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December 21, 1993

Director

Executive Director

Request of the Department of 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.

Attached is the petition the Commission received from the Santa Cruz County Fish and Game Advisory Commission on December 16, 1993. Pursuant to Section 2073 of the Fish and Game Code, the Commission is referring the petition to the Department for its evaluation. As required by Section 2073.5 of the Fish and Game Code, please provide the Department's recommendations to the Commission within 90 days from receipt of this memo.

Thank you for your assistance in this matter.

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Robert R. Treanor

Attachment

cc: Deputy Director Petrovich
Natural Heritage Division
Region 3
Fish and Game - Monterey

A PETITION TO THE STATE OF CALIFORNIA FISH AND GAME COMMISSION

For action pursuant to Section 670.1, Title 14, California Code of Regulations (CCR), and sections 2072 and 2073 of the Fish and Game Code, relating to listing and delisting endangered and threatened species of plants and animals.

I. SPECIES BEING PETITIONED:

Common Name: Coho salmon

Scientific Name: Oncorhynchus kisutch

II. RECOMMENDED ACTION (check the appropriate categories):

XXX List ____ Change Status

____ as Endangered from: ____

XXX as Threatened to: ____

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CALIFORNIA
FISH AND GAME
COMMISSION
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III. AUTHOR OF PETITION:

Name: Dave Hope

Address: 701 Ocean Street, Room 406-B

Santa Cruz, CA 95060

Telephone Number: (408) 454-3096

I hereby certify that, to the best of my knowledge, all statements made in this petition are true and complete.

Signature: Dave Hope

Date: December 13, 1993

EXECUTIVE SUMMARY

SUMMARY OF COASTAL SOUTH OF SAN FRANCISCO BAY COHO SALMON POPULATIONS

The Santa Cruz County Fish and Game Advisory Commission is formally petitioning the California Fish and Game Commission to list the coho salmon populations south of San Francisco Bay (central coast coho salmon) as a threatened species, pursuant to the California Code of Regulations. These populations of coho salmon have declined at an alarming rate. In the last 30 years 11 of the 13 streams known to have coho salmon in this region have completely lost their runs of these locally adapted stocks, leaving only two streams with self sustaining runs of salmon, Scott and Waddell Creeks. The coho using these streams are genetically, behaviorally, and physically distinct stocks of coho salmon that are adapted to and self sustaining in their last two remaining natal streams.

The petition is warranted because these last two refuges of central coast coho are in jeopardy of going extinct if action is not taken immediately. All efforts possible have been taken by the County of Santa Cruz to stem the losses, but we believe and the data shows that the loss of the central coast coho salmon will occur soon without the special protections afforded by State Threatened Species designation.

This listing is requested after considerable review of this issue by staff and Commissioners. The review showed that although few studies have been conducted in the last 50 years, recent evidence exists that streams to the north and south of Waddell and Scott Creeks appear to have completely lost their runs of coho salmon. Waddell and Scott Creeks have lost over 90% of their average documented runs of 50 years ago and declines of from 95% to 98% are evidenced from estimates of the historical runs in the 1800's.

When reviewing the following description of factors which threaten the continued existence of central coast coho, it should be noted that many of these factors combine to produce cumulative effects. For instance, natural predation, which is normally not critical to the survival of a population, has assumed increased significance due to depressed numbers and other pressures on the population. Some of the present threats to the coho salmon come from disease, stream dewatering, lagoon degradation/constrictions, habitat degradation in the lower stream sections, over-exploitation, and poaching.

Lack of summer water due to overuse of drought-limited flow, coupled with a generalized degradation of stream habitat due to excessive bedload accumulations, has contributed to the serious decline in quality coho habitat. Habitat conditions have been degraded due to land use practices that have caused sedimentation and a loss of deep pools. Large woody debris that provides valuable cover and helps create deep pools has been removed and due to the lack of old growth component is not as abundant as needed. Side channel habitats are currently rare, and when the streams are dewatered, no habitat remains for any aquatic life in the lower stream section and lagoon areas, critical habitats for juvenile coho salmon during the summer months.

An additional threat to the coho salmon comes from disease. Studies being conducted on Bacterial Kidney Disease (BKD) show that this disease is rampant in the local coho salmon populations. All coho salmon tested in the Scott and Waddell Creeks tested positive for BKD. The data to date show that this dis-

ease is a serious problem for coho salmon (Dr. W. Cox, California Department of Fish and Game).

In 1991, a census of salmon returning to the San Lorenzo River by the Monterey Bay Salmon and Trout Project (MBSTP) staff showed that a part of the winter migration of coho salmon may also have been lost to marine mammals. (Monterey Bay Salmon and Trout Project, personal communication.) The recent population increase in sea mammals locally coupled with the effects of the drought has caused losses in returning adult and in general depleted spawning runs. The drought reduced flows have not opened sand bars at the mouth of the rivers and streams until February or March in some years. This allows schooled fish to become prey to sea mammals and blocks migration of the returning adults.

Instream competition for "wild" coho can come from hold over hatchery steelhead and coho smolts, illegally stocked rainbow trout and to a lesser extent "wild" steelhead in Scott Creek (Weldon Jones, personal communication; Shapovalov and Taft, 1954). Steelhead and coho salmon normally exist side-by-side without serious losses if stream conditions provide adequate cover, deep pools and glides. Degraded habitat has caused increased competition which has reduced the stream's carrying capacity for coho salmon. Predation and competition is also intensified because of the disproportionate size difference between hatchery steelhead and coho and "wild" coho. This artificial situation adds an additional predator to the system an in an area already lacking in pools and cover needed for escape.

SCOTT SMITH

To reduce predation and competition, habitat conditions should be improved. If not corrected these conditions could lead to a total loss of coho over the next 10 to 20 years. To survive predation coho need cover and other preferred habitats readily available, deep pools which provide cover and also provide refuge from warm surface waters. Lack of habitat and cover created by artificial dewatering has increased predation by other natural enemies such as raccoons, garter snakes, egrets, kingfishers and herons. If we expect to save the remaining coho populations in this region, there is a critical need to improve these vital coho habitats by increasing summer flows, improving and stabilizing spawning habitat and creating better pool and rearing conditions to reduce the effects predation and critically warm water temperatures.

Hatchery practices and water usages must also be adapted to reduce artificial competition in this critical habitat for central coast coho. Introduction of hatchery smolts has lead to increased predation on Scott Creek. These losses are considered to play a role in the decline of these coho salmon populations, the significance has increased due to the limited number of juvenile coho supported by these streams.

Central coast coho have been faced with limited spawning and rearing habitat for most of the years since the original clear-cut logging. The resulting reduction in reproduction has caused populations to be depressed for a long period of time. The ability of these depressed populations to recover from floods or drought events has been severely limited by the generally low population levels.

Available habitat on Waddell Creek, for instance, is not adequate to produce the 4,000 to 8,000 juvenile coho needed to produce spawning runs of 200 to 400 adults that can sustain the populations through further stochastic events

(Waples and Teel, 1990). Dr. Jerry Smith has conducted studies that show there are presently coho habitats that are not occupied. An underutilization of the preferred habitat by local cohos does not indicate that there is an overabundance of coho habitat. This situation does appear to suggest that coho do not exist in numbers adequate to fill the existing habitat or to sustain natural production over a long period of time.

Salmon have clearly evolved in and are accustom to a system that has occasional huge upheavals and they are adapted for survival in this environment. It must be made clear that it is the addition of numerous chronic negative effects that ultimately weakens the species and causes long term reduction in populations that finally leads to extinction (Dave Hope personal observation).

The ocean commercial and sport take of salmon on the central coast is established from estimates of runs from Oregon, northern California and Sacramento River coho and chinook salmon populations. Because the local coho salmon share ocean migration routes with these salmon populations, they can be incidentally harvested at rates beyond their capacity to sustain minimal escapement goals. With every return adult being critical, any losses can be considered excessive and adjustments in ocean harvest must be enacted to protect these stocks. In steam fishing can also be very detrimental, in reviewing 1990 through 1993 returns on Scott Creek (Monterey Bay Salmon and Trout Project (MBSTP), if 2 females were caught instream, 15 to 100% of the returning spawners would be lost. The existing allocations for Ocean commercial and sport fishing, combined with stream sport fishing, are problematic for the dwindling central coast coho spawning runs.

EVOLUTIONARILY SIGNIFICANT UNIT

South of San Francisco Bay or central coast coho salmon originated from specific watersheds and return to those streams to spawn, creating reproductive isolation of groups, or stocks, of salmon (Ricker, 1972). Because the central coast coho are separated by 50 miles from any other northern California coho stream (a long-standing condition), they may be considered a genetically isolated stock of Pacific salmon (Waples, 1991). The populations of central coast coho should be considered a distinct population segment of Pacific coast salmon, because these fish are reproductively isolated from north of San Francisco Bay coho salmon. The coho remaining in the central coast region of California as exhibited in Scott and Waddell creeks, are genetically , behaviorally and physically distinct stocks of coho salmon that are adapted to and self sustaining in their last two remaining natal streams.

Researchers have found that salmon populations can maintain genetic isolation even if one individual per year from an outside population enters and spawns with a given stock of salmon (Wright, 1978). This threshold is referred to as the maximum allowable gene flow rate. Studies on Scott and Waddell Creeks have shown that 15% to 26% of cohos respectively, may stray to streams up to 5 miles away (Shapovalov and Taft, 1954). This study also shows that a mere 1% of coho strayed to the San Lorenzo River, 13.5 miles away. In the case of central coast coho salmon, considering the limited straying rate of 15 miles the likelihood of fish straying 50 miles south from Marin County or 50 miles north from San Mateo County is so remote that justification for isolation is strong. Therefore the isolation of central coast salmon is both behaviorally and -

geographically founded and the declaration as a stock of pacific salmon is justified.

Given the great distance between Marin and San Mateo County it is unlikely that the maximum allowable gene flow rate has been exceeded until hatchery stocks were introduced in the early 1900's.

The first hatchery plantings did move coho in from outside stocks, the first plants were conducted in 1913. Because this may have brought in other stock genes, we must then consider what possible effects hatchery plantings may have had on central coast coho genetics. Table 1 is an excerpt from data compiled on hatchery fish plants into the central coast of California (this report is considered to be the most comprehensive research into hatchery plants ever compiled and is complete and up to date) (Streig, 1991).

TABLE 1

COHO SALMON

Coho Salmon Hatchery Plants and Returns

Fingerling Plants July-September	Fingerling Plants SCOTT	Fingerling Plants WADDELL	Source of Fish	Year	Adult Returns SCOTT	Adult Returns WADDELL
1909	None	None		1908-09	1,295*	N/A
1910	None	None		1909-10		
1911	None	None		1910-11	N/A	
1912	None	None		1911-12		
1913	25,000	15,000	Sisson	1912-13	N/A	
1914	None	None		1913-14		
1915	25,000	18,000	Sisson	1914-15		
to						
1928	None	None		1927-28		
1929	25,000	22,700	Unknown	1928-29	333*	N/A
1930	36,700	30,000	Unknown	1929-30	150*	N/A
1931				1930-31	N/A	409**
1932	15,000	None	Unknown	1931-32	N/A	748**
1933	18,592	16,005	Prairie Cr	1932-33	N/A	131**
1934	15,020	None	Unknown	1933-34	138*	395**
1935	10,000	None	Unknown	1934-35		111**
1936	5,248	None	Unknown	1935-36	72*	130**
1937	81,275	None	Unknown	1936-37	513**	279**
1938	77,060	None	Unknown	1937-38	681*	279**
1939	53,518	None	Unknown	1938-39	374*	324**
to						
1965	None	None	None	1964-65		
1966	None	10,000	Darrah Spr	1965-66		
1967	10,000	None	Darrah Spr	1966-67		
1968	# unknown	None	Noyo	1967-68		
1969	None	None	None	1968-69		
1970	None	# unknown	Noyo	1969-70		
1971	None	# unknown	Trinity	1970-71		
1972	None	None				
to						
1992	None	None				

*Estimates taken from Scotts Creek egg taking station. Egg production was divided by 2,700 (average female egg production) times 1.5. This formula assumes all females were trapped that year and a 60 to 40 male to female spawning run (Shapovalov and Taft, 1954; Streig, 1991).

**Shapovalov and Taft, 1954, FB #98, Table 10-11

N/A - Not available

Table 1 indicates that during 14 of the last 79 years on Scott Creek and 8 of the last 79 years on Waddell Creek, hatchery plants from an outside source

occurred. On Waddell Creek there were five fingerling plants between 1913 and 1933, three plants between 1966 and 1971 and no hatchery plants in the last 22 years. What is of greatest significance is that no hatchery plants have been made on Waddell Creek in the last 22 years and only three plants (that were all trapped upon return) in the last 60 years. Scott Creek has had only two plants from outside sources in the last 54 years. THE STOCKS OF COHO IN SCOTT AND WADDELL CREEKS HAVE BEEN SELF SUSTAINING FOR MORE THAN TWO DECADES AND HAVE WITH ONLY MINOR INFLUENCE HAVE BEEN SELF SUSTAINING FOR AT LEAST FIFTY TO SIXTY YEARS.

The effect these hatchery plants had on genetic makeup of local coho populations should be viewed by using extensive genetic testing to determine their exact makeup. But in light of the limits of the existing science, several factors should be considered as reasons for limited genetic mixing with hatchery plants. With sporadic fingerling plants, it is unknown whether these hatchery coho survive to return and mix with the wild coho at rates high enough to influence the genetic makeup. This is due to the reduced survival of coho transplants from foreign streams (R. Reisenbichler, 1988).

There are reasons to believe that many planted fingerlings don't survive, due to a lack of predator avoidance skills possessed at the time when they are placed in the stream. In addition, feeding behavior is not well established in hatchery fingerlings due to their time spent as hand-fed young. In Pacific salmon, adaptation to local environments creates unique characteristics that increase fitness within a stock (E. Mayr, 1971). The non-native hatchery coho used within Santa Cruz County were derived from stream habitats that are dissimilar from local streams. Generally poor spawning conditions, high sediment loads and late winter storms create special conditions that require local adaptations which few other anadromous fish possess. These conditions are coupled with generally warmer waters, resulting in an overall success rate of transplanted hatchery stocks which approaches zero.

There has been much local discussion on behavioral differences between salmon from other locations. Observational evidence indicates coho plants from outside sources (northern California, Oregon, Washington), do not fare well in local streams (MBSTP). The difference in timing of return runs is especially evident in hatchery fish from other locations (D. Streig, personal communication). The return spawning runs of hatchery fish have been documented as early as August and generally from September through November (MBSTP Staff). The success of early run coho in accessing spawning grounds during the early fall period is poor, at best, due to the closure of the river mouths by sand bars (Shapovalov and Taft, 1954; Smith, 1990). Survival of eggs in these early run coho spawning redds is also poor due to the disturbance of the extremely mobile bedload and high sediment input from storms that occur from December to as late as March and April (Smith, personal communication).

Spawning success for early run hatchery fish under these circumstances is very poor. In reviewing the literature on hatchery return runs, their success at sea is poor, as documented by the lower percentage return rates (Chilcote, Leider, Lock; 1986). In the case of coho, hatchery reared smolts have not shown the same tenacity for producing adult returns as have naturally produced fish (McMahon, 1983). All of these factors reduce the total number of hatchery plants which have returned to mix with the "wild" stocks, as evidenced by Table 2.

TABLE 2

WADDELL CREEK DATA

Plant* Year	Plants	Year	Downstream Migrants	Returning Adults	Age Class 1/1	Age Class 1/2	
1930	30,000*	1930-31					
1931		1931-32		748	137*	611	
1932		1932-33		131	22	109*	246*
1933	16,005**	1933-34	3,430**	395	85	310	
1934		1934-35	3,573	111	4**	107	
1935		1935-36	4,911	130	34	96**	100**
1936		1936-37	1,067	279	24	255	
1937		1937-38	1,926	279	64	217	
1938		1938-39	852	324	71	253	
1939		1939-40	1,740	317	No data	No data	
1940		1940-41	152	288	No data	No data	
1941		1941-42	711	260	No data	No data	

Data taken from Shapovalov and Taft, 1954, Table 10-11

"Wild" Downstream Migrants	Adult Returns	%	Hatchery Plants or Plants + D.S. Migrants		Adult Returns	%
3,573	284	4.9	*P	30,000	246	.82
4,911	241	4.9	**P+D.S.	19,435	100	.51
1,067	417	39.0				

This table shows that very few fish returned to spawn in the years following hatchery plants. The return of 1/1 males and all 1/2 males and females show that the 1930 plant of 30,000 fingerlings combined with the "wild" coho produced 137 1/1 males and 109 1/2 males and females. The 1933 plant of 16,005 fingerlings combined with 3,430 wild juvenile to produce 4 1/1 male and 96 1/2 male and females. The data indicates a low rate of return for these years, suggesting that the influence on genetic makeup by hatchery plants may be less than would be assumed by merely reviewing the number of fish originally planted.

Average return runs of coho salmon subtracting years of influence by plant was 4.9%, 4.9% and 39% (Table 2) during the Shapovalov and Taft study. Average returns for years including planting were 0.82% and 0.51%.

These figures do not take into account other factors that may influence the coho salmon return, but they do show that hatchery plants were probably not successful in returning great numbers of adults to affect the native populations.

It has been reported that as soon as the hatchery plants on many local streams were stopped, the coho salmon population crashed, some to extinction (Streig, personal communication). The San Lorenzo River is an example of this phenomenon. The extensive planting of fish from northern California streams and elsewhere appear to have helped to drive out native populations and created hatchery runs that were not able to sustain themselves after the hatchery program ceased (MBSTP).

Since hatchery plants from outside sources were discontinued 22 years ago, the remaining coho salmon runs on Scott and Waddell Creeks appear to be remnants of those "native" coho that could survive both the negative effects of hatchery plantings including some minor genetic mixing from sporadic fingerling plants. The poor survival rate of hatchery plants in general compared to the 5%-30% survival rate of native coho reported by Shapovalov and Taft (Table 2) also supports the assertion. The rate of gene influence by hatchery fish should not be considered adequate to remove important genetic differences between central coast coho salmon and north of San Francisco coho salmon. The fact that these stocks of coho are self sustaining even in the face of a BKD epidemic and abusive land practices gives credence to their adapting to the local conditions. (Silver-King Oceanic farms operated a commercial salmon ranching facility near Waddell Creek from 1967 through 1972. This facility trapped all returning fish, but some strays were noted by the Monterey Bay Salmon and Trout Project staff. The number of strays was not documented.)

"The existence of stocks, as defined by Ricker (1972), is no longer in doubt. The subdivision of a species into local populations which posses genetic differences that are adaptive is the fundamental basis of the stock concept, and it is this concept that must be incorporated into management if fishery reserves are to be restored and maintained" (MacLean and Evans, 1981). "We recognize that many instances will arise where there is doubt about the existence of a stock and insufficient evidence to remove the doubt. In those cases, we believe the prudent manager will recognize the stock in question until such time that enough evidence is collected to show otherwise. Since the loss of a stock is an irreversible loss, its existence should be given the benefit of any doubt" (Nehlsen, Williams and Lichatowich, 1991).

SPECIES DESCRIPTION AND BIOLOGY

COHO SALMON - Oncorhynchus kisutch

Coho salmon are widely distributed in streams along the California coast and are important to sport and commercial fisheries. Their life history is well known because one of the southernmost populations was the subject of the classic life history study by Shapovalov and Taft, 1954. They have adapted to the unpredictable conditions present in most California coastal streams. Coho salmon, nevertheless, have demanding habitat requirements and are most abundant in least disturbed, heavily forested watersheds. They move upstream in response to an increase in stream flows caused by fall storms, especially in small streams when water temperatures are 39-57 degrees F. Spawning sites are typically at the head of riffles or tail of pools where there ideally are beds of loose, silt-free, course gravel and where cover exists nearby for the adults. Optimal temperatures for development of the embryos in the gravel is 43-50 degrees F. Juveniles prefer deep (greater than 3 feet), well shaded

pools with plenty of overhead cover. Juveniles prefer water temperatures of 50-59 degrees F and demand high oxygen and food (invertebrates) levels. High turbidity is detrimental to emergence, feeding and growth of young coho.

Description: These are fairly large salmon, with spawning adults typically attaining 22 to 28 inches in length and weighing 6.5-13.2 pounds. They have 9-12 dorsal fin rays, 12-17 anal fin rays, 13-16 pectoral fin rays, and 9-11 pelvic fin rays. Lateral line scales number from 121-148 and the scales are pored. 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 half of the first arch.

Spawning adults are dark and drab. The head and back are dark 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, and a slightly humped back. Both sexes have small black spots on the back, dorsal fin, and upper lobe of the caudal fin. The gums of the lower jaw are gray, except the upper area at the base of the teeth which is generally whitish (Fry, 1973). Parr have 8-12 narrow parr marks centered along the lateral line. The marks are narrow and widely spaced. The adipose fin is finely speckled, imparting to it a gray color, but the other fins lack spots and are tinted orange.

Taxonomic Relationships

Coho salmon are one of five species of Pacific salmon (Oncorhynchus) found in California. They do not appear to have the genetically distinct, temporally segregated runs that characterize the more abundant chinook salmon and steelhead trout. However, the strong homing abilities of coho salmon make it likely that each coastal stream has a distinctive strain of coho adapted to local environmental conditions. For the purposes of this section, the coho populations are divided into big-river coho salmon and short-run coho salmon. Big-river cohos are those that migrate up large river systems 65-130 miles or more to spawn in the river tributaries. They typically start entering the streams in September or October, somewhat earlier than short-run coho. In the Klamath River and some other systems, much of the production of the big-river fish takes place in hatcheries.

Short-run coho salmon occupy the smaller coastal streams and the tributaries of the lower reaches of the big rivers and rarely migrate more than 65 miles upstream. These populations in any one stream system are typically small and highly dependent on natural reproduction. Overall, coho populations in California are the southernmost for the species and have adapted to the extreme conditions (for salmon) of many coastal streams. From Mendocino County south, the conditions in California are even more extreme. The physical, climatic, and hydrologic factors make coho salmon survival in the far southern end of the range even more rigorous.

Life History

The life history of the coho salmon in California has been well documented by Shapovalov and Taft (1954) and Hassler (1987). Most coho salmon return to their parent streams to spawn after spending two years in the ocean (up to three years in Alaska). Jack males may, however, return after one growing