fish	Location of Plant	Origin[3]
	Steelhead	307,928	Santa Cruz Co.	
	Coho	18,592	Scott Creek	Prairie Creek
		16,005	Waddell Creek	Prairie Creek
		21,030	San Lorenzo River	Prairie Creek
	Steelhead	260,611	Santa Cruz Co.	
	Coho	15,020	Scott Creek	
		12,730	Soquel Creek	
		12,345	San Lorenzo River	
		50,000	San Lorenzo River	Prairie Creek
1935	Steelhead	922,492	Santa Cruz Co.	
	Coho	10,000	Scott Creek	Prairie Creek
		22,025	San Lorenzo River	Prairie Creek
	Steelhead	766,070	Santa Cruz Co.	
	Coho	5,248	Scott Creek	
		40,095	San Lorenzo River	
1937	Steelhead	1,076,322	Santa Cruz Co.	
	Coho	81,275	Scott Creek	
		44,710	San Lorenzo River	
	Chinook	22,164	San Lorenzo River	Mt. Shasta
1938	Steelhead	872,742	Santa Cruz Co.	
	Coho	77,060	Scott Creek	
		40,840	Soquel Creek	Prairie Creek
		45,800	San Lorenzo River	Prairie Creek
1939	Steelhead	749,546	Santa Cruz Co.	
	Coho	53,518	Scott Creek	
		18,900	San Vicente Creek	
		50,000	Soquel Creek	
1940	Steelhead	311,777	Santa Cruz Co.	
	Coho	No Data		
1941	Steelhead	328,765	Santa Cruz Co.	Prairie Creek
	Coho	14,685	San Lorenzo River	Prairie Creek
1942	Brookdale was shutdown			

[3] If no hatchery is listed, fish are Scott Creek stock from either Big Creek or Brookdale Hatchery.

Sisson Hatchery name changed to Mount Shasta Hatchery.

Table 2. Scott Creek Egg Taking History and Estimated Number of Adult Spawners Used from 1908-1940. (Streig 1991)

Year	Species	# Green Eggs	Estimated[a] # Females	Estimated[b] Total #
1905-1907	No Data			
1908	Steelhead	725,000	145	
	Coho	None Spawned		
1909	Steelhead	2,182,000	437	874
	Coho	1,400,000	518	1036
1910	Steelhead	2,709,300	542	1084
	Coho	None Spawned		
1911-1914	No Data			
1915	Steelhead	3,357,000	672	
	Coho	None Spawned		
1916	Steelhead	3,111,000	632	1264
	Coho	None Spawned		
1917	Steelhead	2,250,000	450	900
	Coho	None Spawned		
1918	Steelhead	3,900,000	780	1560
	Coho	None Spawned		
1919	Steelhead	3,900,000	780	
	Coho	None Spawned		
1920	Steelhead	1,060,000	212	424
	Coho	None Spawned		
1921	Steelhead	4,200,000	840	1680
	Coho	None Spawned		
1922-1923	No Data			
1924	Steelhead	2,590,000	518	
	Coho	None Spawned		
1925	Steelhead	3,000,000	600	1200
	Coho	None Spawned		
1926	Steelhead	1,300,000	260	520
	Coho	None Spawned		

(Table 2. continued)

Year	Species	# Green Eggs	Estimated[a] # Females	Estimated[b] Total #
1927-1928	No Data			
1929	Steelhead	4,167,000	834	1668
	Coho	298,000	111	222
1930	Steelhead	4,167,000	278	556
	Coho	134,000	50	100
	No Data			
1932	Steelhead	2,025,000	405	810
	Coho	None Spawned		
	Steelhead	1,225,000	245	490
	Coho	None Spawned		
	Steelhead	808,000	162	324
	Coho	124,000	46	92
1935	Steelhead	1,987,000	398	796
	Coho	None Spawned		
1936	Steelhead	1,777,500	356	712
	Coho	64,000	24	48
1937	Steelhead	1,711,000	343	686
	Coho	148,000	55	110
1938	Steelhead	1,545,000	309	618
	Coho	97,500	36	72
1939	Steelhead	1,745,000	349	698
	Coho	207,000	77	154
1940	Steelhead	418,000	84	168
	Coho	None Spawned		

Big Creek Hatchery and Scott Creek fish trap destroyed by flood.

[a] Estimated # of females (Steelhead averaged 5,000 eggs and Coho averaged 2,700 eggs per female as reported by Shapovalov and Taft 1954)

[b] Estimated total number of adults used for egg production (average sex ratio of 1:1 male/female as reported by Shapovalov and Taft 1954)

Table 3. History of Fish Plantings by SilverKing Oceanic Farms (SKOF) in Davenport Landing Creek from 1980 through 1988, Santa Cruz County, California.

Year	Species	Brood Year	Orgin of Stock	Total Releases
1980	Steelhead	1978	Whale Rock Reservoir	235
	Coho	1978	Univ. of Washington	100,000
		1979	Univ. of Washington	29,497
		1979	Cowlitz River	21,818
		1979	Univ. of Washington X Klamath River	33,989
		1979	SKOF	59,781
	Chinook	1979	Bonneville	38,000
		1979	Univ. of Washington	136,338
1981	Steelhead	1980	Whale Rock Reservoir	1,030
	Coho	1979	SKOF	49,401
		1979	Univ. of Washington X Klamath River	21,500
		1979	Univ. of Washington	3,383
		1979	Alsea River	81,840
		1980	SKOF	5,333
		1980	Univ. of Washington	64,255
		1980	Toutle River	15,378
		1980	Oregon Aquaculture	11,062
		1980	Cowlitz River	13,191
		1980	Miscellaneous stocks	3,150
	Chinook	1979	Univ. of Washington	4,000
		1980	Univ. of Washington	1,153
1982	Steelhead	1981	SKOF	453
	Coho	1980	SKOF	2,371
		1980	Cowlitz River	2,800
		1980	Univ. of Washington	4,650
		1981	Noyo River	15,304
		1981	Univ. of Washington	77,743
	Chinook	1980	Univ. of Washington	355,900
		1981	Univ. of Washington	203,149
		1982	Univ. of Washington	137,021
1983	Steelhead	1981	SKOF	16,579
		1982	SKOF	2,619
	Coho	1982	SKOF	17,959
		1982	Noyo River	8,000
	Chinook	1982	SKOF	37,050
1984	Steelhead	1984	Dry Creek	35,777
	Coho	1983	SKOF	201,824
		1983	Univ. of Washington	95,625
	Chinook	1983	SKOF	14,014

cont. Table 3.

Year	Species	Brood Year	Origin of Stock	Total Releases
1985	Steelhead	1983	SKOF	121,000
	Coho	1984	SKOF	63,000
	Chinook	1984	SKOF	51,225
1986	Steelhead	1984	SKOF	41,250
	Coho	1985	SKOF	102,520
	Chinook	1985	SKOF	502
1987	Steelhead	1985	SKOF	65,000
	Coho	1986	SKOF	10,000
	Chinook	1986	SKOF	19,500
1988	Steelhead	1986	SKOF	211,000
	Coho	1987	SKOF	2,400
	Chinook	No Plants		
1989	SKOF no longer in operation.			

Table 4. History of Fish Plantings by the Monterey Bay Salmon and Trout Project and California Department of Fish and Game in Central California Coastal Watersheds from 1978 through 1993 (includes smolt, fingerling, and fry, plants).

Year	Species	# Fish	Location of Plant	Origin of Stock
1978	Steelhead	No Data		
	Coho	1,500	Monterey Bay	Ten Mile River
1979	Steelhead	No Data		
	Coho	8,800	Monterey Bay	Noyo River
	Steelhead	No Data		
	Coho	9,540	Monterey Bay	Noyo River
	Steelhead	17,040	Pajaro River	Mad River
	Coho	No Data		
1982	Steelhead	20,385	San Lorenzo River	Mad River
		22,650	Pajaro R.	Mad River
	Coho	No Data		
	No Data			
1984	Steelhead	13,500	San Lorenzo River	Carmel River
		26,625	San Lorenzo River	Russian River
		4,900	Big Creek	Carmel River
		3,260	Big Creek	Scott Creek
		41,277	Carmel River	Carmel River
		12,375	Soquel Creek	Carmel River
		7,500	Soquel Creek	Russian River
		8,200	Pajaro River Tribs.	Carmel River
		17,000	Parjaro River	Russian River
	Coho	17,160	San Lorenzo River	Russian River
1985	Steelhead	24,586	San Lorenzo River	Russian River
		3,835	Big Creek	Scott Creek
		9,604	Soquel Creek	Russian River
		6,750	Pajaro River	Russian River
		5,145	Uvas Creek	Russian River
		5,635	Arroyo Seco River	Russian River
	Coho	428	Big Creek	Scott Creek
1986	Steelhead	28,900	San Lorenzo River	Scott Creek
		9,200	Big Creek	Scott Creek
		6,000	Soquel Creek	Scott Creek
		7,800	Uvas Creek	Scott Creek
		5,200	Llagas Creek	Scott Creek
		7,000	Corralitos Creek	Scott Creek
		12,500	Arroyo Seco River	Scott Creek

(cont. Table 4)

Year	Species	# Fish	Location of Plant	Origin of Stock
1986	Coho	15,860	San Lorenzo River	Noyo River
1987	Steelhead	53,890	San Lorenzo River	Scott Creek
		9,212	Big Creek	Scott Creek
		21,450	Soquel Creek	Scott Creek
		28,600	Pajaro River	Scott Creek
		5,200	Arroyo Seco River	Scott Creek
	Coho	No Plants		
1988	Steelhead	35,746	San Lorenzo River	Scott Creek
		1,000	Scott Creek	Scott Creek
		17,970	Soquel Creek	Scott Creek
		5,700	Pajaro River	Scott Creek
		10,840	Uvas Creek	Scott Creek
		5,000	Corralitos Creek	Scott Creek
		3,000	Browns Creek	Scott Creek
		12,040	Branciforte Creek	Scott Creek
		4,500	Salinas River	Scott Creek
	Coho	20,822	San Lorenzo River	Noyo River
		5,997	San Lorenzo River	Scott Creek
		2,450	Scott Creek	Scott Creek
1989	Steelhead	37,245	San Lorenzo River	Scott Creek
		4,930	Scott Creek	Scott Creek
		1,000	Sempervirons Res.	Scott Creek
		11,620	Soquel Creek	Scott Creek
		14,700	Pajaro River	Scott Creek
	Coho	25,362	San Lorenzo River	Noyo River
		2,756	Scott Creek	Scott Creek
1990	Steelhead	53,645	San Lorenzo River	San Lorenzo R.
		8,715	San Lorenzo River	Scott Creek
		7,611	Scott Creek	Scott Creek
		1,000	Sempervirons Res.	Scott Creek
		14,710	Soquel Creek	San Lorenzo R.
		5,590	Soquel Creek	Scott Creek
		19,866	Pajaro River	San Lorenzo R.
	Coho	34,500	San Lorenzo River	Prairie Creek
		6,552	Scott Creek	Scott Creek
1991	Steelhead	47,112	San Lorenzo River	San Lorenzo R.
		19,048	San Lorenzo River	Scott Creek
		9,745	Scott Creek	Scott Creek
		18,080	Soquel Creek	San Lorenzo R.
		11,150	Pajaro River	San Lorenzo R.
		6,650	Corralitos Creek	San Lorenzo R.
		15,345	Salinas River	San Lorenzo R.
		16,955	Carmel River	Carmel River

(cont. Table 4)

Year	Species	# Fish	Location of Plant	Origin of Stock
1991	Coho	19,880	San Lorenzo River	San Lorenzo R.
		5,040	San Lorenzo River	Scott Creek
		5,460	Scott Creek	Scott Creek
1992	Steelhead	60,861	San Lorenzo River	San Lorenzo R.
		7,502	Scott Creek	Scott Creek
		11,648	Soquel Creek	San Lorenzo R.
		10,509	Pajaro River	San Lorenzo R.
		7,728	Uvas Creek	San Lorenzo R.
		230	Tar Creek	San Lorenzo R.
		506	Little Arthur Creek	San Lorenzo R.
		5,115	Corralitos Creek	San Lorenzo R.
		828	Pescadero Creek	San Lorenzo R.
		10,090	Salinas River	San Lorenzo R.
		102,777	Carmel River	Carmel River
	Coho	1,872	San Lorenzo River	San Lorenzo R.
1993	Steelhead	34,377	San Lorenzo River	San Lorenzo R.
		3,360	San Lorenzo River	Scott Creek
		10,070	Scott Creek	Scott Creek
		12,224	Soquel Creek	Scott Creek
		4,770	Pajaro River	San Lorenzo R.
		5,970	Uvas Creek	San Lorenzo R.
		3,350	Bean Creek	San Lorenzo R.
		1,241	Little Arthur Creek	San Lorenzo R.
		1,095	Bodfish Creek	San Lorenzo R.
		6,570	Corralitos Creek	Scott Creek
		2,940	San Vicente Creek	Scott Creek
		8,020	Arroyo Seco River	San Lorenzo R.
		9,812	Carmel River	Carmel River
	Coho	11,808	San Lorenzo River	San Lorenzo R.
		1,860	Scott Creek	Scott Creek