

Salmon Management in California^{1/}

Anadromous Fisheries Branch

California Department of Fish and Game

INTRODUCTION

In 1977, the responsibility for managing the ocean salmon fisheries between 3 and 200 miles off California was delegated to the U.S. Secretary of Commerce (Secretary). This resulted from passage of the Fishery Conservation and Management Act of 1976 (P.L. 94-265). Since 1976 Pacific Fishery Management Council (PFMC) has made recommendations for ocean salmon management plans to the Secretary. The State of California is currently represented on the Council by 4 of 13 voting members.

In inland areas of California, the California Department of Fish and Game (Department) is the lead agency in making salmon management decisions. It is the inland areas where the production potential of California's salmon resources are largely determined. Utilization of California salmon generally takes place in Federal waters (3-200 miles) off California with California residents catching most of the fish. The State, therefore, has a vested interest in PFMC decisions as they affect California salmon and California fishermen.

PFMC members have expressed growing interest in California's inland salmon management programs. In large part this has stemmed from new programs launched

^{1/} Prepared for the Pacific Fisheries Management Council, January 3, 1983.

by the State aimed at increasing salmon production, coupled with perceived reluctance to enact greater ocean fisheries restrictions. Due to declining natural chinook runs in some California streams and severely reduced coho landings the alternative has been either to reduce the harvest or increase the production. The State has consistently favored increasing production as the opportunity to do so has become available, coupled with prudent regulation of the ocean and river fisheries. This position is affirmed in the Governor's twenty year "Investing for Prosperity" plan dated January 1, 1982.^{1/}

Unfamiliarity by many with California's inland salmon management programs has prompted the preparation of this report. In it we seek to i) inform those interested of progress in increasing salmon production in California streams, and to ii) reassure the Council and the salmon users that these programs will continue and be augmented when possible, to restore salmon production in California streams to its full potential.

Salmon Spawning Streams

Production of natural spawning salmon in California is primarily of fall-run chinook. The Sacramento and Klamath river systems (Figure 1) comprise the major chinook salmon spawning streams. Other significant producers of fall chinook in California include the Eel and San Joaquin river systems and the Smith and Mad rivers. Minor production occurs on the coast in the Mattole and Little rivers and Redwood Creek.

^{1/} Copy available on request.

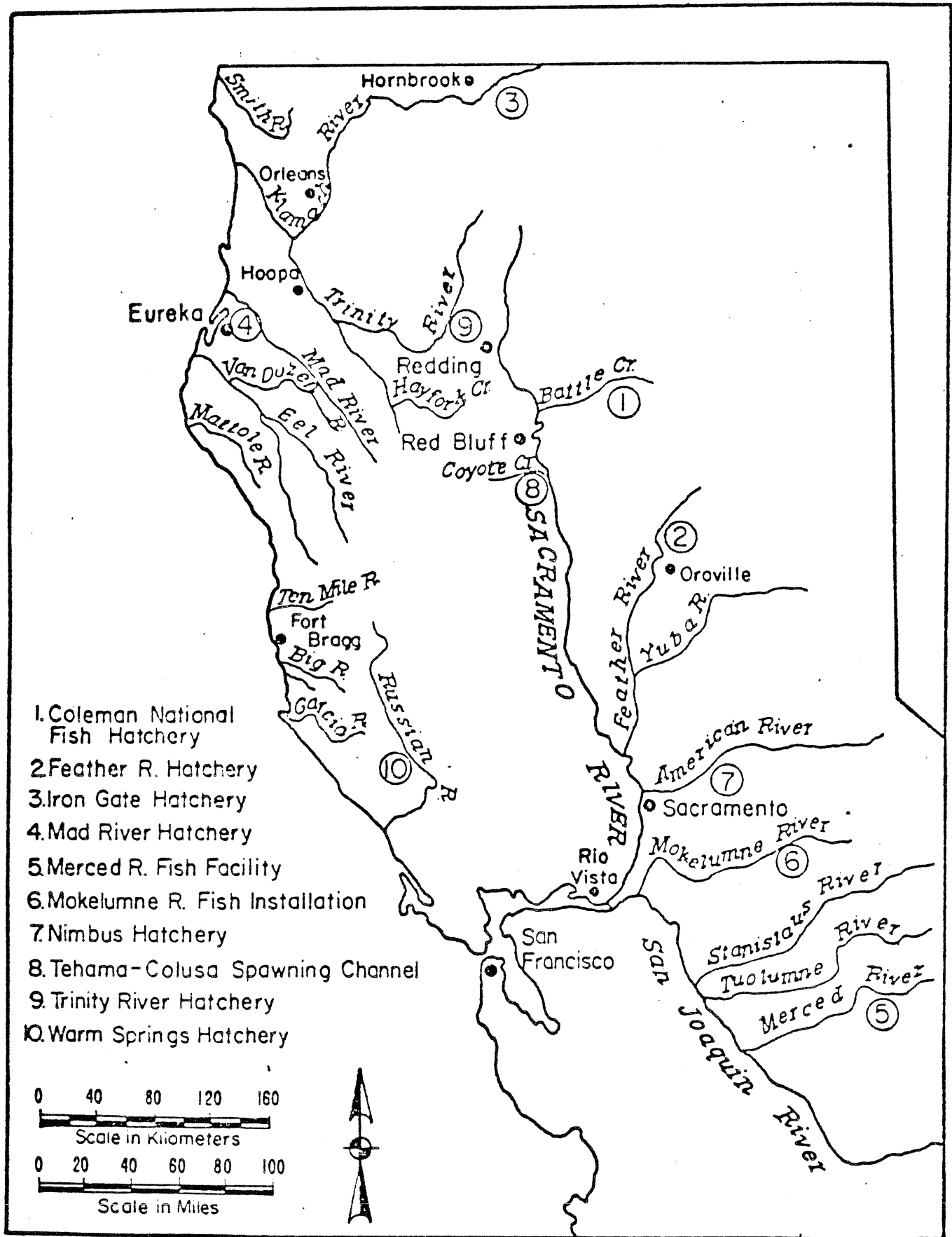


Figure 1.

Natural coho production is relatively small in California. This species is most abundant in the coastal rivers north of and including Monterey Bay although major production occurs north of San Francisco Bay. Spring run chinook occur in small numbers in the Sacramento and Klamath river systems. The following section describes efforts to increase production of natural spawners.

HABITAT MANAGEMENT

Problems

Salmon habitat quantity as well as quality have declined with the development and growth of California over the past century. For example, of the 6,000 miles of salmon habitat that formerly existed in the Sacramento-San Joaquin Valley, only 520 (9%) and 300 (5%) miles were left in 1928 and 1968, respectively^{2/}.

In the Sacramento-San Joaquin River system, the habitat problems stem primarily from dams, water diversions and pollution. Every tributary in the region has been dammed usually at low elevation excluding salmon and steelhead from the upper reaches. In addition to blocking the migration of salmon to many miles of spawning and rearing habitat, these dams halted the recruitment of gravels to downstream spawning areas. Quality of spawning habitat decreased as spawning gravel areas became armoured or paved with gravel materials too large for salmon to use. This process continues today. In the upper Sacramento River, pollution from heavy metals (zinc and copper) is a continuing, highly perplexing problem.

^{2/} Citizens Advisory Committee on Salmon and Steelhead Trout. 1971. An environmental tragedy. State of California, The Resources Agency, and California Department of Fish and Game, Sacramento, CA 95814.

The environment of the Sacramento-San Joaquin Delta, the estuary through which both naturally and hatchery produced salmon must pass enroute to and from the ocean has become hazardous to both juvenile and adults. Increasing diversions of water from the south and west delta create flow reversals, changes in ocean outflow and impair water quality. Many juveniles are lured by prevailing currents from their destination and end up as food for a large group of predators or entrained on giant screens. Adults frequently stray, searching for their natal streams, finally spawning where the opportunity presents.

Our coastal stream systems have suffered from poor land use practices. Here, road construction and logging on unstable slopes have filled many streams with silt and fines. Past poor logging practices have left denuded stream banks, slash, debris, cull logs and crossing bridges left behind after logging which eventually reached streams to form jams that still block fish passage.

The Klamath River system has suffered from the full spectrum of environmental problems. These include power generating dams, strip bank logging, poor road construction practices, pollution, agricultural diversions, mining, etc.

Salmon habitat problems in California have long been evident. The Department in conjunction with other government agencies and private enterprises, has increased dramatically efforts to manage and improve habitat for salmon.

Participant Programs

Salmon habitat restoration and enhancement efforts in California in recent years

have involved several governmental and private organizations. Progress by the various groups is summarized in this section.

California Department of Fish and Game. Department salmon habitat programs deal with enforcement of regulations, construction and operation and screens and ladders, and coordination of all stream improvement programs. Activities include coordination of cooperative grant projects, and implementation of the Resources Agency's Salmon and Steelhead Restoration Project, a segment of the "Investing for Prosperity" program.

Regulations. The Department is authorized under several Fish and Game Code sections to protect habitat and to enforce the regulations of other agencies as appropriate. Code Section 1505 of the Fish and game Code directs the Department to "...manage, control, and protect..." spawning areas in certain streams on Stateowned land. These include much of the prime salmon spawning habitat in the State. The principal effect of this section is to give the Department authority to prevent dredging or other instream work which would be harmful to fish habitat.

Additional regulatory authority over streambed alterations is given in Sections 1601 through 1606 of the Code. In general, these sections require public and private agencies to notify the Department of plans to divert, obstruct, or change the natural flow or bed of any river, stream, or lake with an existing fish or wildlife resource. The Department generally inspects the projects and obtains written agreements between the sponsor and the Department to minimize

environmental damages. These agreements then become binding on the sponsor and any violations are prosecutable.

The Department has separate authority (Section 5663) to regulate suction dredging. Sections 2014 and 5610 provide for action against pollution and littering. The Department also coordinates with State and Regional Water Control Boards to control pollution and to set water quality standards for water development programs.

Regulations protecting California's fish and wildlife are enforced by the Department's Wildlife Protection Branch. There are numerous field wardens stationed in the Department's salmon management regions (Regions 1, 2, 3 and 4). As noted earlier, persistent threats to aquatic habitat in coastal streams are siltation and removal of streamside vegetative cover as a result of logging. Under the State's Forest Practices Act, Department representatives review timber harvest plans, and recommend changes which prevent degradation of salmon habitat. It is unlikely that logging will ever have the serious environmental impacts that they had up to the early '70's.

Screen and Ladder Shops. The Department operates three screen and ladder shops. Each shop is responsible for design, construction and operation of fish ladders and fish screens in their respective areas. There are numerous irrigation diversions along most of the important chinook salmon streams in the State. Under Sections 5980-5993, 6030-6028, and Section 6100 of the Fish and Game Code, the Department can order the installation of screens at existing or new

unscreened water diversions. The Department usually does the work and then bills the diversion owner for the cost of the screen. Each year, 92 screens are installed, operated, and maintained by CDFG screen-shop personnel during the season when smolts are emigrating (Table 1).

The Region 1 screen shops (Yreka and Red Bluff) constructed new fish screens along anadromous fish streams in Siskiyou, Trinity, and Tehama counties during the past five years. Screens on two other diversions were reconstructed during the same period. Region 1 now operates and maintains 73 screens.

Screen shop personnel in Region 2 (Elk Grove) operate and maintain 9 major screens in their central California area. They also do major repair and overhaul on screens in Regions 3 and 4.

The Department's screen shops have also operated new fish ladders during the last five years to improve fish passage at dams on Antelope Creek, the Shasta River, and at a culvert on a small unmarked tributary to the Klamath River. Region 1 is now responsible for the maintenance of 24 fish ladders. In Region 2, four new ladders have been built in the past five years. This region annually inspects and maintains 17 ladders.

Using Dingel-Johnson and State Wildlife Conservation Board funds, Region 1 screen shop crews placed salmon spawning gravel at three sites on the Sacramento River at Redding since 1977. Gravel placement selection was based on proximity to previously heavily used spawning riffles and low probability of gravel wash out. During the same period the Region improved three side channels of the Sacramento

TABLE 1. Distribution of Fish Screens Operated by Department Screens Shops

County	Number Screens	Watershed
<u>Region 1</u>		
Shasta	2	Sacramento
Siskiyou	44	Klamath
Tehama	11	Sacramento
Trinity	16	Trinity
Subtotal	<u>73</u>	
<u>Region 2</u>		
Contra Costa	2	Sacramento-San Joaquin
Glen	1	Sacramento
Mendocino	1	Eel
Merced	1	Merced
Monterey	1	Greenfield Canal
Sacramento	2	Consumnes
Santa cruz	1	San Lorenzo
San Joaquin	5	San Joaquin
Sonoma	1	Russian
Stanislaus	2	San Joaquin
Sutter	1	Feather
Yuba	1	Yuba
Subtotal	<u>19</u>	
<hr/> TOTAL		

River near Redding and Anderson for salmon spawning by changing streamflow and riffle contours.

Those same crews provided access for anadromous fish to 90 miles of stream in Region 1 during 1977-82 by constructing pools or blasting of natural barriers. The work was done in the Eel, Mad, Trinity, Van Duzen and Little river systems.

Each spring, personnel from Region 1 screen shops salvage young salmonids from drying streams in the region when and where feasible. During the past five years they returned more than 1,300,000 young, naturally produced salmonids to flowing water of the proper quality in the same drainage. Most of the fish were salvaged in the Klamath River system.

Cooperative Restoration Grant Projects. This program began in 1981 when \$925,000 in Geothermal Resources Development funds were made available for grants to nonprofit organizations and political subdivisions of the State to rehabilitate salmon and steelhead runs in the north coast streams. In the first year (1981-82 fiscal year) the Department entered into contracts with 20 eligible organizations. Projects were funded for work in the counties of Del Norte, Humboldt, Mendocino, Siskiyou, Sonoma, Marin, Santa Cruz, and Monterey. Highlights of the first year habitat projects were:

- 1) Major modification of Healdsburg Dam on the Russian River to improve fish passage.

- 2) Revegetation of slide areas to reduce sediment input along 1.5 miles of stream in the Eel River system.
- 3) Removal of about 70 logjams and five other types of barriers to adult salmonid migration, and the construction of three small fishways throughout the north coast. A total 57.7 miles of previously unavailable stream habitat was opened up to anadromous salmonids.
- 4) Construction of 12 gabion gravel collection and stabilization structures to add spawning habitat in gravel poor streams in the Klamath River system.

In 1982 an additional \$900,000 was made available for continuing the cooperative grant program through the 1982-83 fiscal year. Three new organizations were given funding in this year, five dropped out from 1981-82 and five received funds for a second year. Through December 1982, these projects have resulted in 53 more miles of new habitat opened up through barrier removal.

"Investing in Prosperity"; Salmon and Steelhead Restoration Projects. Begun in 1979, the goals of the State's Salmon and Steelhead Restoration Project are:

- 1) Restore California's salmon populations to at least two-thirds of their historic levels.
- 2) Double the number of salmon presently entering California's major river systems.

The State's Energy and Resources Fund provides \$2 million annually for anadromous salmonid habitat work. The project is scheduled for ten years. Improvement of salmon habitat is the principal objective. Among the projects now underway are reconstruction of spawning riffles, removal of stream barriers, increasing stream flows, screening watershed diversions, construction of fishways and ladders, erosion control and restoration of riparian vegetation.

Since 1979, the Department has contracted annually with the California Conservation Corps (CCC) as part of this effort to do full time stream habitat work in north coast watersheds. The contract has totaled \$1 million annually and provides for a 60 person crew assigned to stream rehabilitation on streams designated by the Department. Through this project, CCC crews have opened up at least 223 miles of streams to anadromous salmonids over the past three years (Table 2). Approximately 6,000 cords of debris have been removed and burned. In addition, they have collected plant seed, planted 5,000 trees in riparian zones, and reseeded over two miles of barren streambank. An estimated 120,000 man-hours have been expended on these activities. The CCC has also provided from their resources substantial time and labor from part-time crews for anadromous stream restoration programs. Statistics from these efforts are not available at this time but probably exceed those of the full-time contracted crews on a statewide basis.

TABLE 2. Summary of CDFG California Conservation Corps Work Crews, 1980-1982

	Feb.-Dec., 1981	Jan.-Dec., 1981	Jan.-Nov., 1982
Miles reopened	62.3	92.3	68.3
Cords of debris removed and burned	317.0 (684,424 bd ft) (1,425,616 cu ft)	2,765.0	2,849.4
Hours	70,387	83,398	84,894
Other progress		140 lb of seed collected, and 5,000 trees planted.	2 miles of stream- bank planted, bushels of seed collected, 120,000 fish marked, and 7,000 fish reared in 5 ponds.

The Salmon Restoration Program provides for creation of salmon spawning habitat. Sites for improved or new spawning riffles have been selected and surveyed in the upper Klamath River, the Shasta River, and the Sacramento River. Site selection for development was based on stream gradient and low probability of wash out. Of the 41 sites selected for development, plans and drawings are complete for five. When developed, these five sites will provide spawning habitat for about 10,000 additional pairs of salmon. Contracts have been let for two of these sites on the upper Sacramento above Red Bluff and will be constructed in the spring of 1983. Department of Water Resources engineers and hydrologists under contract to us and working with Department biologists surveyed potential gravel restoration sites in the upper Sacramento River below Red Bluff in 1982.

California Department of Forestry. All State forests in California are administered by the California Department of Forestry (CDF). The CDF is active in managing State forests to protect and restore salmon and steelhead using

conservation crews supplied by the California Department Corrections or by the CCC. Since 1979 CDF-funded crews have cleared 63.7 miles of streams, replaced numerous culverts and other impediments to salmonid migration in coordination with Department regional biologists. The CDF also administers the California Forest Improvement Program.

California Forest Improvement Program. This State-sponsored cost sharing fund is intended to encourage small (<5,000 acres) land owners to undertake silvicultural and other resource related projects. Funding comes from proceeds from the sale of timber on State owned Forests, 15% of which must be spent for fish and wildlife programs. This program is administered through CDF. Approved water quality projects are aimed at restoring watersheds and reducing silt and sediment input to streams; approved fish habitat projects are for the purpose of enhancing cover, removing barriers, and improving instream habitat.

Projects funded under this program included \$60,000 for water quality improvement and \$150,000 for fish habitat improvement in 1980-81. Because of lagging timber sales, in 1981-82 only \$25,000 was spent on water quality projects and \$13,000 on fish habitat work.

Center for Education and Manpower Resources. The Mendocino County Center for Education and Manpower Resources (CEMR) began in 1978. It is a county based stream restoration project serving Mendocino County. The primary goal of the program is to increase native stocks of salmon and steelhead trout throughout the county. Mendocino County has approximately 1100 miles of anadromous streams, most of which suffer some environmental damage.

Emphasis is on coastal areas. Four basic activities are conducted in the program.

- 1) Stream barrier removal (primarily by removal of log jams): Since 1978 CEMR has opened 128 miles of streams.
- 2) Streambank stabilization and erosion control.
- 3) Habitat development: Field crews form pools and riffles, spawning beds, and nursery areas by leaving selected logs in place during barrier removal projects. These logs become gravel retainers, pool diggers, or bank deflectors.
- 4) Monitoring completed projects: They evaluate costs, procedures and methods used in habitat development or stream barrier removal.

The Program maintains field crews in Laytonville and Fort Bragg. Headquarters are in Ukiah. Financing has been provided by the California Employment and Training Agency (CETA) and the Department of Fish and Game with Energy and Resources Funds. Department biologists and habitat specialists select streams with the highest priorities and obtain necessary access and permits.

California Youth Authority

The California Youth Authority (CYA) operates conservation camps employing young adult offenders. The CYA contracts work with government agencies to accomplish

public works, conservation, and habitat goals. Since 1979 the CYA work crews, in cooperation with the Department of Fish and Game, have opened 94.7 miles of habitat to salmon and steelhead.

Federal Agencies

Federal land and resources agencies are involved in the management of salmon habitat in California, particularly in areas under federal purview.

U.S. Fish and Wildlife Service. The U.S. Fish and Wildlife Service (FWS) has federal responsibility to evaluate or predict the effect of existing or planned federal projects on fish and wildlife resources. Other federal agencies usually consult with the Fish and Wildlife Service on their programs affecting fisheries matters.

While they do limited "hands on" habitat work in California some of their activities do lead to habitat development. An example is the Fish and Wildlife Service inventory of Hoopa Indian Reservaton waters to assess the status of native fish stocks and an evaluation of habitat condition.

U.S. Forest Service. In recent years the U.S. Forest Service (USFS) has been active in the development of improved or additional spawning and rearing habitat for salmon on National Forests in California (Table 3). Funding for the habitat projects has been through Sikes Act cost sharing, Knutsen-Vandenberg Act (shares of timber harvest receipts), and operations budgets. Over the last two years the

Department has contributed \$740,000 as their share of Sikes Act anadromous fish projects. The programs have included migration barrier removal, watershed and landslide stabilization, spawning gravel recruitment, rearing habitat improvement and hatchbox incubation facilities. Working closely together USFS and DFG select the highest priority programs.

TABLE 3. Summary of U.S. Forest Service Salmon Habitat Improvement Project in California Streams, Recent Years Through 1982^{1/}

National Forest	Period	Habitat structures (number)	Barrier removal (acres)	Habitat increase (acres)	Cost
Klamath	1976-1982	145	367	107	NA
Lassen	1982	8	0	0	\$20,300
Shasta-Trinity	1979-1982	4	87	6	NA
Six Rivers	1966-1982	403	234	175	\$756,100
TOTALS		560	688	297	\$776,400

^{1/} Mendocino National Forest activities for 1979-1982, not shown, totaled 7 habitat and 3 watershed projects. Expenditures totaled \$176,000.

U.S. Bureau of Land Management. The U.S. Bureau of Land Management (BLM) administers Public Domain lands. These lands and resources are managed using multiple-use concepts for outdoor recreation, fish and wildlife production, livestock grazing, timber and watershed protection.

Most habitat work by the BLM is done in cooperation with other agencies. Several projects are ongoing in the King Range (Mattole River drainage). Stream clearance work by the CCC during 1980-81 removed 61 mid-channel obstructions and 15 barriers to migration. Through Sikes Act projects and the CCC, ten 100-ft sections of streams in 1980-81 were narrowed by construction of rock deflectors

to reestablish the thalweg, increase water velocity, and create additional nursery area. During 1981-82 the CCC stabilized 45 acres of stream banks with BLM funds. That same year, 25 projects to reclaim tributary channels filled by logging roads construction were completed, and 20 acres of abandoned, eroding logging roads were seeded, fertilized, and mulched.

Bureau of Indian Affairs. The Bureau of Indian Affairs has the trust responsibility of the United States to Indian tribes. This agency has the responsibility for protection and restoration of Indian lands and natural resources. Stream clearance projects have been completed under State and cooperative Federal-State funding. Since 1980 the BIA has spent \$426,000 in stream habitat work on reservations lands. Stream clearance projects opened 42.8 miles of salmon habitat and resulted in removal of 32 barrier log jams, one old dam, and 12 rock barriers. Fish habitat was improved by construction of eight gravel collecting babions, two bank retention flood walls, and one fishway. In 1981 DFG contributed \$210,000 and in 1982 \$180,000 for these programs.

Summary

Streams Clearance. Results of salmon habitat management activities over the past five years were collected from 13 government or private agencies. Unfortunately the data supplied from the various groups is not always in compatible units of measurement. Results of stream stabilization projects, for instance, were sometimes reported in yards of streambank seeded, acres seeded or stabilized, number of trees planted, pounds of seeds used, or some combination of one or more units. Stream habitat improvement projects involving logjam and/or barrier

removal were most consistent in like units of work completed. Collectively, the several agencies conducting stream clearance have opened up an estimated 893 miles of stream habitat for salmon spawning and nursery rearing since 1977 (Figure 2).

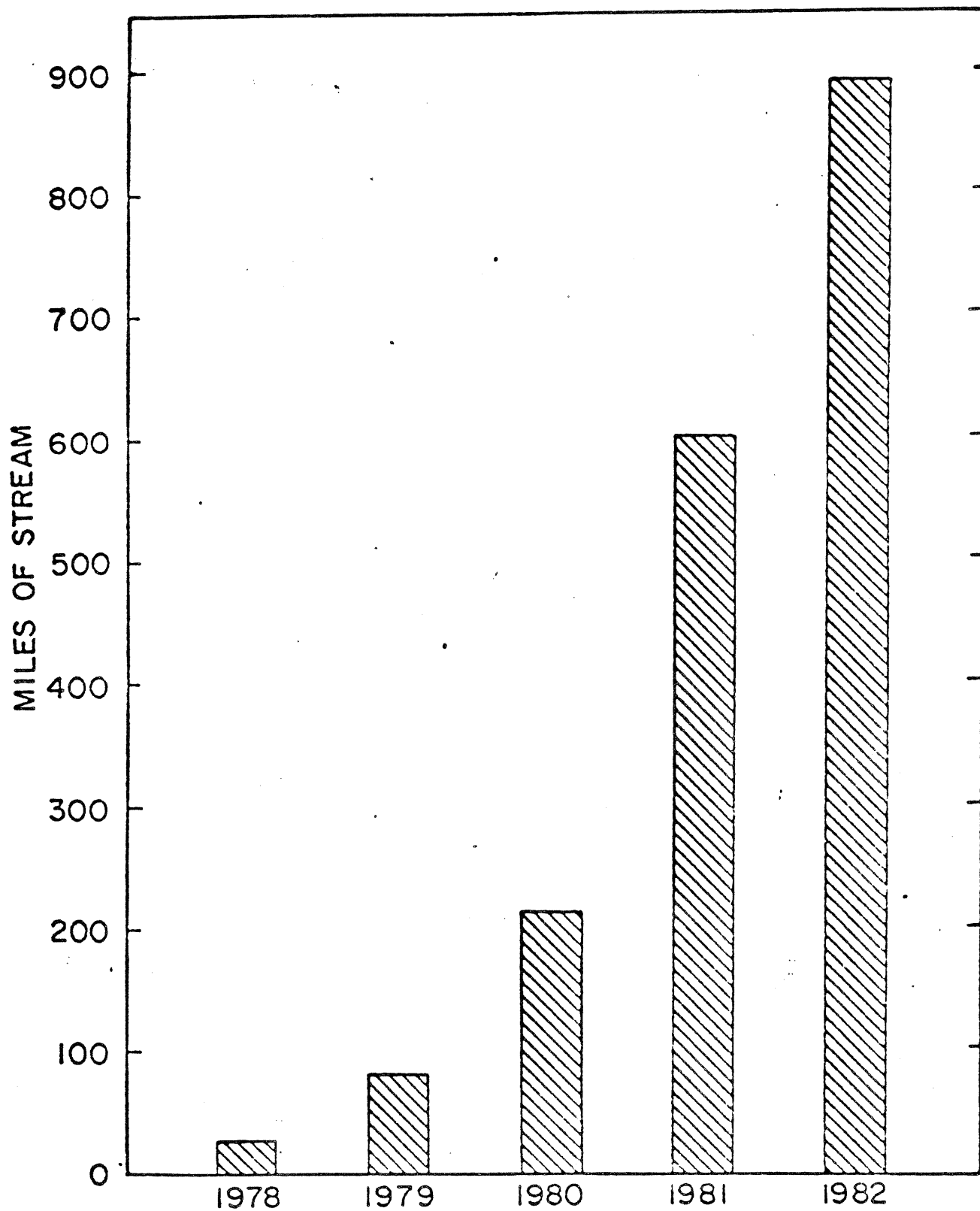


Figure 2. Cumulative Miles of Streams Opened to Salmon, 1978-1982.

HATCHERIES

There are ten State or Federal artificial propagation facilities (hatcheries) for salmon in California; eight are operated by the State (Feather River, Iron Gate, Mad River, Mokelumne River, Merced River, Nimbus, Trinity River and Warm Springs) and two by the U.S. Fish and Wildlife Service (Coleman and Tehama-Colusa). Locations of these facilities are shown in Figure 1.

All of these facilities were built to mitigate for losses of salmon caused by impassable dams except for the Mad River Hatchery and Tehama-Colusa Spawning Channels which were built to augment salmon fisheries. Operating costs of the mitigation facilities are borne by the developers; Mad River is operated with State funds; and Coleman and Tehama-Colusa with Federal funds.

This section presents the operations and production of salmon in California hatcheries in recent years, with emphasis, on the State facilities.

Capacity

The combined maximum annual production capacity of State hatcheries for migrant-sized salmon is approximately 30 million chinook fingerlings (90-16/lb), 6 million chinook yearlings (larger than 16/lb) and 1 million coho yearlings. (Table 4). Production capacity of nonmigrant chinook (swimups) is an additional 10 million fish.

TABLE 4. Capacities of California State Salmon Hatcheries

Name	Newest town	Species reared	Maximum capacity 1/
Mad River	Blue Lake	Coho salmon Chinook salmon	300,000 yearlings 5,000,000 fingerlin
Iron Gate	Hornbrook	Coho salmon Chinook salmon Chinook salmon	75,000 yearlings 4,000,000 fingerlin 1,000,000 yearlings
Trinity River	Lewiston	Coho Chinook salmon Chinook salmon	500,000 yearlings 7,000,000 fingerlin 1,300,000 yearlings
Feather River Hatchery	Oroville	Chinook salmon Chinook salmon	8,000,000 fingerlin 2,000,000
Nimbus	Rancho Cordorva	Chinook salmon	4,500,000 fingerlin
Mokelumne River Hatchery and Spawning Channel	Clements	Chinook salmon	1,100,000 yearlings
Merced River Spawning Channel and Rearing Ponds	Snelling	Chinook salmon	400,000 yearlings
Warm Springs	Healdsburg	Coho salmon Chinook salmon Chinook salmon	110,000 yearlings 1,000,000 fingerlin 100,000 yearlings

Federal facilities on the upper Sacramento have the combined capacity to produce approximately 15 million chinook fingerlings.

Operation and Production

Research involving the marking of millions of hatchery produced salmon in recent years has shown that rearing chinook to larger sizes and transporting chinook of all sizes in the Sacramento-San Joaquin river system (Central Valley) to release sites downstream from major environmental hazards greatly increases their survival. These findings have led to increased emphasis on extended rearing of chinook and releasing of Central Valley chinook from State hatcheries at or downstream from Rio Vista (Figure 1). Increased costs of fish feed and transportation have been covered primarily with revenues from sale of commercial salmon permits. The commercial salmon fisherman sponsored legislation establishing this \$10 fee to rear 1 million yearling salmon. DFG matches the revenue generated.

Including swimup fry, the annual number of chinook released from State hatcheries since 1969 has ranged from 16-40 million fish (Table 5). The pounds planted, however, has been increasing (Figure 3). Yearling chinook production has increased from 1.8 million average in 1970-1974 to 4.0 million average in 1977-1981 (5.2 million average in 1979-1981). (Figure 4).

Coho production has varied widely since 1969 from 2.2 million fish in 1972 to 788,000 fish in 1974. The average for the years 1979-1981 is 1,370,000 coho.

TABLE 5. Salmon Production in California State Hatcheries, 1970-1981

Year	Total chinook			Chinook yearlings 1/			Total coho		
	Pounds	Number	Size	Pounds	Number	Size	Pounds	Number	Size
1970	239,039	12,189,356		122,611	1,437,695	11.7/1b	121,244	1,441,970	11.9/1b
1971	469,923	36,548,996		224,891	1,848,159	8.21/1b	76,146	924,201	12.1/1b
1972	408,718	28,628,159		117,035	1,772,359	15.1/1b	154,564	2,216,745	14.3/1b
1973	437,372	23,264,327		211,745	2,046,890	9.7/1b	79,745	1,505,071	18.9/1b
1974	372,918	16,650,254		208,327	2,150,980	10.3/1b	39,541	881,333	22.3/1b
1975	416,090	25,123,644		204,027	1,989,936	9.8/1b	142,167	2,098,408	14.8/1b
1976	560,879	25,138,778		327,995	2,865,788	8.7/1b	79,645	1,540,756	19.3/1b
1977	429,966	23,541,212		177,928	1,289,315	7.2/1b	97,278	1,320,197	13.6/1b
1978	496,412	16,476,352		334,129	2,863,423	8.6/1b	78,640	1,264,251	16.1/1b
1979	737,645	24,317,046		504,794	5,075,609	10.1/1b	60,213	787,922	13.1/1b
1980	625,604	18,044,209		455,538	4,937,655	10.8/1b	85,047	1,381,750	16.2/1b
1981	729,050	39,921,679		511,722	5,577,957	10.9/1b	86,330	1,079,524	12.5/1b

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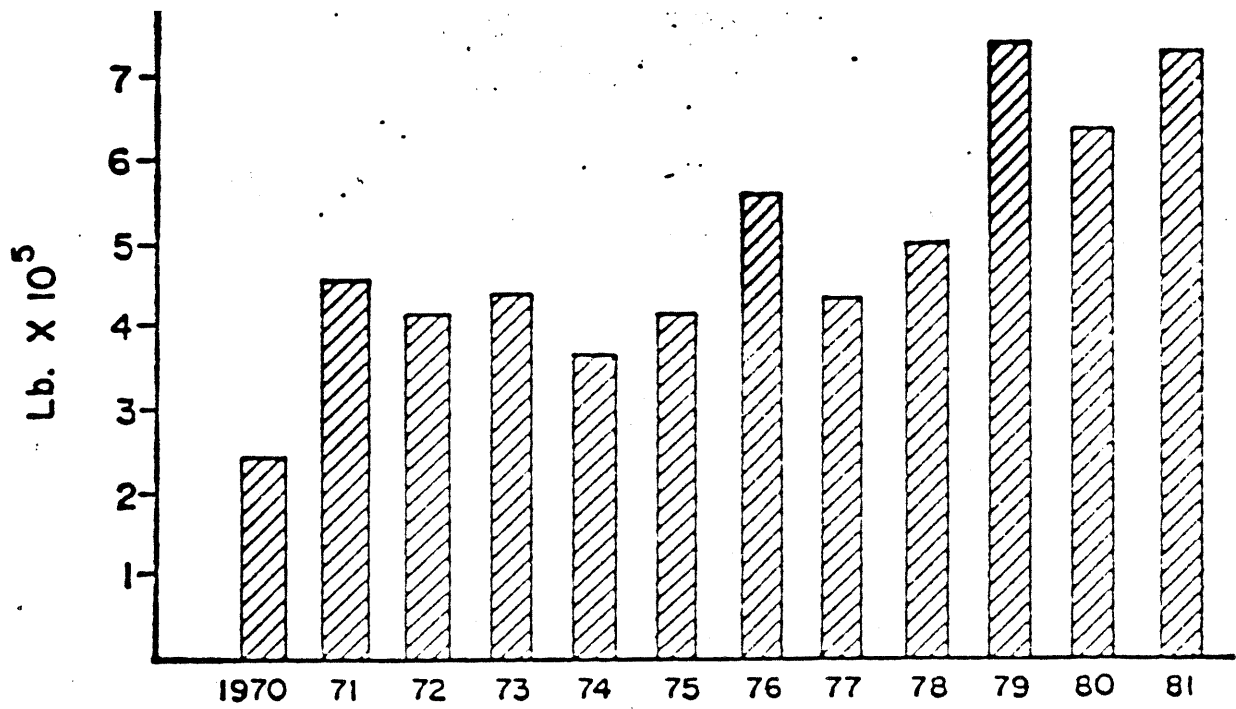


Figure 3. Chinook Salmon Juveniles in California State Hatcheries, 1970-1981.

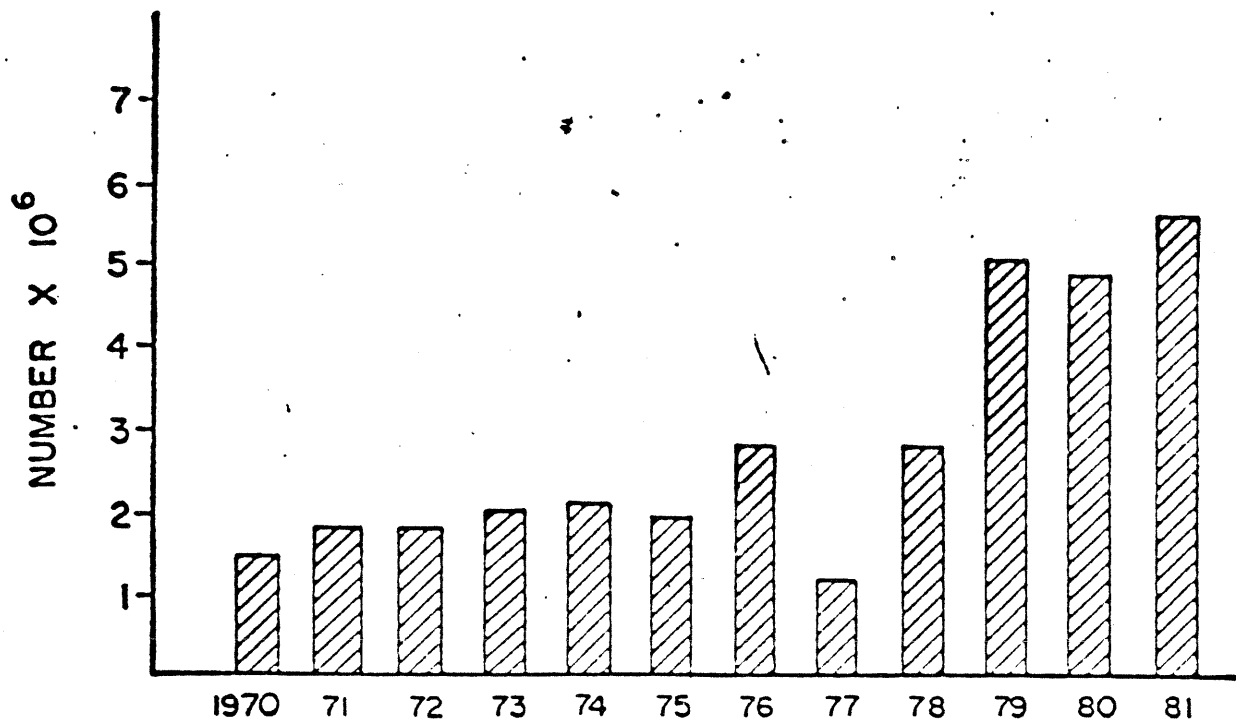


Figure 4. Yearling Chinook Salmon Juveniles in California State Hatcheries, 1970-1981.

Major operational changes or facility modifications at California State hatcheries in recent years are described in more detail below.

Iron Gate Hatchery. The current schedule for Iron Gate Hatchery calls for the annual production of 75,000 yearling coho, about 1 million yearling chinook salmon and 4 million 90/lb chinook salmon.

The yearling chinook production of current levels began in 1979, and was accomplished through a combination of changes in operations at Iron Gate Hatchery, restoration of rearing ponds on Fall Creek, and operation of Indian community rearing ponds in the Orleans and Klamath areas. The latter program provides \$189,000 annually from DFG funds for employment of Indian fish culturists and food costs to rear 150,000-200,000 yearlings in 7 ponds while the former (Fall Creek) produces about 180,000 yearlings.

Trinity Hatchery. Trinity Hatchery has been operated at or near capacity in recent years. In general, operations have changed little over the last decade. Changes now being considered which may improve production include converting existing gravel rearing ponds to vertical-wall concrete ponds, and increasing springtime water temperatures to improve growth rates. Experimental transport of smolt chinook salmon to downstream release sites to improve survival is planned.

Mad River Hatchery. Mad River Hatchery is the State's only anadromous enhancement facility. Operations began in January, 1971. The most significant impediment to reaching the full chinook production potential at Mad River has

been a continuing difficulty in obtaining chinook eggs. To help resolve this problem DFG built and installed a new fish trapping facility on the North Fork of Mad River and an experimental temporary weir at the hatchery. This season they took 1.1 million chinook eggs from salmon at the two weirs. In addition, 1.2 million surplus chinook salmon eggs were transferred from Iron Gate Hatchery. To accelerate reseeding of new habitat in the Klamath basin, Iron Gate fish will be widely distributed throughout the basin beginning in June into streams recently rehabilitated through the various programs described earlier. The coho egg take at Mad River should approach 150,000 this year. Though the hatchery will not achieve its planned maximum production capacity of 5 million chinook salmon this year, production there will be closer to maximum than in any past season. All Mad River progeny will be returned to either the North Fork or the mainstem.

Warm Springs Hatchery. Warm Springs Hatchery came on line in 1981. Salmon production is expected to reach 110,000 and 100,000 yearling coho and chinook respectively and 1 million chinook salmon smolts over the next 4-8 years. Normal water flow regimes demand a late fall (after November 15) running stock and since chinook have not been recorded for many years in the Russian River, approximately 10,000 chinook from late fall fish from the Eel River have been reared annually for two years. First returns from 3-year-old adults are expected in 1983.

Feather River Hatchery. Research conducted at Feather River Hatchery during the early 1970's showed that rearing chinook salmon to yearlings greatly increased their survival over releasing them at 90/lb. This led directly to modifications to the unused spawning channel at Feather River Hatchery to allow the annual rearing there of 1 million additional chinook salmon yearlings. Additional feed

and labor costs associated with the production increase have been funded by the commercial salmon permit fees mentioned earlier.

Other studies, for which only preliminary findings are available, indicate that chinook salmon released in summer at sizes ranging from 20-30/lb survive at a greater rate than fish released at 90/lb in the spring. Moreover, when these same fish were transported to saltwater release sites downstreams from Rio Vista, survival rate was comparable to more expensive yearling chinook. Experiments to sharpen these findings are underway.

Current management strategy, in conjunction with continual marking studies, is to rear chinook smolts to the largest size feasible and to transport one-half of the smolt production to downstream release sites. Because trucking the fish to downstream release sites increases the rate of straying of returning adults, the remaining production is released at the hatchery to assure an adequate adult return to the hatchery and to meet mitigation requirements of our agreement with the Department of Water Resources.

Nimbus Hatchery. Pond space and water temperatures presently limit Nimbus Hatchery to the production of chinook smolts only.

Current management strategy at Nimbus Hatchery is to rear chinook salmon smolts to as large a size as possible, up to 20/lb, and to transport the entire production to Sacramento-San Joaquin Delta release sites. We rarely experience difficulty in obtaining chinook eggs at Nimbus, since fish from throughout the

Central Valley, particularly hatchery fish released at Rio Vista, favor the American River when returning as adult spawners. This practice of releasing all Nimbus salmon at or below Rio Vista was implemented during the late 1970's. Marking experiments conducted during the early 1970's provided the basis for this policy.

Mokelumne River Hatchery and Spawning Channel. The current production schedule of the Mokelumne River facility calls for 100,000 yearling chinook salmon for planting in the Mokelumne River, and, since 1978, 1 million yearling chinook salmon for release in the Sacramento-San Joaquin Delta. The production costs for the 1 million chinook salmon released in the Delta are paid for by DFG and matching funds derived from revenues from the previously mentioned commercial salmon fishing permits. Eggs for Mokelumne River are generally taken from surpluses at Nimbus although some eggs are taken annually from returning adults at the facility.

Merced River Spawning Channel and Rearing Ponds. Successful rearing of chinook salmon yearlings at the Merced River facility first occurred in 1976. Yearling production has been sporadic since then because of difficulties in obtaining sufficient eggs. The facility has operated at about two-thirds of capacity (400,000 yearlings) during the last two years, (277,000 yearlings in 1981 and 252,000 in 1982). Using these fish the Department has embarked on a program to improve the spawning runs in other San Joaquin Rivers such as the Stanislaus and Tuolumne Rivers, both currently severely depressed stocks.

Progress in Expanding Artificial Production

Plans are continuing to construct a new chinook hatchery on the Shasta River, and to expand Nimbus Hatchery. We are currently negotiating land price with the owner of the Shasta (Big Springs) property and drawings for additional rearing ponds for Nimbus are nearly complete. It is expected that construction at Nimbus will begin in 1983 or 1984 with completion scheduled in the same year.

Cooperative Pond Rearing and Hatchboxes. In cooperation with various interested sports and commercial fishermen's groups, DFG presently oversees and funds through Energy and Resources Funds and Geothermal Resources Funds 13 private pond rearing programs. Most are of fairly recent origin and have just begun to produce fish for local coastal streams. Some like the Salmon Restoration Committee in Fort Bragg have been in existence for over 10 years and have had highly variable results. To assist these groups the Department has assigned a halftime Fish Culturist to work with them to improve their operations and to provide technical advice and counsel.

Similarly, small scale hatchbox programs are increasing. Last year programs on Lagunitas Creek and several tributaries of the Klamath were initiated. One program on a tributary of Big River in its fifth year, has succeeded in returning several hundred adult coho to the system this year after years of virtually no recorded escapement.

Private Hatcheries. Rowdy Creek Hatchery on the Smith River after 10 years of funding from private donations and in the last year with an infusion of money from the Geothermal Resources Fund, is finally at a stage where efficiency of operations is a reality. It is California's only privately operated anadromous fish hatchery. They already have made a positive contribution to the chinook resource of the Smith River using native stocks. They are expected to improve dramatically.

Humboldt County funds and operates the Prairie Creek Hatchery. This small hatchery rears a variety of anadromous fish and takes its eggs from the creek or from Mad River surpluses. Recent surpluses at Mad River have been rare so few chinook are reared. With a grant from the state the county will install in the summer of 1983 a permanent egg taking station to produce salmon eggs for this hatchery and several local pond rearing and hatchbox programs.

EXPERIMENTAL MANAGEMENT PROGRAMS

The Department is actively involved in monitoring the status of the State's salmon resources, in evaluating and improving management activities aimed at protecting, restoring and enhancing these resources. Following are descriptions of major experimental management programs the State currently has underway in California.

North Coast Programs

The Department currently has investigations underway on several north coastal salmon streams. These projects are designed to provide data on the status of California's most important coastal chinook salmon stocks, and to provide direction for Department efforts aimed at restoring and maintaining these valuable resources. These projects are described briefly here.

Trinity River Project

In 1963, the U.S. Bureau of Reclamation completed the Trinity River Division of the Central Valley Project, and export of Trinity River water to the Sacramento River and south began. The Trinity Project was California's first experience with a major transbasin diversion. Since completion of the Project, a number of major environmental changes affecting salmon and steelhead populations have occurred in the main stem Trinity River downstream from Lewiston Dam. These changes were largely the result of alterations in the river's historic flow

patterns caused by diversions to the Sacramento River of 80-90% of the preproject flows past Lewiston.

Coincident with the environmental changes that have occurred, dramatic declines have occurred in the numbers of adult steelhead and fall chinook salmon entering the Trinity River. In 1977, the Department's Anadromous Fisheries Branch initiated a study aimed at finding the causes and to recommend a course of action to reverse declines in Trinity River fall chinook salmon and steelhead runs. This program is currently funded by the U.S. Bureau of Reclamation and U.S. Bureau of Indian Affairs with the approval of the Trinity River Basin Fish and Wildlife Task Force.

A major study activity is to develop annual spawning escapement and harvest estimates for Trinity basin salmon stocks. These estimates have been generated annually since 1977.

The Project is also conducting studies aimed at determining relative return rates and contributions to spawning escapements and to the fisheries, of salmon produced at Trinity River Hatchery. Hatchery management practices such as time, place and size at release, designed to increase adult ocean contribution and river returns are also being evaluated. To date, approximately 4.4 million spring and fall run chinook and 0.8 million coho salmon have been coded wire tagged and released from Trinity River Hatchery as part of these studies. Relative return rates to the Trinity basin and Trinity Hatchery of the various mark groups are monitored at weirs on the lower Trinity River and at the hatchery.

A third element of the Trinity Project deals with determining the contribution of Trinity River Hatchery produced chinook to the Trinity run, and the rate and distribution within the Trinity system of Trinity Hatchery salmon. To date, a total of 1.7 million 1979, 1980 and 1981 brood year spring and fall chinook have been fin-clipped and released as part of this "Constant Fractional Marking Program". Chinook are examined for marks during adult trapping/tagging operations and carcass surveys, and upon entering Trinity River Hatchery.

In a related Department funded operation, Region 1 personnel annually conduct a salmon carcass survey in the approximately 18 mile reach of the main stem Trinity River between Lewiston Dam and Douglas City. This effort is directed at developing an index of chinook salmon spawning escapement in the upper main stem Trinity. This index is used to assess the effects of changing river flows, and to evaluate effectiveness of reconstructed spawning riffles there.

Klamath River Project

The Klamath River, located in the northwestern portion of the State, has been the focus of much attention in recent years because of its major importance to the ocean salmon fisheries off northern California and southern Oregon and to instream users. Our Klamath River Project, started in 1976, is directed toward monitoring the salmon and steelhead runs in the balance of the Klamath River system (excluding the Trinity River basin); maximizing the contribution of the production of salmon and steelhead from Iron Gate Hatchery; and filling gaps in our understanding of the life histories and harvest in ocean and river fisheries

of the Klamath salmon and steelhead stocks. This Project is currently funded by the National Marine Fisheries Service (Anadromous Fish Act) and the U.S. Bureau of Indian Affairs.

Mark and recapture studies, carcass surveys and weir counts have been used on the Klamath River annually since 1976 to estimate the magnitude of the fall chinook and coho salmon runs. Estimates on river fishery harvest have been developed from tagging of upstream migrants. Additional information on length frequencies, timing of the runs, and incidence of hatchery marked fish are collected in a project seining and creel and census operation.

Since 1965, Iron Gate Hatchery has released an average of 5.7 million fingerling chinook, 59,000 yearling chinook salmon and 56,000 yearling coho salmon annually. The Klamath Project is in the process of estimating survival and catch escapement ratios for these releases based on marked (CWT) salmon returns. Tagging began in 1979. To date, Project personnel have marked 22 groups of Iron Gate salmon. Information on their survival, contributions to the fisheries, and returns as adult fish is being collected during hatchery and spawning ground surveys.

Wild and Scenic Rivers Fisheries Project

The California Legislature funds fishery studies for designated Wild and Scenic Rivers of the State. These rivers include parts of the Smith, Klamath, Trinity and Eel river systems and the lower American River. With Anadromous Fish Act and Department funds, limited studies have been carried out on most of these rivers.

The major effort over the past eight years has been on the Van Duzen, Salmon, Scott, lower American, Smith, South Fork Trinity and Eel rivers. Fishery evaluation and management plans have been completed for the Salmon, Scott, lower American, Smith and South Fork Trinity rivers. A status report for the entire system was published in 1982 with management and enhancement recommendations.

The two major studies presently underway by the Wild and Scenic Rivers Project are described separately below.

South Fork Trinity River Studies. The South Fork Trinity River studies are conducted in cooperation with the U.S. Forest Service and California Trout (an angler organization with special interest in steelhead). The studies have involved i) population estimates for both spring and fall chinook; ii) angler surveys to gather information on adult steelhead; iii) habitat evaluation, and iv) development of population data on juvenile steelhead. A summary of the habitat evaluation has been published as the "South Fork Trinity River Salmonid Habitat Enhancement Studies". Additional information will be published by the U.S. Forest Service for the "South Fork Trinity River Model Steelhead and Salmon Demonstration Project" committee.

Eel River Salmon Study. The Eel River salmon study is being conducted to establish base line information for management and preservation of the salmon resource of the Eel River system.

The study's goals are as follows:

- 1) Determine the distribution of salmon in the Eel River system.
- 2) Determine the population size of Eel River salmon.
- 3) Determine sport angler effort and catch of Eel River salmon.

Some of the methods in the study, particularly involving juvenile fish, are experimental. The adult studies are complicated by typically high flows and turbid water frequently encountered in the system in the fall and winter. It may require, therefore, many years of effort before suitable weather allows completion of a tagging study and/or carcass surveys to estimate population size or to establish reliable indices.

In addition to the above activities in the Eel River system, a cooperative salmon carcass survey between the Department's Region 3 and Pacific Gas and Electric (PG&E) has been conducted annually for the past four years in Tomki Creek, a tributary to the Eel River below Van Arsdale Dam. Chinook counts were highest in 1979 when 1,200 carcasses were recovered. Counts have been lower during the past three years (163, 565, and 560 during 1980, 1981 and 1982, respectively). These data are being used to evaluate changes in flow releases from PG&E's Potter Valley Project. Under the past flow regime at Van Arsdale Dam, flows were often inadequate for adult fall-run chinook in the river below the dam and above the confluence of the Middle Fork Eel River. Recently negotiated augmented flows in this reach will enhance main stream spawning conditions and improve access to upper river tributaries.

Central Valley Programs

The Central Valley consists of the main stem Sacramento and San Joaquin rivers, their tributary streams, the Delta, and San Francisco Bay. The Anadromous Fisheries Branch, Regions 1, 2, 3, 4, and the Department's Bay Delta Study work together in managing the salmon resources of this area. In addition, the U.S. Fish and Wildlife Service (USFWS), U.S. Bureau of Reclamation (USBR), California Department of Water Resources (DWR), and National Marine Fisheries Service (NMFS) cooperate in most of the programs aimed at maintaining fishery resources in the area. The following are highlights of major experimental management programs currently in progress in the Central Valley.

Region 1

Central Valley Project--Several cooperative studies (USFWS, USBR, DWR and the Department) have been conducted to evaluate the impact of Red Bluff Diversion Dam upon chinook salmon passage. Results show a 55% greater return of adults from fingerlings released immediately downstream of the dam compared to fish released above the dam. Studies of survival among fingerlings transported to several other locations downstream of the dam are currently underway. Holding fish in Coleman Hatchery for a longer time prior to release has also been shown to increase survival and returns to the upper river.

Adult salmon have also been shown to be affected by the dam. Studies indicate the dam reduces migration past Red Bluff by 30%. There was up to a forty day delay among those adults which finally did negotiate the dam fishway. The release of water from the gates closest to the fish ladders improved adult passage.

Studies of adult fish tagged with sonic tags in the Delta have shown flow reversal, caused by Delta water pumping, stopped adult migration. Migration resumed when pumping stopped. The Bureau supplied \$23,000 in equipment and the Department \$57,000 in manpower to complete this study.

The Central Valley Project plans to mark approximately 3 million fish for experimental management studies throughout the Central Valley in 1983. These fish will be used by the Anadromous Fisheries Branch, the Regions, the Bay Delta Project and others. This marking program will cost approximately \$120,000.

Region 2

Region 2 is currently planting surplus chinook salmon fry (120-400/lb) from Nimbus and Feather River hatcheries into habitats which are currently underutilized. This program is aimed at increasing production for these areas and rebuilding depressed natural stocks. Spawning stock surveys are conducted annually by Region 2 personnel.

Mokelumne River--A study of the effects of release location upon returns of chinook salmon as adults to the hatchery showed that yearlings released at Rio Vista and Vallejo return to the hatchery at similar rates. Adult returns from yearlings released at the Mokelumne River Fish Installation were 50% the returns of releases from two downstream locations, Rio Vista and Vallejo. A study is planned for next year to evaluate the impact of Delta water pumping upon hatchery released smolts. The feasibility of expanding the Mokelumne River Fish Facility to produce another 1 million yearling is being considered for 1983 with first release scheduled for 1984.

Feather River--Studies of tagged chinook fry (120-400/lb) planted at Benecia, Clarksburg, below the Red Bluff Diversion Dam and in the Delta, have shown the adult return from fry to be the highest from plants below Red Bluff Diversion Dam (upper river) and lowest from plants in the Delta.

The 1982 adult contributions to ocean fisheries from smolts (60/lb), postsmolts (45/lb), and yearlings (20/lb), released at Vallejo showed very high survival of the fish. Fish planted as smolts averaged 1 pound larger at return than those released as post smolts; post smolts were 1 pound larger than fish released as yearlings. One problem with releasing smolts and postsmolts at Vallejo has been increased straying among adult fish. The strays, however, have been migrating in large numbers to tributaries in the upper Sacramento River where greater natural spawning escapements are needed. Regional personnel plan to evaluate various saltwater planting locations this next year to determine which locations give the best survival, return to the fisheries and to spawning escapement.

Two thousand spring run chinook returned to Feather River Hatchery this year. Few of these fish were caught in the ocean commercial fishery but many were taken in the ocean and river sport fishery. In 1983, a study will be included to evaluate the effects of trucking spring run smolts to Vallejo.

Region 3

There was a small run of fall chinook salmon (50-100 fish) in the mainstem of the Napa River between Yountville and St. Helena in 1982. One fish caught by an angler had a coded wire tag from a Feather River Hatchery release at Port Chicago in 1979. A survey was conducted in Lagunitas Creek (Marin County) to assess the juvenile coho salmon population following last winter's storms. Few fish were present. Volunteers, National Park Service and Department personnel conducted the surveys.

Region 4

Work is continuing on the three year evaluation of the Merced River Fish Facility. One element of this study is directed at evaluating the effects of releasing fish at the hatchery versus releasing them at locations downstream from the hatchery, beyond the influence of the State and Federal pumps diverting water to southern California adult fish from this study will begin returning next year. Another phase of the study is directed at evaluating contributions to fisheries from release of surplus fingerlings (90/lb). Approximately \$15,000 is being spent annually on the Tuolumne River in cooperative studies involving local

irrigation districts and the U.S. Fish and Wildlife Service. Work includes salmon carcass surveys, downstream migrant surveys and assessment of instream flow requirements of spawning chinook salmon.

Bay Delta Project

The Bay Delta Project is funded principally by the State Department of Water Resources to determine the environmental impacts of present diversion facilities and planned development of increased diversion on the Sacramento-San Joaquin Delta and proposed water developments of the California Water Plan. They are also charged with making recommendations to ameliorate these effects.

Studies have been completed which showed that chinook salmon smolt survival in the Delta increases as flows increase and water temperatures decrease. In 1978 and 1981, smolt survival of marked chinook in the Delta was estimated near zero because of low flows and elevated water temperatures.

There are several studies in progress designed to provide additional data on the life history and habitat requirements of chinook salmon within the Bay Delta area.

Specifically, these studies include: i) determining outmigration patterns and size distribution of wild fall run chinook juveniles, ii) evaluating the importance of the San Francisco Bay estuary as a rearing area for presmolt chinook, iii) estimating the relative abundance of fall run chinook fry within the estuary, iv) determining the life history patterns of the four runs of chinook

salmon in the Sacramento River drainage, and v) evaluating the physical, biological, and chemical variables which may influence chinook salmon abundance in the upper Sacramento River. These studies will be completed in the next few years.

National Marine Fisheries Service

A small scale cooperative Fish and Game, National Marine Fisheries Service (NMFS) and Tyee Club study has been underway for several years at the NMFS Tiburon facility. Chinook and coho salmon smolts from various Department hatcheries have been reared in sea water pens for 53 to 136 days prior to release into the bay. Results have shown these fish grow rapidly (1.5 to 10 times) during the holding period. Recovery of adults from this program has been highly variable. One release, however, recorded almost a 5% return. This program has used volunteer labor (Tyee Club), and NMFS facilities. The Tyee Club, a sportsman's organization interested in improving sport fishing in the Bay also provides some food. Approximately \$3,500 is spent annually for food, trucking and supplies. The Department expended about \$2,700 for tagging the fish used in these studies. This work will continue next year.

MISCELLANEOUS SIGNIFICANT MANAGEMENT EFFORTS

The California Fish and Game Commission sets regulations for salmon sport angling in the inland areas. In order to reduce harvest of both juveniles and adults they recently reduced the daily possession to two fish statewide and toughened up regulations against snagging.

They have also adopted a rigid program of revoking or suspending the fishery privileges of all violators of commercial salmon laws. Perhaps their most significant action was the closing of 16 miles of the Sacramento River to the taking of salmon to accelerate the repopulation and use of this area by the four races of chinook.

Chronic zinc and copper pollution have killed millions of fry and fingerlings in both the Sacramento River and in our hatchery on the Mokelumne River. In the latter case, the offending abandoned mine has been sealed and runoff impounded. No significant pollution has occurred in several years despite heavy runoffs.

In 1982 DFG contracted with the Regional Water Quality Board to build a pilot plant to strip zinc and copper at the Iron Mountain Mine from which the pollutants reach the Sacramento River. This plant will be operated during 1983 to determine its effectiveness and to provide data for increasing the volume of flow through a larger plant. Further studies have been completed by contractors to the RWQCB and by the Bureau of Reclamation describing other actions to be taken to further reduce the pollution.

SUMMARY

The magnitude and quality of State inland programs provides a basis for optimism for the future of inland salmon production and a healthy sport and commercial fishery. Several examples given below justify this optimism.

Already at Warm Springs Hatchery several jack chinooks and over 1,100 jack coho have returned to the facility. Butler and Bond Creeks, tributary to the South Fork of the Eel River, both cleared of numerous mountainous logjams in 1979, have had several hundred spawning chinooks annually. Tributaries to the Russian River, most producers of coho and ravaged by the drought, are once again seeing spawning coho.

Our success in reaching tentative agreement with Pacific Gas and Electric Company on augmented flows from their Potter Valley Project Federal Energy Regulation Commission relicensing will once again bring salmon to the upper Eel River and its tributaries. We are anticipating that these new flows will provide habitat for approximately 3,000 adult salmon annually in the mainstream below Van Arsdale Dam and provide more consistent access to the upriver mainstem and its tributaries.

NEW PROGRAMS OR PROJECTS FOR 1983
CALIFORNIA DEPARTMENT OF FISH AND GAME

Klamath/Trinity Rivers

- 1) Begin planning of engineering to increase yearling chinook production in offsite rearing ponds in the Klamath basin by 500,000 to 1.0 million fish. One site in particular, located near Trinity River Hatchery, looks promising.
- 2) Rearing space has been allocated at the Mad River Hatchery to produce up to 2.0 million chinook salmon smolts (larger than 90/lb) annually from surplus eggs taken at Iron Gate Hatchery on the upper Klamath River until Mad River stocks increase sufficiently (3-5 years). These smolts will be planted in the lower Klamath River.
- 3) Construct permanent weir on Mad River at hatchery to increase capture of adult salmon for the hatchery and local pond rearing programs.
- 4) Begin cooperative program with the U.S. Forest Service this spring of reseeding Klamath River tributaries with surplus chinook salmon fry from Iron Gate Hatchery. Primarily streams that have been agreed upon as potential salmon spawning streams within U.S. Forest Service and state stream clearance programs would be involved.

- 5) Begin experimental trucking in the Klamath River of 600,000 smolts and yearlings annually from Trinity River and Iron Gate hatcheries for release in the lower Klamath Trinity basins. We are being cautious about trucking hatchery fish in the Klamath because of anticipated straying of adult fish and problems in securing enough eggs to operate at capacity.
- 6) Construct a new fish ladder at Iron Gate Hatchery. This addition is needed to insure an annual egg supply at Iron Gate sufficient to meet current and planned programs based on Iron Gate Chinook.
- 7) Realign and stabilize channel of South Fork Trinity to provide better access to upstream spawning areas.
- 8) Complete gravel restoration projects on Shasta and Klamath Rivers.

Sacramento/San Joaquin Rivers

- 1) Build in cooperation with DWR, new rearing ponds at Thermolito Afterbay to alleviate IHN problems at Feather River Hatchery and to produce an additional 1.0 million FRH yearlings.
- 2) Begin program of reseedling upper Sacramento River with chinook fry surplus to hatchery needs at Nimbus and Feather River hatcheries.

- 3) Replace old fishway on Clear Creek.
- 4) Reconstruct unused spawning channel at Mokelumne River Fish Installation to rear an additional 1,000,000 yearlings.
- 5) Complete remaining gravel restoration projects on Upper Sacramento River.

Eel River

- 1) Construct new screen on the Potter Valley PGE diversion.

Russian River

- 1) Build holding and imprinting facility at Coyote Dam as part of mitigation for Corps of Engineers project.
- 2) Double capacity of Warm Spring Hatchery as remaining portion of mitigation for Coyote Dam.

