BIOLOGICAL ASSESSMENT

for

The Fishery Management Plan for Commercial and Recreational Salmon Fisheries off the Coasts of Washington, Oregon, and California as it affects the Sacramento River Winter Chinook Salmon

National Marine Fisheries Service Southwest Region
Fisheries Management Division
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INTRODUCTION

Each year, the Pacific Fishery Management Council (Council) submits management measures for the ocean salmon fisheries off California, Oregon and Washington to the Secretary of Commerce for approval. The management measures must be developed in accordance with an Ocean Salmon Fishery Management Plan (FMP) and, in addition, must meet the requirements of any Biological Opinions issued by the National Marine Fisheries Service (NMFS) following formal consultation under Section 7 of the Endangered Species Act (ESA) on the impacts of the ocean salmon fishery on populations of salmon listed as threatened or endangered under the ESA. Sacramento River winter chinook were listed as a threatened species in 1989 and NMFS concluded a formal consultation on the impacts of ocean harvest in 1991, prior to the ocean fishing season. The Biological Opinion issued from that consultation concluded that the 1990 level of incidental harvest by ocean fisheries would not prevent the recovery of winter chinook salmon.

Since 1989, the winter chinook population, while no longer declining, has shown little, if any, growth, despite improvements to spawning, juvenile rearing, and migration habitats. The purpose of this biological assessment is to re-evaluate the effects of the continued implementation of the FMP, as constrained by the 1991 Biological Opinion, on the recovery of Sacramento River winter chinook. The assessment will be used in a formal consultation between the Protected Species Division and the Management Division, NMFS, Southwest Region, being conducted under Section 7 of the ESA. Although the Council develops the annual salmon management measures, the Magnuson Fishery Conservation and Management Act gives the Secretary of Commerce ultimate authority to implement them. Thus, the formal consultation must be conducted within NMFS, as both the action agency and the consulting agency.

This assessment will describe the listing history of winter chinook, the management of the recreational and commercial ocean fisheries for salmon, and the biology of winter chinook salmon. It will also review winter chinook ocean harvest information obtained since the issuance of the 1991 Biological Opinion and evaluate what effects the fishery may be having on the recovery of the species.

LISTING HISTORY

Between 1970 and 1989, the number of adult winter chinook salmon returning to spawn in the Sacramento River declined from 40,000 to 500. The primary cause of the collapse was the degradation of spawning, rearing and migration habitats in the Sacramento River and Sacramento-San Joaquin Delta. In 1985, NMFS received a petition to list the species as threatened under the ESA. Sacramento winter chinook was listed as a threatened species under the ESA emergency listing procedures by NMFS on August 4, 1989, and was formally added to the list of threatened and endangered species on November 5, 1990. The species was reclassified as endangered on January 4, 1994.

NMFS has issued over 20 Biological Opinions on winter chinook, addressing a wide range of activities that impact the species in the river and delta. On March 1, 1991, NMFS issued a Biological Opinion on the Salmon FMP. The opinion concludes that the fishery as managed under the FMP is not likely to jeopardize the continued existence of winter chinook and the accompanying Incidental Take Statement authorizes the take of winter chinook in the ocean fisheries which occur lawfully under the fishing regulations. The Biological Opinion referred to throughout this assessment is the ocean harvest Opinion issued March 1, 1991.

LIFE HISTORY OF SACRAMENTO RIVER WINTER CHINOOK

Chinook salmon are categorized into separate races or runs according to the time when adults enter fresh water to begin their spawning migration. Four distinct runs of chinook exist in the Sacramento: fall, late fall, winter, and spring. It is believed that prior to the construction of Shasta Dam (completed in 1945), winter chinook spawned in the highest portions of the headwaters of the Sacramento, in streams fed mainly by the flow of constant-temperature springs. The completion of Shasta Dam cut off all access to streams above the dam, but release of cold water from Shasta Reservoir created conditions that were favorable to winter chinook in the mainstem Sacramento below the dam. Winter chinook currently spawn in the mainstem of the Sacramento from Redding downstream to Tehama, just below Red Bluff Diversion Dam (RBDD).

The timing of various life history stages of winter chinook is summarized in Figure 1. Winter chinook begin to enter San Francisco Bay in November and their migration past RBDD begins in mid December and continues into early August. The majority of the run passes RBDD between January and May, with the peak in mid-March (Hallock and Fisher 1985). Spawning occurs from late April to mid August with peak activity in May and June.

Winter chinook mature and return to the river to spawn at the beginning of their second (returning age 2 fish are called grilse or jacks), third, or fourth year of life, as measured from the time their parents entered the river. Thus, unlike the fall race, which is vulnerable to the ocean fisheries (primarily the recreational fishery) prior to the time the grilse enter the river, winter chinook grilse enter the river before any significant fishery impacts occur. This is due to the fact that at the end of a single ocean growth season in October they are not large enough to be vulnerable to ocean fisheries, and the majority of the grilse that are destined to mature enter the river before the start of the next season in March. Winter chinook maturing at the start of their third year of life (small adults) have been subjected to one full fishing season, and those maturing at the start of their fourth year of life (larger adults) have been subjected to two fishing seasons. Throughout this assessment, winter chinook that do not mature as grilse will be referred to as age 2+ fish in the ocean fisheries and the following year's spawning escapement will be called age 3 fish. Those that do not mature at age 3 as small adults will be called age 3+ fish, all of which are considered to mature at age 4.

The fecundity of winter chinook is low. Hallock and Fisher reported the average number of eggs taken from 234 females spawned at Coleman National Fish Hatchery to be 3,353 (range from

2,500 to 4,453). This compares with average fecundity reported by Healey and Heard (1984) for Sacramento chinook (presumably fall chinook) of 7,295 (range from 4,295 to 11,012). The range of mean fecundities for 18 other reported chinook populations was 3,634 to 10,622. Although complex relationships exist among age-specific life history parameters such as size, fecundity, maturity, mortality, and productivity, such a large difference in fecundity could put winter chinook at a disadvantage, compared to other chinook runs, especially with regard to the rate at which winter chinook would be expected to recover from extremely low population levels.

MANAGEMENT OF THE OCEAN FISHERY FOR SALMON

Pacific salmon support important commercial and recreational fisheries off the coasts of California, Oregon, and Washington. Recent chinook salmon harvests are summarized in Appendix II. The management of the resource is complex, involving many stocks that originate from various rivers, multiple fishing gear types, and several management jurisdictions. The ocean fisheries are managed between 3 and 200 miles by the Council under a framework FMP; within 3 miles they are managed by the states and treaty tribes under regulations consistent with the FMP. The framework FMP provides the mechanism to make pre-season and in-season management adjustments to respond to changes in stock abundance, socio-economic changes and other variations in the fishery. Annual management specifications may include allowable ocean harvest levels, allocations, management boundaries and zones, minimum length restrictions, recreational daily bag limits, fishing gear restrictions, quotas, seasons, and selective fisheries.

Management of the ocean fisheries in California seeks to achieve two fall chinook salmon spawning escapement goals: one for the Klamath-Trinity River system and the other for the Sacramento and San Joaquin Rivers in California's Central Valley (CV). The indicator stock for the CV is Sacramento River fall chinook, for which the FMP specifies a spawning escapement goal of between 122,000 and 180,000 combined hatchery and natural adults. The methodology used by the Council to estimate ocean fishery impacts and spawning escapement of Sacramento River fall chinook has been generally the same since 1984. An index of CV chinook abundance (the Central Valley Index, or CVI), is used in projecting the annual escapement of CV fall chinook. The CVI is the annual sum of ocean fishery landings south of Point Arena and the spawning escapement of adult CV chinook stocks in the same year. A harvest rate on CV stocks is approximated by the CV ocean exploitation index, which is the landings south of Point Arena divided by the CVI.

Considerable uncertainty is associated with the pre-season estimates of the CVI and the CV ocean exploitation index, due primarily to variations in CV chinook stock contributions to the ocean fisheries south of Point Arena and variable maturity schedules and survival that are not accounted for in the predictor. In addition, the CVI and the ocean exploitation index are themselves only crude approximations of actual abundance and harvest rates of CV chinook; the Council's Salmon Technical Team has emphasized that the ocean exploitation index does not represent a harvest rate. Table 1 summarizes preseason and postseason estimates of the index since the issuance of the Biological Opinion. While the ocean exploitation index has been underestimated for the past

three years by substantial amounts, it has not exceeded the maximum value of 0.79 specified in the Biological Opinion.

Prior to the issuance of the 1991 Biological Opinion, the primary concern of the Council in developing the seasons off California was achieving the spawning escapement goals for Sacramento fall chinook and the Klamath fall chinook. The Incidental Take Statement of the Biological Opinion required that future impact indices not exceed the ocean exploitation index experienced in 1990, which was a record high 0.79. The ocean exploitation index is the best available surrogate for a harvest rate on CV chinook stocks and is the only long term measure of relative impact on winter chinook. Because of their maturity schedule and run timing, winter chinook experience a harvest rate significantly less than that which occurs for fall chinook, which comprise roughly 90 percent of the CVI. Since 1990, harvests of CV chinook have been restrained primarily by low abundances of Klamath fall chinook, as well as a large increase in the allocation of Klamath chinook to the in-river Indian harvest; the ocean exploitation index ceiling of 0.79 set by the Biological Opinion has not been a major factor in shaping seasons.

ASSESSMENT OF OCEAN IMPACTS

Harvest Rate

The impact of ocean harvest on the many races of west coast salmon is generally estimated from the recovery rates of tagged hatchery produced fish. These estimates assume similar behavior for hatchery raised salmon and salmon produced by naturally spawning fish in the same river basin. The more closely the two stocks are genetically related, the more likely it is that their behavior will coincide. Information on the contribution of winter chinook to ocean fisheries is available from two data sets. The first, referred to here as the fin clip data, was produced using wild winter chinook juveniles from the brood years 1969, 1970, and 1971. The fish were seined, fin clipped and released as juveniles; estimates of age at harvest and harvest rate were made based on the recovery of clipped fish (Hallock and Reisenbichler 1980, Hallock and Fisher 1985, CDFG 1989). Table 2 summarizes the ocean and in-river recoveries of the two broods with useable data (1969 and 1970); the ratios of catch to catch plus escapement (C/C+E) are 0.47 and 0.56 respectively. The C/C+E ratio is calculated by dividing ocean catches of age 2+ or older by the sum of ocean catches of age 2+ or older and river returns of age 3 or older. The fin clip data set was confounded by a duplicate mark used in other California and Oregon chinook studies. This problem was compensated for by assuming landings of marked fish south of Point Arena were winter chinook and catches of marked fish north of Point Arena were from other stocks. Data from the 1971 brood year are not included in the analyses because ocean fishery sample sizes were low for this year class.

The second data set is produced by the recovery of coded-wire tagged (CWT) winter chinook originating from Coleman National Fish Hatchery. These winter chinook are produced as part of the U.S. Fish and Wildlife Service's ongoing enhancement program in which artificially

propagated, CWT marked, winter chinook are released as fry into the upper Sacramento River. The first juvenile winter chinook from this program, the 1991 brood year, were released in 1992. During the 1993, 1994 and 1995 ocean salmon fishing seasons, CWTs from winter chinook were recovered in the ocean in the California Department of Fish and Game's (CDFG) fishing port monitoring program.

Brood stock for the hatchery reared winter chinook is selected only from adults returning to spawn naturally and in such a way as to maximize genetic diversity; all released hatchery winter chinook are marked with a CWT. The degree to which the hatchery reared winter chinook are different from wild winter chinook with regard to ocean distribution, vulnerability to fishing gear, and run timing is not known. However, in spite of the care taken in brood stock selection, recent genetic analysis suggests that Sacramento spring chinook have been misidentified as winter chinook and used for hatchery propagation at the U.S. Fish and Wildlife Service's Coleman National Fish Hatchery (Hedgecock 1995). The 1993 and 1994 brood year production were estimated to be 27 percent and 7 percent spring-winter hybrids respectively. The 1991 and 1992 brood years, however, appear to be pure winter chinook and the ocean and in-river tag recoveries from those broods would not have been affected by hybridization. There is no evidence that hybridization between the two runs occurs naturally in the upper Sacramento River.

Ocean recoveries of winter chinook CWTs, as reported by the Pacific States Marine Fisheries Commission Regional Mark Information System, are listed in Table 3 and summarized in Tables 4 and 5. During 1993, two CWTs originating from the 1991 brood year release were recovered in the ocean sport fishery. These two recoveries represent an estimated catch of 12 hatchery produced winter chinook when the sample is expanded for sampling rate. During 1994, eighteen winter chinook CWTs were recovered in the ocean salmon fisheries: one from brood year 1991 and seventeen from brood year 1992. When this sample is expanded for sampling rate, an estimated 107 hatchery produced winter chinook were caught in the 1994 fishery: 104 from brood year 1992, and three from brood year 1991. Of the estimated 104 fish from brood year 1992, nearly equal proportions were caught in the ocean recreational and commercial fisheries (50 in recreational, 54 in commercial). During 1995, four winter chinook CWTs were recovered in the ocean salmon fisheries, all from the 1993 brood. When expanded for sampling rate, this represents 22 hatchery produced winter chinook, all taken in the recreational fishery.

The first observations of CWT adult winter chinook returning to the river occurred in 1995, at RBDD and in Battle Creek. It appears that most, if not all, of the 1992 brood year hatchery reared winter chinook returned to spawn in Battle Creek instead of the mainstem Sacramento River, apparently having failed to imprint on the Sacramento River as juveniles. As a result, an escapement estimate was made for Battle Creek alone, based on observations of videotaped passage counts at the Coleman National Fish Hatchery's barrier dam on Battle Creek, and supported by stream surveys and carcass recoveries in Battle Creek (U.S. Fish and Wildlife Service 1995). The resulting escapement estimate is 88 hatchery-origin winter chinook for 1995, all of which are assumed to belong to the 1992 brood year (a total of 8 tags were actually recovered, all from the 1992 brood year).

The C/C+E ratio for the 1992 brood year is estimated at 0.54, assuming none return to spawn as age 4 adults in 1996. It is important to stress that this estimate is based on limited data. The release numbers of juvenile winter chinook are small compared to release numbers typically needed for statistical analyses. For example, CWT releases for Central Valley hatchery stocks usually need to be 100,000 juveniles per group to evaluate the distribution and timing of ocean catches with any statistical reliability. By contrast, Coleman National Fish Hatchery released only 10,866 juveniles from the 1991 winter chinook brood year, 27,383 from the 1992 brood year, and 17,034 from the 1993 brood year. In general, existing fishery monitoring levels cannot accurately quantify ocean impacts on a stock as rare as winter chinook. However, the recovery of tagged winter chinook both verifies the incidence of harvest, and provides a rough approximation of present ocean harvest impacts, which can be compared to previous estimates for winter chinook.

Recent Trend of Ocean Harvest of Winter Chinook

The data in Tables 2 and 4 suggest that the present ocean harvest level of winter chinook has not changed from catch levels of 20 years ago. The 1991 Biological Opinion cited an "ocean impact rate" of 0.346. This rate, which was actually a C/C+E ratio, was calculated using the returns from all three brood years of the fin clip data published by Hallock and Fisher and it included age 2 returns to the river in escapement. If age 2 returns are not included in the calculation, the C/C+E ratio becomes 0.48. The Klamath River fall chinook brood escapement rate, which is an E/C+E ratio, and the CV ocean exploitation index, which approximates a C/C+E ratio for Central Valley stocks, are both calculated using adult escapement; age two returns to the rivers are not counted because they are not considered an important biological component of spawning. It therefore seems inappropriate to include the return of age 2 winter chinook in spawning escapement, particularly if comparisons are then made with other harvest rates calculated using adult escapement only. The C/C+E ratios (0.47, 0.56 and 0.54) for 1969, 1970, and 1992 winter chinook brood years compare with a C/C+E ratio of 0.68 for Klamath fall chinook using the sum of adult catches (ocean and in-river) and spawning escapement for the years 1985-1994. The average of the CV ocean exploitation index is 0.70 for the same time period. Because no winter chinook CWTs from the 1991 brood year were recovered in the river, a C/C+E ratio cannot be computed for that brood.

Distribution of Harvest

The ocean distribution of winter chinook is thought to be similar to that of other CV chinook runs, which remain primarily in California coastal waters. Results from the fin clip data indicated that 77 percent of the winter chinook catch was landed at San Francisco and Monterey, and about 75 percent of that harvest occurred in the recreational fishery and 25 percent in the commercial fishery (Hallock and Reisenbichler 1980). Table 5 and Figures 2, 3, 4 and 5 show the distribution of tag returns from the fin clip recoveries and CWT recoveries by month and sector. Winter chinook were caught throughout the recreational and commercial fishing seasons, although fewer fish were caught in October and November. Most winter chinook (about 80 percent) were caught at age 2+. The recent CWT data are not sufficiently robust to statistically evaluate the distribution

and timing of fishery impacts. The data, however, generally parallel results from the fin clip study: CWT age 2+ winter chinook were recovered south of Point Arena throughout most of the recreational and commercial fishery seasons (Table 5).

Tables 6 and 7 present estimated CWT and fin clip recoveries from the sport and commercial fisheries and the total annual chinook harvest by each sector in California. The relative impacts of the two sectors on winter chinook are not as great as the two data sets would suggest. At the beginning of the sport season, the mean length of age 2+ winter chinook is just above the minimum recreational size limit of 20 inches (Figure 6). The troll fishery, like the sport fishery, contacts age 2+ winter chinook throughout the season. However because of the 26 inch minimum size limit, most age 2+ winter chinook are released by the troll prior to June or July when they become legal-sized. Consequently, few, if any, age 2+ CWTs are recovered in the spring troll and all CWT recoveries from the troll fishery are 26 inches or greater (Figure 7). The troll fishery nevertheless results in nonlanded mortality of fish 20 to 26 inches not accounted for in the CWT recoveries and both sectors cause some amount of nonlanded impacts on fish less than 20 inches. The mortality rate from the catch and release of sublegal-sized chinook is estimated by the Council to be 26 percent for the commercial fishery and 8 percent in the sport fishery; an additional 5 percent drop-off mortality is added for fish hooked but not landed. These rates are applied to the estimated number of sublegal-sized fish encountered in the fishery.

CURRENT STATUS OF WINTER CHINOOK AND REINITIATION OF CONSULTATION

The 1991 Biological Opinion's conclusion of "no jeopardy" with respect to the effect of ocean harvest on the recovery of winter chinook was based primarily on Hallock and Fisher's analysis of the fin clip data that indicated winter chinook experience a harvest rate less than that which occurs for the other three races of Sacramento chinook, due to their maturity schedule and run timing. The Biological Opinion concluded that because other west coast chinook stocks were managed at harvest rates greater than that for winter chinook and were not depressed, a harvest rate below these rates should not prevent the winter chinook population from growing. To ensure that the ocean harvest rate of winter chinook did not increase, the Biological Opinion required a two-week closure at the beginning and end of the normal recreational season south of Point Arena and prohibited the opening of the commercial season south of Point Area prior to May 1.

The Biological Opinion acknowledged that the productivity of winter chinook probably was less than that of other chinook stocks due to winter chinook's low fecundity and the large number of habitat problems in the Sacramento River that result in poor survival of eggs and juvenile salmon. Conditions in additional Biological Opinions issued by NMFS on the operations of State and Federal water projects have resulted in substantial progress in remedying major habitat problems, such as blockage of upstream migrants at RBDD, lethal temperatures in reaches of the river during spawning or while eggs are incubating, and the entrainment of juveniles at various diversions.

The continuing critically low spawning population and the new ocean catch information have provided the basis to reinitiate consultation on the Ocean Salmon FMP. Following the issuance of the 1991 Biological Opinion, the returning year class of 1991 declined by about 90 percent (from 2,094 to 191 adults). Since then, winter chinook spawning escapements have remained at extremely low levels, exhibiting little, if any, increases in size (Figures 8 and 9). Currently the only available method for estimating spawning abundance is from counts at RBDD during the time the gates are closed and migrating salmon are forced to use the fish ladder. Since 1986, the RBDD gates have been open during a substantial part of the run to improve adult fish passage conditions and the precision of the run estimate has declined significantly. The variance of the current run size estimate is 1.0; this means that the ratio of estimated to actual values varies between 0.36 and 2.72 (NMFS 1996). For example, the 1995 run size estimate of 1362 would have a range of 500 to 3700.

The recent CWT data on ocean harvest of winter chinook, limited though they are, are consistent with the earlier fin clip data with regard to ocean harvest levels and suggest that the C/C+E ratio has not been affected by the season and area restrictions imposed by the Biological Opinion. The winter chinook population currently consists of a single relatively strong year class represented in the 1992 and 1995 returns and two weaker year classes. Of particular concern is the year class represented by the 1991 and 1994 returns, which consisted of fewer than 100 females. This brood cycle will be impacted in 1996 ocean fisheries and will return to spawn primarily in 1997.

PROVISIONS OF THE FMP TO PROTECT WINTER CHINOOK

The FMP contains no provisions which specifically protect winter chinook. There is no spawning escapement goal for this race nor is it an objective of the FMP to provide for the recovery of listed populations. The annual process of setting seasons, quotas, and other ocean fishery management measures has included consideration of the need for ensuring that the impact of the fisheries on winter chinook does not exceed the maximum impact specified in the Biological Opinion of 1991. The time and area closures required in that Biological Opinion have been included each year in the measures adopted in advance of the fishing season. Specifically, the recreational fishery off central California has been shortened by approximately four weeks, beginning two weeks later, about March 1, and ending two weeks earlier, about November 1, compared to the seasons that existed before the winter chinook listing. In addition, during the month of March, an area outside the Golden Gate is closed to fishing to protect winter chinook migrating into the San Francisco Bay. These protective measures have been implemented annually since 1991, but have not been formally incorporated into the FMP.

Among the fishery management tools that currently are available for use under the FMP are the following: time and area closures, quotas, bag limits, species restrictions, minimum size limits, and gear restrictions.

- Time and area closures can be used to reduce fishing effort in an area when winter chinook are expected to congregate and to constitute a larger portion of the total chinook

catch than at other times and in other areas. Effective use of this tool requires knowledge of the distribution of winter chinook in the ocean throughout the fishing season. This information is usually gained from CWT recoveries over several years, but winter chinook data are very limited. Despite the data limitations, the seasonal closure of the area outside the Golden Gate has been employed based on an assumed migration timing of maturing fish through that area. CWT data from the 1992 brood year of winter chinook maturing the following year do not demonstrate a particular time, area or fishery that can be isolated as having a disproportionate impact on winter chinook.

! Quotas on the number of chinook that can be taken in an area or time period can be a useful tool in controlling fishery impact when the abundance of chinook can be forecast reliably. There is not currently a reliable forecast of the abundance of winter chinook or of total chinook abundance in the area where winter chinook are taken. As a result, quotas for the ocean fisheries would be subject to over- and underestimating the available number of chinook for harvest and the fraction of that harvest that would be winter chinook. Additional research and a longer time series for winter chinook may improve the utility of quotas in this fishery. Under quotas, fishers tend to fish earlier during the quota season, since it is not known if opportunity will exist later. South of Point Arena, this would have the effect of increasing catch in May and June.

! Recreational bag limits on the number of fish that an individual fisherman can land reduce the impact on fish stocks when the catch rates are high. Daily limits can be used to spread the impact of the fishery over a longer period and may afford more individuals an opportunity to participate. Daily limits can be combined with weekly or annual individual limits. There is currently a two salmon daily limit placed on the recreational fishermen in the area of concern. In general, the two fish bag limit is not constraining, except in times when fish are most available. Because the bag limit applies to all chinook, relying on bag limits to reduce winter chinook catches would reduce the total chinook landings proportionately.

! Species restrictions can be established which require the release of a salmon species that requires additional protection. The protected fish must be readily identifiable so that it can be released promptly when it is caught incidentally to the target fishery. This tool has been used to reduce coho impacts for the past three years while continuing to allow a chinook fishery. Because winter chinook cannot be distinguished from chinook of other runs by the fishermen, this particular tool is not useful in reducing the fisheries impact at this time.

! Minimum size limits can be useful in reducing the fishing mortality on fish smaller than the limit. It was thought that because of the winter chinook life history, fishery impacts on winter chinook would be substantially less than on fall chinook. While the impact on winter chinook is apparently less than on fall chinook, winter chinook are vulnerable to the recreational fisheries as two and three year olds and may be large enough to be retained in the commercial fishery as three year olds starting in July or August. The current minimum

size for chinook in the recreational fishery is 20 inches while the commercial minimum is 26 inches. The protection afforded by a minimum size limit is highly dependent on the survival of the undersized fish that are released.

- Gear restrictions of various types are used currently in the salmon fisheries. Barbless hooks are required in all salmon fisheries to reduce mortality of undersized fish and others that must be released. In the commercial fishery, the number of spreads that can be fished are limited to also improve the survival of released fish. Measures that enhance the probability of released fish surviving are important to combine with strategies that lead to fish being hooked and released because of size or species criteria. In some recreational fisheries the number of rods and hooks used by a fisherman is limited to control fishing effort. Off Washington State, special terminal gear are required in ocean troll fisheries which are intended to target pink salmon. At this time there are no gear requirements that are known to select against winter chinook and for other chinook.

Other management measures, such as a winter chinook escapement goal, can be made available for ocean fisheries management, but probably would require amendment to the FMP. Such an amendment is a rather lengthy and complex process requiring considerable public involvement and would not be considered a minor modification of the current action evaluated in this consultation. An amendment would constitute a separate action.

CONCLUSION

The FMP does not contain any goals or objectives which address winter chinook directly or species listed under the ESA in general. Adoption of a spawning escapement goal for winter chinook would require amendment to the FMP, which is not a minor modification to the current action subject to consultation.

The FMP, however, contains provisions that can be, and have been, used to reduce the impact of the ocean fisheries on winter chinook. The requirements of the Biological Opinion and Incidental Take Statement issued in 1991 have been met through the measures incorporated in annual setting of the regulations for the fisheries. New information gathered from the CWT program on winter chinook appears consistent with the results from earlier work on the 1969 and 1970 brood years. Without further restricting the ocean fisheries, management under the FMP will result in ocean harvest levels of approximately 50 percent on each cohort of winter chinook.

Current survival to spawning of winter chinook has been allowing a cohort replacement rate of 1.0 or slightly better for the 1989 to 1992 brood years. This survival rate is achieved with the ocean fishery operating under the FMP as constrained by the 1991 Biological Opinion and Incidental Take Statement. Since 1991, however, changes in the operations of the Federal Central Valley Project and screening of major diversions from the Sacramento River have improved winter chinook survival during early life stages in the spawning and rearing areas and during out-migration. The State of California also has closed recreational fishing in the river to improve the survival of adult winter chinook. With those changes in freshwater survival, greater gains in the population size of winter chinook were expected, but not achieved. However, these changes have only been in place a short time and have been incrementally implemented. Ocean fisheries, as they are currently managed, are a substantial source of mortality for winter chinook and may be hindering recovery of the population.

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Table 1. CVI preseason projections and postseason estimates.

	Preseason		Postseason	
Year	CVI	Exploitation Index	CVI	Exploitation Index
1991	466	72	444	72
1992	452	34	323	71
1993	501	65	501	72
1994	503	53	610	74
1995	654	72	1273a/	77 a/

a/ Preliminary Data

Table 2. Fin clip recoveries from brood years 1969 and 1970 expanded for sample size.

		Brood Estimated Recoveries			
Brood Year	Location	age 2	age 3	age 4	Total
1969	Sacramento River	a/	333	21	354
	Ocean				
	Sport	239	27	0	266
	Commercial	14	23	12	49
	Total	253	50	12	315
1970	Sacramento River	a/	124	50	174
	Ocean				
	Sport	151	0	0	151
	Commercial	35	35	0	70
	Total	186	35	0	221

a/ Jack returns to the river not included in escapement
Data reproduced from CDFG (1989) Tables 9 and 10
Catch/Catch+Escapement for BY 1969 = 0.47
Catch/Catch+Escapement for BY 1970 = 0.56

Table 3. Winter chinook CWT recoveries from 1993, 1994 and 1995 fisheries.

Tag Code	Brood Year	Fishery	Area	Month	Yr	Observed Tags	Estimated Tags	FL mm	TL in
0501010405	1991	Sport	FORT ROSS-PIGEON PT	Jul	1993	1	5	510	22
0501010406	1991	Sport	PIGEON PT.-POINT SUR	May	1993	1	7	540	23
	Total 1993 Recoveries					2	12		
0501010406	1991	Troll	FORT ROSS-PIGEON PT	May	1994	1	3	724	31
0501010703	1992	Troll	FORT ROSS-PIGEON PT	Jul	1994	1	6	644	27
0501010614	1992	Troll	FORT ROSS-PIGEON PT	Jul	1994	1	7	688	29
0501010611	1992	Troll	FORT ROSS-PIGEON PT	Sep	1994	1	11	600	26
0501010614	1992	Troll	PIGEON PT.-POINT SUR	Jul	1994	1	10	627	27
0501010609	1992	Troll	POINT SUR-CA/MEX.BOR	Jul	1994	1	10	652	28
0501010705	1992	Troll	POINT SUR-CA/MEX.BOR	Jul	1994	1	10	595	25
	Total 1994 Troll Recoveries					7	57		
0501010711	1992	Spor t	FORT ROSS-PIGEON PT	Apr	1994	1	5	570	24
0501010611	1992	Sport	FORT ROSS-PIGEON PT	Jul	1994	1	4	650	28
0501010610	1992	Sport	FORT ROSS-PIGEON PT	Mar	1994	1	5	550	24
0501010609	1992	Sport	FORT ROSS-PIGEON PT	Apr	1994	1	5	484	21
0501010609	1992	Sport	FORT ROSS-PIGEON PT	May	1994	1	4	528	23
0501010713	1992	Sport	FORT ROSS-PIGEON PT	Jun	1994	1	4	494	21
0501010614	1992	Sport	PIGEON PT.-POINT SUR	Apr	1994	1	4	550	24
0501010711	1992	Sport	PIGEON PT.-POINT SUR	Apr	1994	1	4	521	22
0501010608	1992	Sport	PIGEON PT.-POINT SUR	Jun	1994	1	4	549	24
0501010609	1992	Sport	PIGEON PT.-POINT SUR	Jul	1994	1	4	594	25

Tag Code	Brood Year	Fishery	Area	Month	Yr	Observed Tags	Estimated Tags	FL mm	TL in
0501010702	1992	Sport	PIGEON PT.-POINT SUR	Mar	1994	1	7	514	22
	Total 1994 Sport Recoveries					11	50		
0501010902	1993	Sport	FORT ROSS-PIGEON PT	Apr	1995	1	3	514	22
0501010907	1993	Sport	FORT ROSS-PIGEON PT	Jul	1995	1	5	596	25
0501010810	1993	Sport	PIGEON PT.-POINT SUR	Jul	1995	1	5	588	25
0501010905	1993	Sport	POINT SUR-CA/MEX.BOR	May	1995	1	9	543	23
	Total 1995 Sport Recoveries					4	22		

Table 4. CWT recoveries from brood years 1991, 1992 and 1993 expanded for sample size.

		Brood Estimated Recoveries			
Brood Year	Location	age 2	age 3	age 4	Total
1991	Sacramento River	a/	0	0	0
	Ocean				
	Sport	12	0	0	12
	Commercial	0	3	0	3
	Total	12	3	0	15
1992	Sacramento River	a/	88	b/	
	Ocean				
	Sport	50	0	c/	
	Commercial	54	0	c/	
	Total	104	0	c/	
1993	Sacramento River	a/	b/		
	Ocean				
	Sport	22	c/		
	Commercial	0	c/		
	Total	22	c/		

a/ Jack returns to the river not included in escapement
b/ Potential returns in 1996
c/ Potential recoveries in 1996 or 1997
Catch/Catch+Escapement for BY 1992 = 0.54

Table 5. Estimated recoveries of CWTs from the 1993, 1994 and 1995 fishing seasons by area, month and fishery.

Area	Sport	Troll
FORT ROSS-PIGEON PT	40	27
PIGEON PT.-POINT SUR	35	10
POINT SUR-CA/MEX.BOR	9	20
Month		
February		
March	12	
April	21	
May	20	3
June	8	
July	23	43
August		
September		11

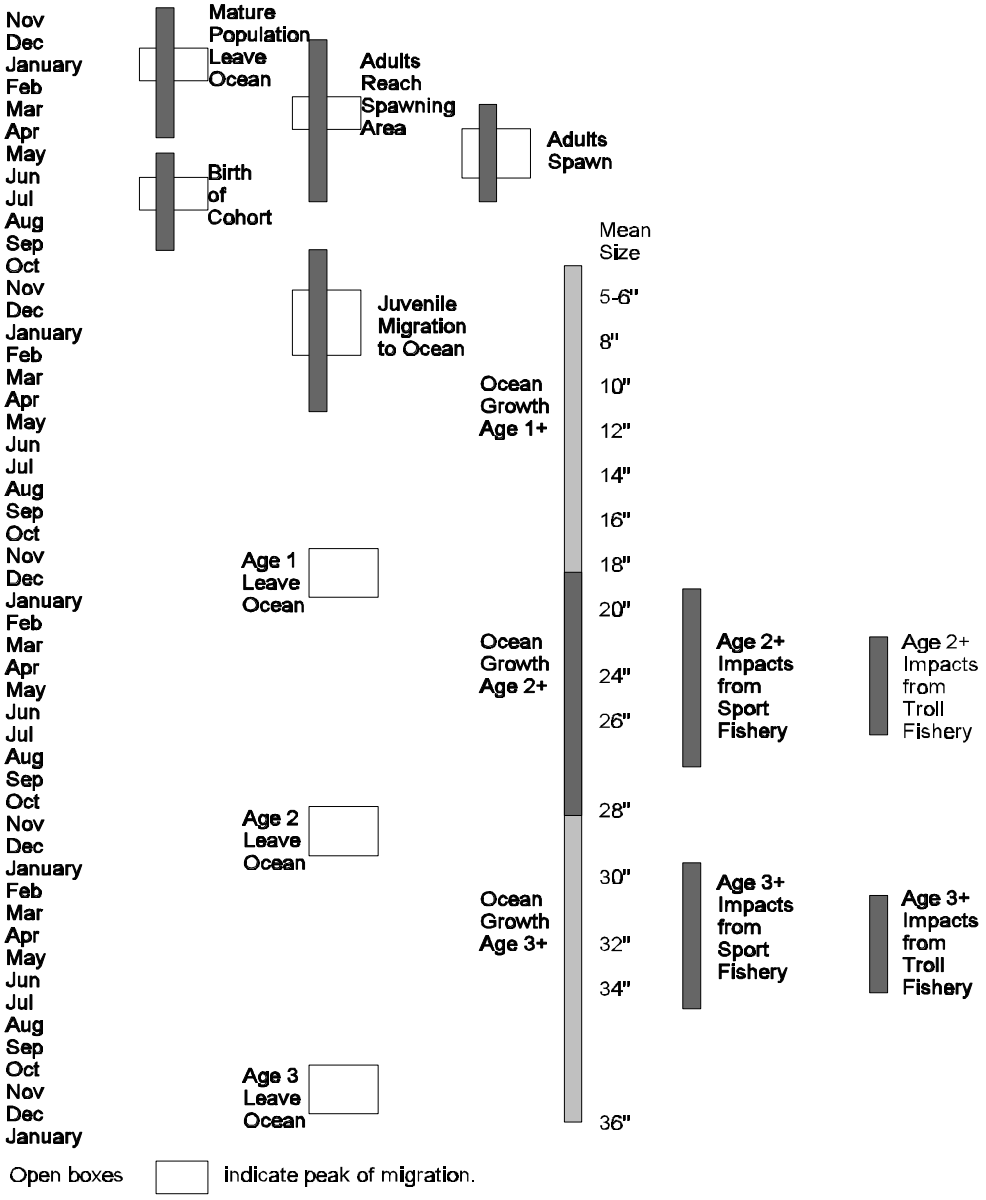
Table 6. Estimated recoveries of CWTs from sport and commercial fisheries for 1993, 1994 and 1995 fishing seasons and respective California chinook landings.

Year Fishery	Landings (1000 fish)	Estimated Tag Recoveries
1993		
Sport	110.0	12
Commercial	279.6	0
1994		
Sport	183.2	52
Commercial	295.6	57
1995		
Sport	397.2	22
Commercial	629.3	0
Totals		
Sport	690.4	86
Commercial	1,204.5	57

Table 7. Estimated recoveries of fin clip from sport and commercial fisheries for 1971 and 1972 fishing seasons with respective California chinook landings.

Year Fishery	Landings (1000 fish)	Estimated Clip Recoveries
1971		
Sport	188.0	239
Commercial	434.0	14
1972		
Sport	201.0	178
Commercial	492.0	130
Totals		
Sport	389.0	417
Commercial	926.0	144

Figure 1. Sacramento Winter Chinook Life History



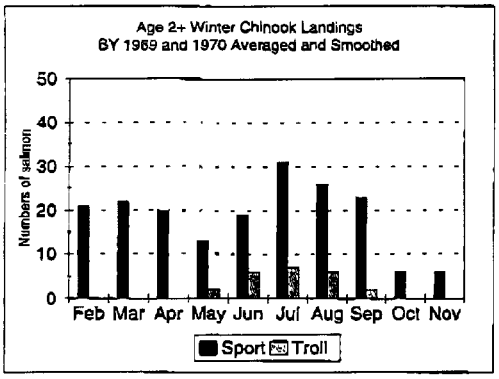


Figure 2. Estimated ocean landings of age 2+ winter chinook. Brood years 1969 and 1970 averaged and smoothed. Data from CDFG 1989, Table 9.

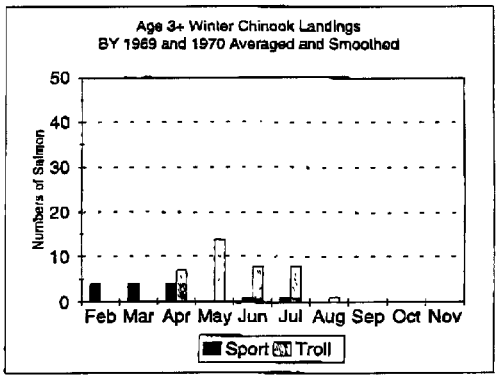


Figure 3. Estimated ocean landings of age 3+ winter chinook. Brood years 1969 and 1970 averaged and smoothed. Data from CDFG 1989, Table 9.

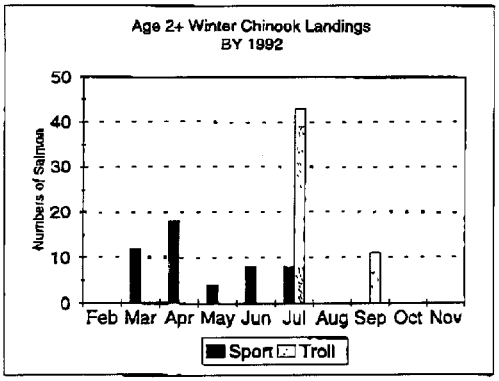


Figure 4. Estimated ocean landings of age 2+ winter chinook, brood year 1992.

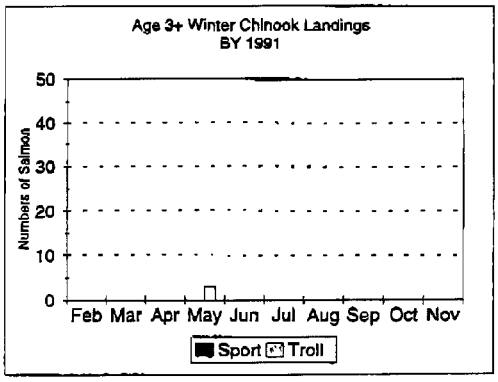


Figure 5. Estimated ocean landings of age 3+ winter chinook, brood year 1991. No age 3+ winter chinook CWTs were recovered for the 1992 brood year.

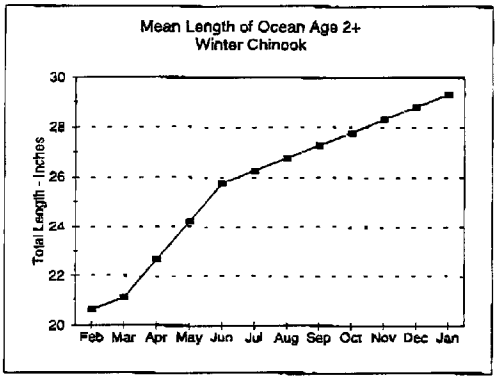


Figure 6. Mean length of ocean age 2+ winter chinook. Data from 1969 and 1970 brood marked fish (CDFG 1989).

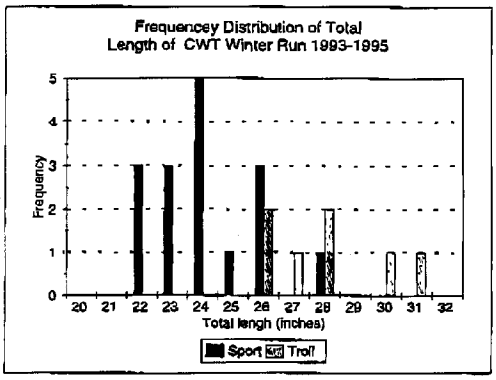


Figure 7. Frequency distribution of tagged winter chinook recovered from 1993, 1994 and 1995 fisheries

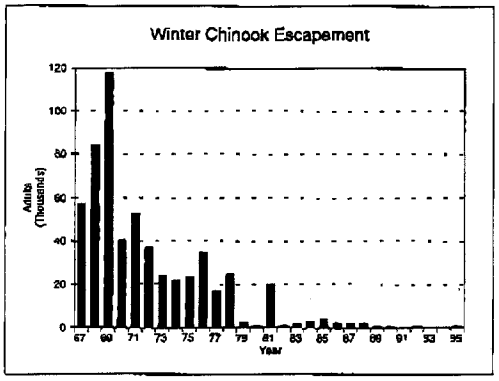


Figure 8. Adult winter chinook spawning escapement estimated by passage at RBBD, 1967-1995.

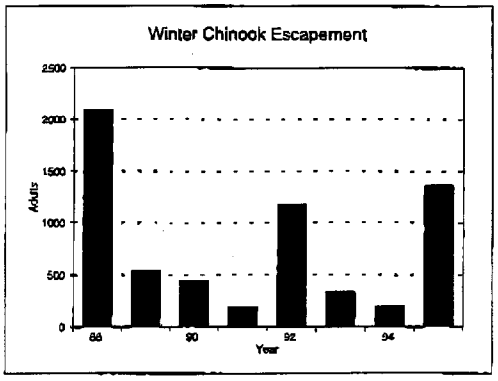


Figure 9. Adult winter chinook spawning escapement estimated by passage at RBBD, 1988-1995.

APPENDIX I

Requirements of the 1991 Biological Opinion

The Incidental Take Statement of the Biological Opinion set forth certain terms and conditions for continued implementation of the FMP.

1. The Council shall continue to monitor the impact of the ocean fisheries on winter-run and report its analysis of ocean impact rates to NMFS prior to the last Council meeting at which regulatory changes could be considered for the subsequent season, but no later than December 1, of the year in which the ocean season ended.

   This requirement has been met only in so far as the Council has provided annual pre-season and post-season estimates of the CV ocean exploitation index, since no data were available on the ocean harvest of winter chinook. The recent recoveries of tagged winter chinook in the ocean fisheries permit the first direct estimates of ocean harvest impact since those using the fin clip data of the early 1970s.

2. The ocean recreational fishing season should be closed two weeks at the beginning and end of the normal season south of Point Arena to ensure escapement of mature fish to the river.

   The normal recreational season off California was mid-February to mid-November and that season has been shortened at the beginning and end in every year since the Biological Opinion was issued. In addition, an area closure off the entrance to the entrance to the San Francisco Bay has been implemented; no recreational fishing is permitted within the area prior to April 1. The State of California has closed recreational fishing in the Sacramento River during the time winter chinook adults are present.

3. The early opening of the commercial fishery (before May 1) south of Point Arena should not be allowed.

   This requirement has also been implemented annually by the Council.

APPENDIX II

Recent California Ocean Harvests of Salmon

The following tables summarize recent annual harvests of chinook salmon in California and provide information on the value of the commercial and sport fisheries to coastal communities. All data were extracted from the Review of 1995 Ocean Salmon Fisheries (Pacific Fishery Management Council 1996)

Table 1. Troll chinook salmon landed in California, estimates of exvessel value and average price (dollars per dressed pound)

Year	Nominal Value (Thousands of dollars)	Real Value /a (Thousands of dollars)	Nominal Price per Pound (dollars)/a	Real Price per Pound (dollars)
1979	17,356	34,383	2.53	5.01
1980	12,741	23,058	2.27	4.11
1981	13,417	22,065	2.25	3.70
1982	18,754	29,039	2.55	3.95
1983	4,290	6,384	2.09	3.11
1984	6,875	9,803	2.67	3.81
1985	11,390	15,656	2.56	3.52
1986	14,874	19,917	2.01	2.69
1987	25,130	32,608	2.78	3.61
1988	41,221	51,479	2.86	3.57
1989	13,095	15,661	2.39	2.86
1990	11,434	13,095	2.77	3.17
1991	8,351	9,214	2.58	2.85
1992	4,487	4,816	2.74	2.94
1993	5,707	5,996	2.25	2.36
1994	6,437	6,624	2.07	2.13
1995b	10,624	10,624	1.76	1.76

a/ Expressed in 1995 dollars
b/ Preliminary

Table 2. Estimates of California recreational ocean salmon trips by port area and boat type.

Year	Crescent City	Eureka	Fort Bragg	San Francisco	Monterey	State Total
			CHARTER TRIPS (thousands)			
1977	1.0	1.2	1.7	72.0	4.8	80.7
1978	2.4	1.3	0.9	47.3	1.3	53.2
1979	2.2	0.7	3.3	69.6	3.1	79.0
1980	1.4	0.6	2.0	62.4	2.9	69.3
1981	0.6	0.5	1.3	56.1	2.7	61.1
1982	0.5	0.4	2.4	72.2	4.4	79.9
1983	0.5	1.4	1.6	50.8	2.7	56.9
1984	0.5	0.9	1.4	56.8	1.9	61.5
1985	1.6	3.5	2.3	74.6	3.2	85.1
1986	1.1	2.8	2.8	69.6	10.1	86.4
1987	1.5	3.8	4.6	82.9	12.3	105.0
1988	0.9	2.5	5.6	81.1	11.7	101.7
1989	0.6	5.4	4.5	83.5	14.0	108.0
1990	0.8	3.2	2.7	54.3	17.4	78.4
1991	1.0	2.1	5.4	43.7	17.0	69.2
1992	0.1	0.2	1.5	38.6	7.3	47.7
1993	0.4	1.0	2.0	53.2	9.4	66.0
1994/a	0.2	0.2	1.3	63.9	7.2	72.8
			PRIVATE TRIPS (thousands)			
1977	21.8	25.5	14.0	34.2	5.1	100.7
1978	15.0	19.8	8.5	48.7	5.4	97.5
1979	9.6	17.3	6.5	34.7	6.7	74.8
1980	17.8	22.5	4.4	23.7	6.7	75.1
1981	13.4	15.8	6.8	19.0	5.7	60.8
1982	24.6	22.3	8.0	28.7	7.7	91.4
1983	21.2	21.5	6.8	9.5	6.8	65.8
1984	23.3	17.9	4.6	8.2	11.4	65.5
1985	29.5	31.4	12.6	18.7	14.6	106.8
1986	24.5	26.1	10.4	22.1	26.1	109.2
1987	50.6	42.4	9.4	25.5	35.4	163.3
1988	43.0	30.3	12.2	27.0	28.2	140.7
1989	33.0	37.7	13.0	11.5	41.7	137.0
1990	41.9	35.4	11.9	35.4	49.0	173.7
1991	24.5	25.3	17.2	26.5	33.8	127.4
1992	9.0	8.9	9.7	23.4	29.1	80.2
1993	15.0	17.3	17.4	29.6	29.7	108.9
1994	9.4	6.3	18.1	43.7	39.6	93.6
1995a/	11.8	12.1	25.4	62.2	114.2	225.6

a/ Preliminary

Table 3. Estimates of California coastal community and state personal income impacts of the troll and recreational ocean salmon fishery for major port areas. Expressed in 1995 dollars.

Year	Crescent City	Eureka	Fort Bragg	San Francisco	Monterey	Coastal Comm Total	State Total
			OCEAN TROLL (thousands of dollars)				
1976-80	5,361	13,552	13,236	17,364	7,551	57,064	73,267
1981-85	2,604	3,141	7,319	13,825	4,718	31,604	39,351
1986	740	2,060	9,435	15,592	10,004	37,830	47,724
1987	2,194	4,309	18,033	28,192	6,966	59,698	73,466
1988	1,150	3,627	24,954	50,774	14,290	94,800	115,083
1989	594	1,096	6,599	14,931	6,599	29,818	36,619
1990	105	746	3,907	12,587	7,767	25,112	30,577
1991	17	402	2,258	10,576	5,367	18,620	22,533
1992	2	3	95	5,880	3,022	9,003	10,666
1993	7	41	823	6,297	4,153	11,320	13,754
1994	0	25	305	9,551	3,129	13,009	15,384
1995a/	10	28	259	10,749	9,960	21,005	25,735
			RECREATIONAL (thousands of dollars)				
1976-80	966	1,121	653	9,808	657	13,205	14,812
1981-85	1,059	1,091	523	8,686	694	12,053	13,566
1986	1,186	1,433	746	9,910	2,125	15,400	17,687
1987	2,374	2,245	879	11,761	2,741	19,999	23,305
1988	1,978	1,585	1,100	11,615	2,374	18,652	21,537
1989	1,510	2,199	1,031	11,087	3,183	19,010	22,129
1990	1,922	1,884	802	8,705	3,839	17,151	20,475
1991	1,184	1,327	1,306	6,900	3,144	13,861	16,537
1992	402	413	581	6,097	1,972	9,464	10,947
1993	700	862	968	8,260	2,209	12,999	15,020
1994	433	297	927	10,360	2,414	14,432	16,388
1995a/	533	603	1,507	13,279	11,762	27,684	33,212

a/ Preliminary

Table 4. California commercial troll chinook salmon landings in thousands of fish by month.

Year	Apr	May	Jun	Jul	Aug	Sep	Oct	Season
1976-1980	34.2	200.0	109.4	173.4	67.9	33.8		618.6
1981-1985	12.4	124.6	74.7	145.1	82.1	23.7		462.7
1986-1990		240.1	257.8	195.1	77.3	24.1	0.2	794.7
1986		223.6	293.2	215.1	84.5	9.1		825.6
1987		264.9	301.6	205.4	84.1	20.2		876.3
1988		390.8	382.8	370.9	111.9	60.8		1317.2
1989		176.2	137.6	112.5	80.5	23.3	0.9	530.9
1990		145.2	174.0	71.7	25.4	7.1	0.1	423.4
1991		80.1	87.1	49.7	65.6	12.1	0.4	294.9
1992		51.6	19.0	21.1	42.7	29.0		163.4
1993		111.1	40.4	55.8	48.4	24.0		279.6
1994		78.8	81.1	89.2	27.4	19.1		295.6
1995a/		280.3	138.8	182.7	23.3	4.2		629.3

a/ Preliminary.

Table 5. California ocean recreational salmon landings in thousands of fish by month.

Year	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct		Season
1976-1980	5.8	8.5	8.7	6.4	13.5	22.0	11.9	7.6	6.7	1.3	92.4
1981-1985	5.9	7.3	7.2	9.4	17.0	27.0	19.6	8.7	5.6	1.4	109.1
1986-1990	5.6	15.3	26.4	11.4	28.4	42.9	22.6	8.3	4.2	1.3	166.4
1986	1.2	16.1	23.5	9.5	24.7	37.4	21.4	5.3	2.0	0.6	141.6
1987	5.5	14.1	19.2	12.4	23.1	51.0	44.1	14.9	7.1	1.1	192.5
1988	6.8	15.9	24.9	20.5	38.2	43.5	12.7	4.0	4.6	0.8	171.4
1989	8.0	12.7	42.6	8.6	27.8	48.7	19.7	12.4	3.7	2.4	186.6
1990	6.7	17.6	21.6	6.1	28.1	34.0	15.2	5.0	3.8	1.7	139.8
1991		8.0	13.0	4.8	19.9	25.1	5.7	2.0	2.2	a/	80.8
1992	0.5	3.4	5.4	6.3	9.5	24.3	10.1	10.3	3.3	0.5	73.6
1993	0.4	9.9	15.0	8.9	7.6	40.4	18.8	5.4	3.6		110.0
1994	1.3	7.3	15.7	18.3	38.8	53.3	24.7	14.1	9.7		183.2
1995b/	0.2	27.3	57.9	47.2	80.3	133.7	31.4	17.0	2.1		397.2

a/ Less than 50 fish.
b/ Preliminary.