THE STATUS OF SALMON POPULATIONS AND HABITAT IN CALIFORNIA COASTAL RIVERS

By

Steven N. Taylor[1/]

INTRODUCTION

This report presents a discussion of salmon management in California coastal rivers. The primary source of information for this discussion is the "California Fish and Wildlife Plan", (the "Plan") published in 1965 by the California Department of Fish and Game.

The "Plan" contains (for the mid-1960's) a comprehensive assessment of California salmon populations, habitat, and management problems, along with a list of proposed solutions to the problems. Except for changes occurring since about 1965 the "Plan" contains the basic information required by the Pacific Fisheries Management Council (PFMC).

This report contains excerpts from the "Plan" which most relate to PFMC needs, along with a discussion of developments since 1965.

King salmon (Oncorhynchus tshawytscha) and silver salmon (O. Kisutch) are the only salmons which enter California rivers in significant numbers.

California coastal rivers (all California rivers outside the drainages [illegible] Valley) contain virtually all of the [illegible] habitat, and [illegible] less than half of the king salmon habitat is [illegible].

[1/] [illegible] Biologist, Salmon/Steelhead Program, Anadromous Fisheries Branch

In the early 1960's coastal river habitat amounted to approximately 2,700 stream miles of silver salmon habitat and 2,304 miles of king salmon habitat. The coastal rivers in 1965 supported estimated spawning populations of 256,200 king salmon and 99,400 silver salmon.

California freshwater salmon habitat is confined to the northern half of the State. Significant runs of king salmon occur as far south as the Russian River, and of silver salmon, as far south as the San Lorenzo River (Figure 1).

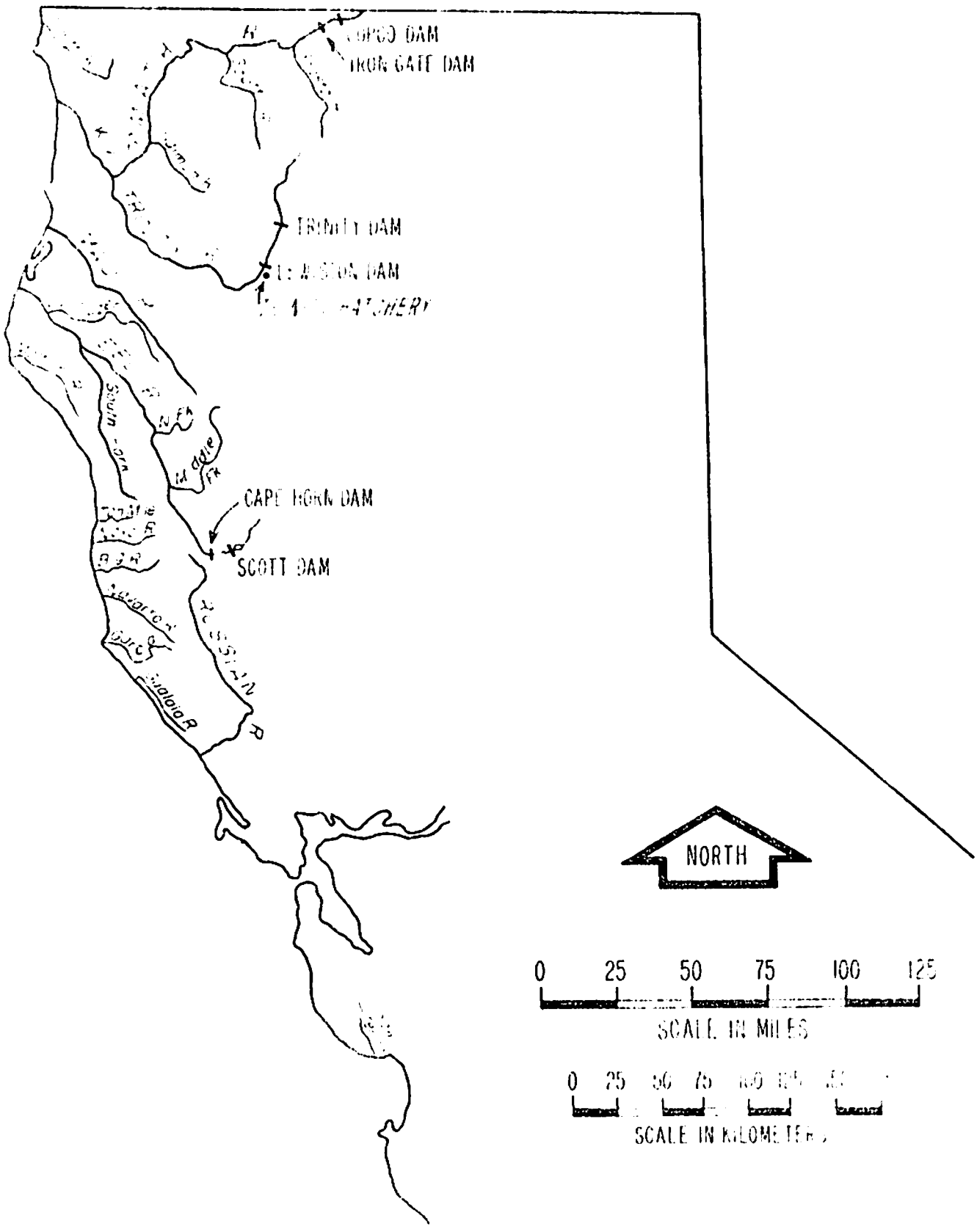
HISTORY OF SALMON SPAWNING ESCAPEMENTS

Klamath River System

General

The Klamath River is the largest coastal California river, the discharge near the mouth (near Klamath, California) averaging 12.9 million acre-feet/year. Approximately 10% of the runoff results from the part of the drainage in Oregon. The Klamath system supports approximately 66% of the king salmon, and 35% of the silver salmon spawning in California coastal rivers (Table 1). Most of the Klamath River drainage is in National Forest holdings.

Four major tributaries contribute to the system: the Shasta, Trinity, Scott, and Salmon Rivers. Considerations or problems unique to each of the major tributaries or to the upper main stem of the upper Klamath are considered under the respective separate headings.



[illegible] salmon-producing rivers.

TABLE 1

AVERAGE ANNUAL SALMON SPAWNING POPULATIONS
IN CALIFORNIA COASTAL STREAMS, IN THE EARLY 1960's*

River System	King Salmon		Silver Salmon	
Smith River	15,000		5,000	
Klamath River System	168,000		15,400	
(Shasta River)		(20,000)		(800)
(Scott River)		(8,000)		(800)
(Salmon River)		(10,000)		(800)
(Trinity River)		(80,000)		(5,000)
(Klamath Main Stem Plus Minor Tributaries)		(50,000)		(8,000)
Redwood Creek	5,000		2,000	
Mad River	5,000		2,000	
Eel River System	55,500		14,000	
(Van Duzen River)		(2,500)		(500)
(South Fork Eel River)		(27,000)		(13,000)
(Middle Fork Eel River)		(13,000)		(0)
(Eel Main Stem Plus Minor Tributaries)		(13,000)		(500)
Mattole River	5,000		2,000	
Noyo River	0		6,000	
Big River	<50		6,000	
Navarro River	0		7,000	
Garcia River	0		2,000	
Gualala River	0		4,000	
Russian River	500		5,000	
San Lorenzo River	0		1,600	
Other Coastal Streams	2,200		21,400	
	256,200		99,400	

Annual counts of adult salmon at fishways or at fish hatcheries date back to 1928 for the upper main Klamath River, to 1930 in the Shasta River, and to 1958 in the upper Trinity River. Estimates of total runs in the Klamath system are based on counts at these locations and on occasional spawning stock surveys in some of the most important spawning areas of the system.

Estimated annual spawning populations in the Klamath River system in 1965 were 108,000 king salmon and 15,400 silver salmon (California Fish and Game 1968).

Shasta River

The Shasta River drainage contains approximately 800 square miles, and contains about 34 miles of salmon habitat. The Shasta River supports approximately 12% of the Klamath River system salmon spawners, essentially all king salmon (Table 1).

Counts of adult king salmon have been made since 1930 at a fishway located either near the mouth of the Shasta River or 7 miles upstream (it was moved twice before 1958). Annual counts have ranged from a high of 51,844 in 1931 to a low of 37 in 1948.

Numerous small diversion dams in the Shasta River prevented fish passage and were the primary cause for a steady decline in salmon runs from 51,844 in 1931 to 37 in 1948. Many of these fish passage problems were corrected in the 1940's, and Shasta River runs increased thereafter until the mid-1960's. In 1964 31,363 salmon were counted over the dams. Runs have generally declined since the early 1960's. In 1970 6,075 salmon were counted through the fishway.

Historically, the Shasta River supported a large spring-run King salmon population as well as a fall-run population. The existing run is almost exclusively fall run.

Trinity River

The Trinity River has a drainage area of approximately 3,000 square miles, most of which lies in Trinity County, California. Useful records of Trinity River salmon spawning populations date back to the mid-1950's. At that time from 80 to 90% of the total Trinity River salmon populations apparently spawned in the upper main stem.

Annual counts of adult salmon at Trinity Hatchery began in 1958. Salmon spawning stock estimates are available for the main stem Trinity River for 11 of the 22 years since 1955 (Table 2).

Annual counts of adult king salmon at the hatchery have ranged from 2,500 to 11,381. The numbers of fall-run fish entering the hatchery have diminished over the last two decades, and the spring runs have increased. The total numbers of king salmon annually entering the hatchery have remained relatively stable.

Three surveys prior to 1968 indicated that the main stem Trinity annually supported from 41,000 to 70,000 king salmon spawners. The "average" for the entire Trinity River system was estimated at 80,000 (Calif. Dep. Fish and Game 1965).

Estimates during eight seasons since 1968 indicate a steady and [illegible] decline in king salmon spawning stocks since 1968. In 1976 an estimated [illegible] king salmon spawned in the main stem of the Trinity below the hatchery [illegible] of the Lewiston Dam.

TABLE 2 (Cont.)

SILVER SALMON

Year	Upper Klamath	Trinity R. Hatchery Counts
1958	-	616
1959	-	119
1960	-	208
1961	-	355
1962	-	16
1963	-	83
1964	-	50
1965	2	12
1966	4	1,025
1967	70	865
1968	357	38
1969	951	1,996
1970	1,623	3,147
1971	146	47
1972	91	2,670
1973	841	8,081
1974	497	95
1975	560	2,237
1976	1,757	2,808

The average annual Trinity River silver salmon run during the early 1960's was an estimated 5,000 spawners (Calif. Dep. Fish and Game 1965). Annual counts of adult silver salmon at Trinity Hatchery indicate that the hatchery program may be maintaining the upper Trinity River silver salmon run approximately at the level of the early 1960's.

Upper Klamath River Main Stem[2/]

Annual counts of adult salmon began in the upper Klamath River at Klamathon racks (River Mile 180) in 1925, and have been made in 42 of the 52 years since 1925, either at the racks or at Iron Gate Hatchery (River Mile 192) (Figure 1). Counts over the 52-year period have ranged from 33,144 in 1937 to 678 in 1965. Counts at the hatchery have steadily increased since 1970. In 1976 13,738 adult king salmon entered the hatchery.

Average annual main stem populations were estimated at 50,000 king salmon in the early 1960's (Calif. Dep. Fish and Game 1965). The counts at the hatchery show encouraging recent increases, but represent a small proportion of the total main stem populations. Limited recent survey work indicates that spawning populations below the hatchery have probably declined since the early 1960's (Millard Coots, pers. comm.), and that the overall trend in the main stem spawning populations is downward. Current total spawning populations are probably less than 50,000.

2/ Above Iron Gate on Klamath River tributaries except the Trinity, Scott, Salmon and Shasta Rivers.

Scott and Salmon Rivers

The Scott and Salmon Rivers each drain approximately 800 square miles. In the early 1960's the Scott River supported an estimated 8,000 king salmon, and 500 silver salmon spawners; the Salmon River, 10,000 king salmon and 1,000 silver salmon (Calif. Dep. Fish and Game 1965). Spawning populations have probably declined in the Scott and Salmon Rivers since the early 1960's (Millard Coots, pers. comm.).

Eel River System

The Eel River system has an average annual runoff of more than 5 million acre-feet/year, second among California's coastal streams only to the Klamath River system.

Nearly all of the precipitation in the 3,600 square mile-Eel River basin occurs as rain; consequently Eel River flows fluctuate rapidly and widely. Late-summer flows at the mouth are low--often less than 100 cfs.

The main Eel River has three important tributaries: the South and Middle forks of the Eel, and the Van Duzen River (Figure 1).

Surveys of salmon spawning stocks have been conducted in the Eel River system, but they have usually covered relatively small portions of the drainage. The limited survey data available in the early 1960's indicated that the Eel River system supported average annual runs of 56,000 king salmon and 14,000 silver salmon.

Counts of salmon at the Benbow Dam Fishway, on the South Fork of the Eel River, date back to 1938. Though counts at Benbow Dam represent a small proportion of the total populations spawning in the Eel River system

TABLE 3

ADULT SALMON COUNTS AT FISHWAYS ON THE MAD RIVER,
EEL RIVER SOUTH FORK, AND THE NOYO RIVER

Year	Sweasey Dam (Mad River)		Benbow Dam (Eel River South Fork)		Noyo Fish Facility (Noyo River)
	King Salmon	Silver Salmon	King Salmon	Silver Salmon	Silver Salmon
1938	1,273	498	6,054	7,370	-
1939	1,357	725	3,424	8,629	-
1940	1,293	73	14,691	11,073	-
1941	3,139	308	21,011	13,694	-
1942	1,576	378	10,612	15,037	-
1943	1,226	259	7,264	13,030	-
1944	-	-	13,966	18,309	-
1945	-	-	12,488	16,731	-
1946	1,181	415	16,024	14,109	-
1947	-	-	13,160	25,289	-
1948	672	515	16,312	12,872	-
1949	484	512	3,803	7,495	-
1950	1,505	147	14,357	12,050	-
1951	1,519	414	12,476	11,441	-
1952	401	72	7,256	3,711	-
1953	847	91	7,948	3,052	-
1954	409	59	5,367	5,952	-
1955	-	-	3,974	5,977	-
1956	129	2	1,530	5,717	-
1957	494	21	3,050	5,433	-
1958	478	11	1,472	3,344	-
1959	19	3	473	2,119	-
1960	55	541	2,665	3,184	-
1961	40	244	2,046	8,479	-
1962	238	710	3,688	10,031	3,603
1963	232	3,580	2,938	14,316	4,940
1964	-	-	8,315	4,468	2,077
1965	-	-	2,455	3,804	1,752
1966	-	-	8,649	1,480	3,048
1967	Dam Removed		3,006	2,461	2,522
1968			2,278	1,289	3,578
1969			3,200	3,170	1,338
1970			9,367	2,070	1,911
1971			5,026	1,509	3,653
1972			2,610	750	2,276
1973			5,006	3,093	2,[illegible]6
1974			3,865	1,224	2,[illegible]0
1975			4,101	509	1,7[illegible]6
1976			-	-	1,[illegible]1
					-

[illegible] counts without [illegible] comparable with other years.

(about 5% of the king salmon and 25% of the silver salmon) they constitute the best long-term information available on Eel River runs.

The numbers of salmon passing Benbow Dam have declined dramatically since counting was begun. Average counts during the first 10 years of operation (1938-1947) were 11,800 king salmon and 14,327 silver salmon. During the last 10 years (1966-1975) average annual counts were 4,714 king salmon and 1,546 silver salmon. The most recent of these counts indicate that king salmon runs are relatively stable but silver salmon runs are continuing to decline. In 1975 only 509 silver salmon were counted past the dam.

Mad River

Mad River drains an area of about 500 square miles in Trinity and Humboldt counties and contains about 65 miles of king salmon and 85 miles of silver salmon habitat.

The best historical data on salmon populations are annual fish counts from 1938 through 1961 at the Sweasey Dam Fish Ladder, which was located 10 miles above the mouth of the Mad River. The counts (up to 3,139 king salmon and 3,580 silver salmon per year) indicated that after 1951 both king and silver salmon populations above Sweasey Dam declined dramatically. King salmon counts remained low throughout the period of record and silver salmon counts increased in the early 1960's.

[illegible] work elsewhere in the Mad River drainage indicated that in the [illegible]'s average annual [illegible] spawning populations were about 5,000 king salmon and 2,000 silver salmon.

Salmon have been counted at Mad River Hatchery since hatchery operation began in 1972, and some stream survey work has been done in recent years, but the available data are insufficient for demonstrating changes in Mad River salmon populations since the early 1960's.

Smith and Mattole Rivers and Redwood Creek

These three drainages together drain approximately 1,300 square miles. All support both king salmon and silver salmon runs, but in each, king salmon are the most abundant species. Spawning stock estimates in these rivers are based on limited survey work and scattered observations. In the early 1960's these streams collectively supported average annual spawning populations of about 25,000 king salmon and 9,000 silver salmon (Table 1). There has been insufficient monitoring on these streams to demonstrate changes in populations since the early 1960's.

Other California Coastal Streams

None of the dozens of remaining California coastal streams support large king salmon populations; their combined annual king salmon populations probably averaging less than 3,500 fish. Many, however, support significant runs of silver salmon. Average annual runs of silver salmon during the early 1960's in these smaller streams totaled 58,400, more than half of California's silver salmon populations. Spawning population estimates for the most important of these appear in Table 1.

The Noyo River is the only one of these streams in which salmon populations have been regularly monitored in recent years. Adult salmon are counted at the Noyo Fish Ladder Station on the South Fork Noyo River [illegible] miles from the mouth. Annual counts date back to 1965.

Counts during the 16 years of record have ranged from 4,940 to 1,151. Populations appear to have declined in recent years: in 1976 the run was the smallest since operation of the counting facility began. However low conditions in some scattered years prevented fish from migrating up to the station as in 1976.

Observations elsewhere in these smaller coastal streams indicate that present populations are smaller than those of the early 1960's, but do not provide a sound basis for estimating the present populations.

ESCAPEMENT GOALS UNDER PRESENT CONDITIONS

The estimated annual average of spawning escapements in California coastal streams for the early 1960's were 256,000 king salmon and 99,400 silver salmon (Calif. Dep. Fish and Game 1965).

In many areas where sufficient recent monitoring has been accomplished to assess current status and trends, populations have declined since the early 1960's. In most areas, insufficient information is available to assess current trends.

Immediate goals are to maintain and where necessary, to increase salmon populations to the levels of the early 1960's.

FRESHWATER AND ESTUARINE FACTORS ADVERSELY IMPACTING SALMON RESOURCES

Klamath River System

General

A critical management problem which applies to all Klamath system salmon populations is the potential for excessive fishing mortality. All California [illegible] are subject to ocean commercial and sport fisheries, [illegible]

which are regulated by State laws and regularly monitored. The Klamath River system supports a freshwater gill net fishery as well.

Extensive gill net fisheries existed in the Klamath River well before the turn of the century. Snyder's (Snyder 1931) account of the commercial fishery indicates that the freshwater gill net catch was more than 141,000 salmon in the most successful year of this fishery (1912). Catches declined thereafter, until legislation banned commercial fishing in California coastal rivers in 1933.

Though the 1933 legislation reduced the total freshwater fishing mortality, it did not affect Indian "subsistence" fisheries, which continued after 1933 to the present. Gill nets are now fished in the lower 40 miles of the Klamath River and in the lower 12 miles of the Trinity River.

The existing gill net fishery constitutes a critical management problem because it has the potential for extremely high fishing mortality, and no satisfactory framework now exists through which a measure of the fishing mortality is made available to a management agency.

Many of the smaller tributaries throughout the Klamath River system contain obstacles to fish passage which reduce the amount of available fish habitat. Examples are logjams caused by logging activities and diversion dams built for domestic and irrigation water supplies. Large-scale transport of water from the Klamath system in recent years has seriously reduced flows in parts of the system and adversely affected water quality. Perhaps the most serious threat to salmon habitat throughout the system is the growing competition for water.

Main Stem (Plus Smaller Tributaries)

Major water development in the upper Klamath River began with the California-Oregon Power Company (COPCO) hydroelectric projects. COPCO Dam number 1 was completed in 1917 and COPCO Dam number 2 in 1925, approximately 200 miles upstream from the mouth of the Klamath. The project blocked upstream migration of salmon. Artificial-rearing programs were conducted to mitigate for fish habitat losses above the dams.

Power peaking operations of the COPCO Dams often caused large rapid fluctuations in river flows, which were detrimental to fish life. Iron Gate Dam and Powerhouse, at River Mile 192, was built in 1962, primarily to re-regulate river flow. The drainage above Iron Gate Dam contains 4,573 square miles.

Iron Gate Hatchery was built by the Pacific Power and Light Company to compensate for fish losses above Iron Gate Dam.

The reregulation of flows by Iron Gate Dam has been beneficial for salmon in the main stem of the upper Klamath. Some degradation of spawning habitat may still be resulting from the cessation of gravel recruitment caused by the projects. However, the critical factors in the upper Klamath River basin are flow depletion and fish passage problems in the smaller tributaries, caused by irrigation water diversion.

Shasta River

The major water development on the Shasta River is Dwinnell Dam (Lake Shastina) completed in 1958. The dam is 32 miles above the mouth of the Shasta River and is a complete barrier to salmon migration.

Shasta River water is heavily used for irrigation. The flow in the lower river during the irrigation season consists of discolored, mossy, irrigation return water. Fall-spawning migrations are dependent upon cessation of irrigation activities in the fall.

Several small diversion dams still exist in the Shasta River which periodically cause fish passage problems.

Trinity River

The major water development in the Trinity basin is Trinity Project, completed in 1963. The principal project features include Trinity Dam, a 2.5 million acre-foot-capacity storage dam; Lewiston Dam, which reregulates flows 7 miles downstream; and Trinity Hatchery, built to mitigate for fish losses caused by the project. The system above Lewiston drains 719 square miles. The California Department of Fish and Game describes the project's effects upon salmon habitat as follows (Calif. Dep. Fish and Game 1974):

"...The most obvious of these [effects] has been the approximate 90% reduction (except for occasional uncontrolled spills) in average annual preproject runoff past Lewiston. Periods when the river is turbid have been prolonged, in some years by several months, as a result of storing and later releasing silt-laden winter runoff from Trinity Dam. The temperature regime in the river below the dam has also been altered. Present flows result in earlier and more rapid warming of downstream areas in the spring than occurred before construction of the project."

"...problems of sediment (decomposed granite sand and silt) accumulation and growth of riparian vegetation have jointly developed in the 40 miles of river between Lewiston Dam and the North Fork Trinity confluence since construction of the project. Sediments have filled pools and compacted spawning gravels. Vegetation encroaching on the stream channel has narrowed it in many places, causing changes in flow patterns that have resulted in erosion of riffles. Natural gravel recruitment to the river immediately below Lewiston Dam was halted by construction of the project; subsequent erosion and scouring have resulted in further spawning habitat losses in this section of the river. King salmon spawning habitat surveys conducted in the Trinity before (1945) and after (1969-70) construction of the dams indicate 44% of the available preproject spawning habitat between the North Fork and the dam has been lost. Habitat degradation from these causes is continuing."

Trinity stocks are harvested in the Trinity River by the Indian subsistense gill net fishery as well as in the lower Klamath River, thus the threat of excessive fishing mortality is greater for Trinity stocks than for any other in the Klamath system.

Scott River

Degradation of spawning areas due to sedimentation continues to occur in the Scott River, primarily as a result of past mining and logging activities. Erosion dams often cause fish passage problems. The most critical Scott River habitat problem however, is the lack of water. Many of the areas used by salmon go dry naturally in the summer months. Consumptive water use [illegible] the period of critically low flows.

Salmon River

Some fish passage and gravel sedimentation problems exist in the Salmon River, but they are minor compared to those elsewhere in the Klamath system. The Salmon River is in relatively good condition.

Eel River System

The major water development in the Eel River system is the Potter Valley Project. The principal project feature is Scott Dam, completed in 1921 which stores up to 87,000 acre-feet of water in the Upper Eel River. Scott Dam is a complete barrier to fish migration. Water released from Scott Dam flows approximately 15 miles downstream to Cape Horn Dam, where about 185,000 acre-feet are diverted annually from the Eel into the Russian River. Cape Horn Dam is laddered, but the flows from Cape Horn Dam downstream to Tomki Creek are generally very low during adult salmon migration periods (sometimes less than 2 cfs) and salmon have difficulty migrating above Tomki Creek.

The timing and amount of rainfall is an important factor governing salmon migration and spawning distribution within the Eel River system.

There are numerous complete or partial barriers within the system which block migration to habitat which is apparently suitable for salmon spawning.

The Eel River basin has been severely damaged by improper land-use practices. In addition the geology of the basin makes the land naturally very susceptible to erosion. As a result, the Eel River has one of the highest sediment loads of any watershed of comparable size in the

United States (Brown and Bailey 1974). The Eel system salmon spawning habitat was severely damaged by recent floods (in 1955 and 1964). Spawning areas in most of the drainage are now in poor condition.

Smith River

The lower Smith River was logged decades ago, and some logging continues today. However the drainage has recovered well from earlier logging damage and is now in relatively good condition.

There are several man-made partial obstructions to fish migration, and many natural barriers. The potential exists for increasing salmon habitat by eliminating some of these barriers.

Redwood Creek

Logging and road building has seriously impaired the productivity of the Redwood Creek drainage, and the drainage is in generally poor condition. The timing and the variations in fall flows have a large influence on salmon production.

Mad River

The Mad River drainage has undergone extensive logging over the years. However the watershed is naturally unstable. Extensive, frequent slides result in very high turbidity following a rain, largely unrelated to man's activities.

There are several obstructions to fish migration in the upper drainage. Most consist of logging debris, but the major ones are natural barriers.

Russian River

Water is diverted by Cape Horn Dam (Potter Valley Project) from the upper Eel River drainage into Lake Mendocino (formed by Coyote Dam) on the East Fork Russian River and released down the Russian River. The result is permanent flows of 100 to 150 cfs year-round in the Russian, which historically went nearly dry in the summer. The project operation tends to prevent clearing of the Russian River following rains, but the negative effects on silver salmon from the operation of Potter Valley Project are greater in the Eel than in the Russian.

Poor land-use practices, stream channelization, and urbanization have caused a loss of salmon habitat and reduction of water quality in much of the Russian River drainage.

Summer and early-fall water temperatures often are critically high for coho in the Russian drainage. The timing and amount of rainfall are factors which influence salmon production especially in lower and middle Russian River tributaries.

Other California Coastal Streams

In most of the remaining California coastal streams the timing and amount of rainfall is a factor which limits salmon production. Flows ordinarily become very low during the late summer and early fall. During years when fall rainfall is slight or late in arriving, adult salmon migration is delayed, or in some areas completely blocked. The amount of rearing area is reduced in years of low summer stream flows.

there is a growing domestic need for water in these smaller coastal drainages. Consumptive use increasingly limits the amount of water available for juvenile salmon. The number of dams which impede or block the migration of fish is steadily growing.

The habitat degradation which follows timber harvesting operations has had an effect in essentially all of these smaller coastal streams whose watersheds have contained commercially-harvestable stands of timber.

RECOMMENDATIONS FOR CORRECTING FACTORS LIMITING PRODUCTION

Increase Habitat and Stock Monitoring

Spawning stock surveys which produce reliable estimates of salmon spawning populations are being conducted in relatively few of California's coastal salmon streams. The large manpower requirements of such surveys are the primary factor which limits the expansion of current survey efforts.

Of the manpower allocated for anadromous fisheries management the California Department of Fish and Game devotes a major portion to stream surveys designed to identify barriers to salmon migration, water quality problem areas, and other specific salmon habitat problems. In spite of ongoing survey efforts, many coastal streams are not given adequate coverage; again because of the manpower requirements of such surveys.

The additional basic information which would be obtained by expansion of both types of survey programs will be necessary for future maintenance and restoration of coastal California salmon populations and habitat.

...should be developed for providing the California Department of ... with complete and up-to-date information on the salmon catch ... the Indian subsistence fisheries in the lower Klamath and Trinity Rivers. ... fisheries have the capability of causing very high rates of fishing ...ality, and may now be doing so. Monitoring of harvest rates in this ...ery, along with the monitoring of spawning populations and harvest rate ... other fisheries, is essential for successful management of Klamath River ... stocks.

Habitat Restoration Programs

...itat restoration programs have the potential for immediate benefits to freshwater salmon habitat.

...tensive instream work to restore salmon habitat has been conducted ... California coastal streams, and more is planned.

...tween 1960 and 1974 the California Wildlife Conservation Board spent ...re than $200,000 on stream clearance and rehabilitation work which resulted in the improvement of more than 500 stream miles of salmon habitat. An ...mple of such work is the removal of 272 logjams on tributaries of the ...ad River South Fork in 1972 and 1973.

...n 1976 and 1977 gravel was replaced or rehabilitated in an 8-mile reach ... the Trinity River at Federal expense. Total cost was nearly $460,000.

...mbers of the Trinity River Basin Task Force are now studying instream ...am rehabilitation plans to reduce the sediment input of Grass Valley Creek, ... tributary of the Trinity River. Activities under consideration are ...

struction of a dam which would form a sedimentation basin, streambed stabilization work, and seeding, mulching and fertilization to hasten establishment of vegetative cover. Though Grass Valley Creek drains only [illegible] acres the work being considered may cost 5.5 million dollars.

Although restoration work of the type described in these examples will have a beneficial impact on salmon habitat, and more activities like these are needed. However the costs listed in the examples are very high, and [illegible] for this sort of repair work. Further, the gains from such activities are often short-lived: scarified gravels for example, quickly become re-cemented unless the cause of excessive sedimentation is corrected. They illustrate the need for stringent habitat protection measures.

Prevention of Habitat Degradation

Water Pollution Control

Day (1977) published a useful and concise description of the role of the California Department of Fish and Game in water quality and pollution control. (Day's report is attached.) It includes, verbatim, the California Department of Fish and Game Code regulations dealing with water pollution, and with streambed and streamflow modification.

Additional anti-pollution regulations and standards have been established by regional Water Quality Control Boards (of the California State Water Resources Control Board). Regional water quality standards are determined in part from input provided by the California Department of Fish and Game. The overall effectiveness of the State in controlling point-source water pollution depends largely on the stringency of standards. Continued [illegible] is needed to determine and demonstrate the effects of all pollutants [illegible].

The principal shortcoming of existing anti-pollution regulations is that they are not effective at controlling non-point-source pollution. This type of pollution is exemplified by the excessive turbidity resulting from overgrazing or deforestation.

The California State Forest Practices Act (1972) enabled formulation and enforcement of forest practice rules on private land. As a result, operations on private lands have improved. Stricter rules and enforcement, however, are still needed in both public and privately-owned forest lands. Section 208 of Public Law 92500 (1972) will eventually result in land-use plans for all California watersheds. The California Department of Fish and Game will provide input for these plans. The eventual impact of such planning remains to be seen. A major effort should be undertaken to assure that the interest of salmon are given adequate consideration in formulation of these plans.

Streambed Modifications

Many prime salmon spawning areas are now owned by the State of California. These are now fully protected from stream altering activities (gravel harvesting operations, etc.) by Fish and Game Code Section 1505 (Day 1977). The code also fully protects spawning areas where ownership is not determined.

In privately-owned areas the Fish and Game Code (Sections 1600-1603) provides that the Department of Fish and Game may make recommendations and negotiate agreements regarding such operations.

These procedures are often effective in modifying operations to reduce [illegible] but losses of spawning areas still occur.

Efforts should be continued to identify these important salmon spawning areas which are still in private ownership. These areas should be fully protected through purchase of the lands by the State or by additional legislation.

Retaining Flows

The primary objective of the Department is "the maintenance of natural conditions in natural waters" (Calif. Dep. Fish and Game 1965).

Licensing (FPC or State Water Resources Control Board) for operation of water developments usually stipulates that a share of the historic run-off is reserved to maintain fish and wildlife. In the case of Trinity Project, this share was approximately 10%. The changes in the Trinity River since project construction indicate that significant habitat losses following flow modifications of this magnitude are unavoidable.

The Wild and Scenic Rivers Act (1972) prevents new water appropriation (except for local domestic use) from the Smith River and all of its tributaries, and from most of the Klamath and Eel River systems. The Act, however, does not prevent increased consumptive water use by users with established riparian rights. Further, many important California coastal rivers are not protected by the Wild Rivers Act.

In rivers not protected by the Act the right to appropriate water for consumptive use is obtained by applying for permit to the State Water Resources Control Board. The Department, through review of these applications attempts to assure that the impact of such water appropriation on fish and wildlife is minimized. The Department annually reviews some

300 of these applications.

In 1975 the Department applied to the Water Resources Control Board for a water permit on the Mattole River to reserve flows for fishery needs. The application was disapproved. The Department subsequently appealed this determination to the Humboldt County Superior Court, and the case is now pending.

New forms of new legislation, and the outcome of litigation, regarding the reservation of natural flows for fish, are likely to be determined by changes in water demand. Rivers now protected by the Wild and Scenic Rivers Act, for example, can be removed from the protected list by the Legislature. Under conditions of steadily increasing consumptive water use, we cannot reasonably expect to prevent further water appropriations from California coastal streams, nor the resulting loss of salmon habitat.

The negative effects may be reduced by further efforts at determining the flow schedules which will provide the most benefits to salmon with the smaller amounts of total runoff. It is inescapable, however, that full maintenance of populations at existing levels will eventually require expansion of artificial fish rearing facilities if development trends continue.

Artificial Rearing Programs

Iron Gate Hatchery (upper Klamath River) and Trinity Hatchery (upper Trinity River) both are operated to mitigate for losses caused by water development projects. Too little marking data are available to adequately

TABLE 4

NOYO RIVER-STRAIN STEELHEAD ESTIMATED YEARLING PLANTINGS
IN CALIFORNIA COASTAL STREAMS, 1963-1976

Year	So. Fork Eel River	Ten Mile River	Noyo River	Albion River	Big River	Navarro River	Garcia River	Gualala River	Russian River	Lagunitas Creek	Total
1963	49,870		123,620		72,612		40,132			40,169	325,403
1964		49,999	129,688		36,247		38,241			32,000	274,176
1965		40,140	98,448		38,025		40,218				216,853
1966		40,014	100,038			40,000					180,042
1967		39,014	114,145			40,014					193,173
1968			102,630			40,018					142,648
1969			95,894	30,000				40,000	15,006	25,000	215,900
1970	30,098		80,005	30,004	30,004			30,000		25,008	225,079
1971		20,004	90,009		20,010			30,000		25,008	185,031
1972		20,016	90,000		20,007			30,006		25,007	180,036
1973		20,002	90,004		20,007			20,007		25,005	175,025
1974	100,005	10,013	100,002		10,013			55,020		25,008	300,061
1975		10,007	200,422		9,997			10,005		25,009	255,440
1976		10,013	125,027		10,013	40,014		10,000		25,002	220,069

evaluate fisher contribution rates, but the annual counts of adults returning to these two hatcheries indicate that the programs are adequately maintaining the runs which historically spawned above the hatchery sites.

2 to 2.5 million king salmon and 500,000 silver salmon are now reared in State-owned and operated hatcheries and planted in California coastal rivers each season. Most of the king salmon are planted in the Klamath River; the silver salmon are planted in numerous coastal rivers. The primary silver salmon egg sources over the years have been the Eel River south fork and the Mad and Noyo Rivers (planting of Noyo-strain silver salmon is detailed in Table 4). The primary king salmon egg source has been from Iron Gate Hatchery. Prairie Creek Hatchery, operated by Humboldt County, and Fowdy Creek Hatchery, operated by the Smith River Kiwanis Club, both rear and plant salmon in northern coastal California rivers.

These artificial production programs undoubtedly contribute salmon to fisheries, and to spawning escapements as well. Marking programs to evaluate planting locations and schedules might increase benefits. The contribution of these programs could probably be increased by augmenting existing State rearing facilities to eliminate the practice of releasing juvenile fish prior to their optimum planting dates. Additional rearing facilities would also allow increasing the benefits resulting from the rescue of juvenile wild fish which become stranded in drying streams.