UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
ARNIE J. SUOMELA, COMMISSIONER

A PRELIMINARY SURVEY

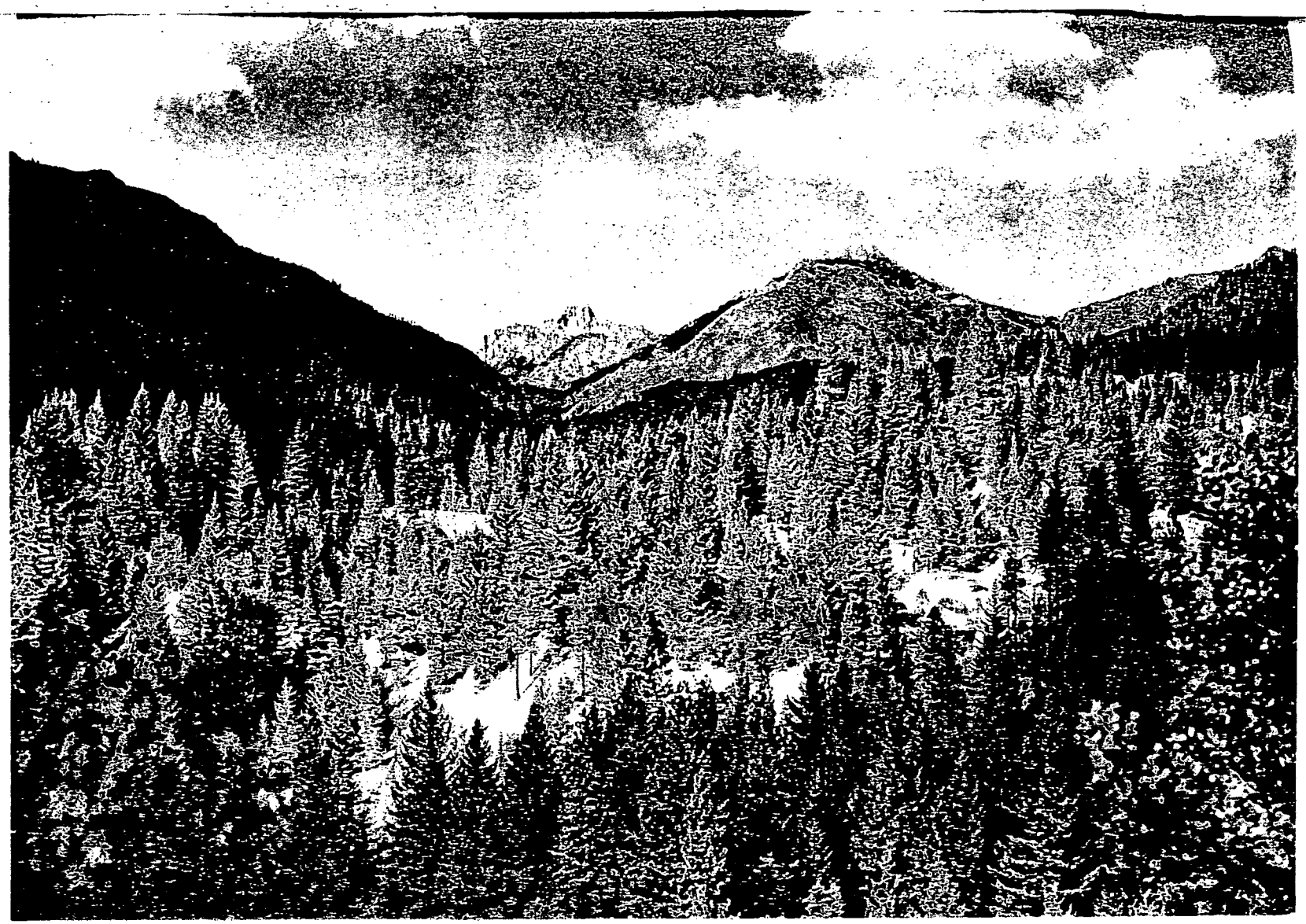
OF

FISH AND WILDLIFE RESOURCES

OF

NORTHWESTERN CALIFORNIA

Portland, Oregon
October 1960



Northwestern California consists of abundant forests with extensive areas of wilderness. A variety of fish and wildlife habitat occurs from the mountainous divides to the Pacific Ocean. View of Trinity Alps from Canyon Creek, a tributary of Trinity River.

REPORT OF THE REGIONAL DIRECTOR

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

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October 20, 1960

Memorandum

To: Chairman, Pacific Southwest Field Committee, Department of the Interior, Salt Lake City, Utah

From: Regional Director, Bureau of Sport Fisheries and Wildlife, Portland, Oregon

Subject: Fish and Wildlife Resources, Northwestern California (1-RB)

This is our survey report on fish and wildlife resources of Northwestern California. It has been prepared at the request of the Secretary of the Interior in accordance with the Fish and Wildlife Coordination Act, (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The attached substantiating report gives emphasis to the fish and wildlife resources as they exist today in Northwestern California. Many problems which presently limit fish and wildlife production and utilization or may limit it in the future are summarized. The report considers the possibilities of improving conditions and of compensating for losses which have been caused by past developments and which may be caused by those of the future.

This report has been reviewed by the California Department of Fish and Game. The report has been endorsed by that department as indicated in a letter from Deputy Director Harry Anderson, dated September 19, 1960, a copy of which is appended to the attached substantiating report.

Northwestern California is an extensive semiprimitive region of more than 13,000 square miles of forested, mountainous terrain which contains several thousand miles of streams and a great variety of fish and wildlife habitat. More than 90 percent of the region is forested, over half of which is administered by the U. S. Forest Service. More than 600,000 acres of National Forest land are devoted to wilderness areas. The region is surrounded by areas which are experiencing rapid increases in population.

Utilization of this region for recreational purposes has shown a marked increase in the past ten years, and growth of urban populations and development of better highways indicate an even greater increase for recreation in the future. The area has a high potential for meeting much of the increasing demand for fishing and hunting. Consequently, planning for fish and wildlife should be made an integral part of future industrial and water development. Fish and wildlife resources of Northwestern California are not only of great value to the area under consideration but also to the entire State and to areas outside California.

Conservation and development of the salmon and steelhead trout fisheries in coastal streams are of prime importance. These fish are migratory and depend on passage to and from their native spawning habitat for continued existence. They need clear, cool waters, abundant gravel areas, and unobstructed migration routes. These needs must be met to insure perpetuation of the resource and fulfillment of future demands for fishing.

Census studies indicate that approximately 160,000 chinook salmon, 56,000 coho salmon, and 580,000 steelhead trout return annually to Northwestern California streams from the ocean. These fish form the basis of an important sport fishery in the area which accounts for more than 300,000 fisherman-days-use and an annual sport catch of about 350,000 fish. This represents an annual expenditure by fishermen of more than $5,000,000. Salmon also serve as the basis of important sport and commercial fisheries in the offshore ocean waters. Annual commercial catches amount to more than 2,000,000 pounds.

Big game, upland game, fur animals, and waterfowl are widely distributed throughout Northwestern California in moderate to high numbers. Estuarine and offshore areas are valuable for both fish and wildlife.

Black-tailed deer are common throughout the area. They are currently subjected to moderate hunting pressure but will be increasingly sought by sportsmen from growing urban centers. Elk, occurring in small numbers in parts of the Prairie-Maple Creek drainages and adjacent areas, have not been hunted in recent years. Historically, elk were widespread in Northwestern California and reestablishment in the more remote parts of this region appears to offer some possibility. However, attempts at stocking and dispersal of this species by California Department of Fish and Game have been only partially successful. Black bears are common in Trinity, Humboldt, and Siskiyou Counties.

California and mountain quails are common throughout the area. The former inhabit the floodplains and deltas of all the drainages where agriculture is practiced, while the latter occur at higher elevations and show a preference for brushy cover along streams, cut-over land, and the edges of clearings in timbered areas. Band-tailed pigeons provide good

hunting throughout the area. About 5,000 of these birds are harvested annually in Humboldt County alone. Mourning doves are also abundant but are subjected to much lighter hunting pressure. Other upland game species in the area are hunted lightly and include gray squirrels, brush rabbits, and snowshoe hares.

Northwestern California supports a variety of fur animals. Minks, river otters, and beavers are the most important of the group and are common throughout the numerous drainages. Muskrats inhabit the marshes near Crescent City. Fur animals are lightly harvested due to the low market demand for fur. Other fur animals of the area are raccoons, weasels, skunks, ringtail cats, gray foxes, and bobcats.

Numerous bays and estuaries attract a variety of waterfowl during the winter. A moderate number of mallards, cinnamon teal, and wood ducks nest along the streams and sloughs. Humboldt Bay is an important wintering area for black brants. In recent years as many as 25,000 to 50,000 of these birds have been counted in the bay. This goose is peculiarly dependent upon the large beds of eel grass found in South Humboldt Bay for food. Brants are eagerly sought by local sportsmen who kill more than 3,000 geese annually in Humboldt Bay. Castle Island offshore from Crescent City is frequented by the Western Canada goose and represents the southern limit of the winter range for this subspecies.

The substantiating report is intended to provide information on fish and wildlife needs to agencies planning water, industrial, and civic developments in Northwestern California. If these needs are to be met, contemplated water development plans should include measures for conservation and development of fish and wildlife resources including specific proposals for accomplishing the following:

1. Prevention of destruction of fish and wildlife habitat caused by gravel removal, mining activities, highway construction, logging activities, flood control measures, and harbor development.

2. Maintenance of adequate streamflow for the needs of fish and wildlife.

3. Prevention and abatement of pollution in streams and estuarine areas.

4. Establishment of a management area in a portion of Humboldt Bay for protection and improvement of habitat utilized by black brant.

5. Improvement of public access for hunting and fishing areas.

SUBSTANTIATING REPORT

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

PREFACE

This report is a preliminary survey of the fish and wildlife resources of Northwestern California. It supplements and brings together existing knowledge of the fish and wildlife resources of the region.

In 1952, the Pacific Southwest Field Committee of the Department of the Interior initiated an over-all survey of the natural resources of this coastal area with the objective of presenting a unified report. Early in 1954, the U. S. Department of the Interior gave recognition to the need for a study of the fish and wildlife resources of Northwestern California. The need for this presentation was apparent because of rapid and imminent development of the area. Seven agencies of the Department of the Interior subsequently undertook assignments for completion of various facets of the report. This report is the contribution by the Bureau of Sport Fisheries and Wildlife of the United States Fish and Wildlife Service to the comprehensive study.

Previous Fish and Wildlife Service reports on river basin development for Northwestern California have been: "Branscomb Reservoir, South Fork Eel, California," 1950; "Trinity River Division, Central Valley Project, California," 1951. Both of these reports on specific areas were preliminary evaluation reports on the fish and wildlife resources. In 1956 a joint report was prepared by the Service and the California Department of Fish and Game entitled "A Plan for the Protection and Maintenance of the Fish and Wildlife Resources Affected by the Trinity River Division, Central Valley Project." In January 1957 the Service prepared for

administrative purposes a report entitled "Progress Report on Fish and Wildlife Resources of the North Coast, California."

The purposes of this report are threefold: (1) to summarize pertinent information on fish and wildlife resources; (2) to supplement the existing knowledge, particularly of the fisheries, by summarizing recent investigations; (3) to make a general analysis of the existing needs of fish and wildlife resources and their needs in relation to proposed and potential development of the area.

In January 1954, a fish and wildlife steering committee was formed. The committee included representatives of the U. S. Fish and Wildlife Service, U. S. Bureau of Reclamation, California Department of Fish and Game, and California Division of Water Resources. The function of this committee has been to establish the general objectives of the fish and wildlife investigations.

The Bureau of Reclamation, the California Department of Fish and Game, and the California Water Resources Board and its successor, the Department of Water Resources, have participated in activities of the fish and wildlife steering committee and cooperated in supplying valuable information and suggestions. Other agencies contributing significantly to information contained in the report or used as the basis for conclusions have been the California Division of Beaches and Parks, the U. S. Forest Service, the Division of Natural Resources of Humboldt State College, U. S. Geological Survey, National Park Service, and numerous other agencies and individuals. Indians of the Hoopa Reservation and Extension have supplied valuable information on fish and wildlife resources.

DESCRIPTION OF THE AREA

Physical Features

The area under consideration comprises about 13,200 square miles, all in Northwestern California except for some minor tributaries which drain the southern fringes of Oregon. This area includes the Klamath River drainage below Copco Dam, near the Oregon-California state line. It extends approximately 200 miles along the Pacific Coast, and 60 to 90 miles inland. All of Del Norte, Humboldt, and Trinity, about half of Siskiyou and Mendocino, and small portions of Lake and Glenn Counties, California are within the area. Small portions of Curry, Jackson, and Klamath Counties, Oregon form the upper reaches of some of the watersheds.

Most of the region is mountainous with many peaks reaching an elevation of 6,000 feet. Maximum elevation, 14,161 feet, is attained at Mt. Shasta on the eastern divide. Principal mountain ranges in the region include the Coast Range on the south and southwest, the Cascade Range on the northeast in Oregon and California, and the Klamath Mountains in northwestern California and southwestern Oregon. Other important mountain groups include the Siskiyou Mountains in Oregon and California; the Yolla Bolly Mountains in the Coast Range; and the Marble, Scott Bar, and Scott Mountains and Trinity Alps lying between the Cascade and Coast Ranges.

Principal streams of the region include the Smith, Klamath, Mad, Eel, and Mattole Rivers and Redwood Creek. More than half of the region of concern is drained by the Klamath River and its major tributaries including the Shasta, Scott, Salmon, and Trinity Rivers. The drainage

basins of Lost River and Lower Klamath Lake, outside the study area, are virtually non-contributing to the Klamath River flow because of the use and loss of water in such areas. The drainages of the Coast Range generally occur at much lower elevations and, as a consequence, there are differences in runoff and water temperature as compared to those drainages of the higher, more extensive Klamath Mountains.

Northwestern California terrain is mostly rugged and mountainous. Small areas of valley land exist in the lowermost portions of the basins and are scattered along the drainages in the interior such as Round, Butler and Hoopa Valleys. About 93 percent of the area is forested.

More than 50 percent of Northwestern California is included in Six Rivers, Klamath, Trinity, Mendocino, and small portions of Siskiyou and Rogue River National Forests. There are three wilderness areas: Marble Mountain (214,543 acres), Salmon-Trinity (285,432 acres), and Yolla Bolly (111,091 acres). Public domain accounts for 170,000 acres and Indian land 126,000 acres. State parks and redwood groves include about 56,000 acres. Privately owned lands, located principally in Humboldt and Mendocino Counties, comprise less than half of the entire area.

The Cascade Range consists of volcanic rocks of the Tertiary and Quaternary ages. Principal mineral deposits of the latter are found as lode deposits in intrusive rock or as deposits formed by stream concentration of lode materials. The Northern Coast Range is underlain by rocks that are sedimentary or volcanic in origin. Younger rocks

overlie these in some areas. Early Pleistocene lake sediments and valley fill occur in small patches in some of the valley lands of the Eel River.

Arable soils of Northwestern California consist of recent alluvial deposits, those derived from coastal plain and old valley filling materials, and wind deposited soils. The alluvial soils are the most valuable for agricultural development and are found in the lower valleys of the Mad, Eel, Smith, and Trinity Rivers and in the valleys located along the upper tributaries. These soils are further classified as to their textures and ease of drainage. Those occupying highest positions on the alluvial fan are well-drained soils and suitable for farming. Those soils occurring in the lower alluvial fan are poorly drained with clay loams predominating in texture. Wind-deposited soils, occurring only near the coast, are also poorly drained and have limited agricultural use. Coastal plain and old valley fill soils are derived from water-laid deposits which have undergone modification and weathering. They are found in a series of terraces which are marine in origin. Some of the better soils are covered by heavy stands of timber, largely redwoods and firs. These soils comprise the more extensive arable soils in the area occurring from Table Bluff to Trinidad, Crescent City to Smith River, and in the lower Eel and Van Duzen River areas.

Temperatures along the coastal portion of Northwestern California are mild and equable. The July average temperature in Eureka, which

typifies areas adjacent to the ocean, is about 56° F., and January the coldest month, averages only 9° F. less, although extremes are much greater. Temperatures along the coast seldom get above 70° F. in the summer or below freezing in the winter. A great amount of fog occurs along the coast, particularly in the summer months. Further inland, where the maritime influence decreases and altitude increases, summers are much warmer and winters much colder. At Weaverville, 90 miles east of Eureka, the July average is 71° F. with summer highs frequently about 90° F. and sometimes above 100° F. The growing season at Weaverville is only 97 days, in contrast to 245 days in the Eureka area.

Storms move inland from the Pacific Ocean, resulting in high precipitation in the winter months. The wet period extends from November to June but highest precipitation occurs during December and January. During the summer, precipitation is light. Smith River basin has an average annual precipitation of about 100 inches. The Klamath River basin has about 90 inches near the coast and has the greatest variation inland of any of the coastal drainages. Annual precipitation in much of Shasta River basin, which is tributary to Klamath River, is only 20 inches. However, the remainder of Northwestern California has abundant precipitation, ranging from annual averages of 40 to 90 inches. Along the coastal region snowfall is meager. Inland, at the higher elevations, particularly above 4,000 feet, snowfall is much greater.

High rainfall contributes to a lush growth of vegetation throughout the area. A combination of the equable climatic conditions and fog along the coast provides the requirements for the renowned redwood forests. Undergrowth is dense and shrubs rapidly appear in areas that have been cut or burned.

Six major streams and several smaller ones are covered in the discussions of fish and wildlife resources that follow. Descriptions of the stream-flow and existing water developments are included in the fishery discussions. The cover, topography, climate, and other pertinent features of the main basins are described briefly in succeeding paragraphs.

Smith River

The Smith River watershed is largely forest-covered. Except for the lowermost narrow coastal plain, it drains large areas of virgin timber in Six Rivers National Forest in California. The reach of the North Fork within Oregon is located in the Siskiyou National Forest. The uppermost reaches and crest portions, reaching elevations of more than 5,000 feet, receive moderate amounts of snowfall in the winter. The main stream, arising on the forested westward slopes of the Siskiyou Mountains, follows a northwest course after joining the North and South Forks, and flows into the Pacific Ocean about four miles south of the Oregon-California state boundary. Smith River drainage receives the highest rainfall of any of the coastal streams, with the annual average precipitation exceeding 90 inches over most of the watershed.

Klamath River

The Klamath River watershed is extensively forested and large areas contain stands of virgin timber. Most of the drainage lies within the Six Rivers, Klamath, Shasta, and Trinity National Forests. The Marble Mountain Wilderness Area, containing 214,000 acres of remote mountainous area, which is drained by tributaries of the Salmon, Scott, and Klamath Rivers, is located in the Klamath National Forest. The Salmon-Trinity Alps Wilderness Area, consisting of 285,000 acres of the spectacular Salmon and Trinity Alps, is situated within the Trinity National Forest. In this primitive area arise New River, North Fork Coffee Creek, and smaller tributaries of Trinity River.

Downstream from Copco Lake, the Klamath River flows westward and is joined on its left bank by the Shasta and Scott Rivers and then turns rather abruptly southward and is joined by the Salmon and Trinity Rivers. After its confluence with Trinity River, it changes its course and flows northwestward and empties into the Pacific Ocean near Requa, California. Throughout most of its course, Klamath River and its ~~tributaries~~ drain forested, deeply cut, mountainous terrain with only the valleys of the Shasta, Scott, and Trinity Rivers providing appreciable amounts of land suitable for agriculture.

The higher elevations of the Klamath Mountains occur at the headwaters of Trinity River. Peaks with elevations of over 9,000 feet are found in the Trinity Alps and the Scott Mountains. Mt. Shasta, rising to 14,161 feet, borders the eastern upper limits of Shasta River. Numerous

peaks and ridges of 5,000 feet or more in elevation occur in many portions of the drainage.

Rainfall is exceedingly variable in this basin. Near the coast the annual average is 90 inches. Inland about 25 miles, the average decreases to 50 inches. Further inland, the average is reduced to less than 40 inches over large portions of the watersheds of Shasta and Scott Rivers. Lower Shasta River Valley has an average of less than 15 inches. High ridges and peaks, receive 50 to 70 inches of precipitation.

Redwood Creek

Redwood Creek drainage, with minor exceptions, consists of privately owned forest lands. It falls largely within the Coast Redwood Belt. Most of the slopes are forested with redwood and fir. Elevations of the basin range up to 5,000 feet.

Average annual rainfall for the entire basin is about 67 inches. The seasonal rainfall occurs during November through March with very little precipitation during June through September. Stream flows are distinctly dependent upon the pattern of precipitation.

Mad River

Upper Mad River watershed is within the Six Rivers National Forest, whereas about the lower two-thirds is in private holdings with the exception of a small State park and public roads. This drainage has been actively logged for many years and the lower portions are being cleared and converted to pasture for cattle and sheep. Highest

peaks rise to 6,000 feet, but most of the drainage lies at 2,500 feet or less. Annual average rainfall for the basin is 62 inches, but only about 50 inches in the coastal portion.

Historically, placer mining for gold has occurred along the channel, but mining is no longer active.

Eel River

Eel River arises in the interior portions of the Coast Range. It flows in a northwesterly direction, joining the Middle Fork at Dos Rios, 113 miles above its mouth. It then joins the South Fork about 40 miles above the tidewaters and Van Duzen River 14 miles above the mouth. The Middle Fork drains Etsel Ridge with elevations as high as 5,500 feet and Shell Mountain and Anthony Peak which approach 7,000 feet. Headwaters of the Middle Fork are in the western portion of the Yolla Bolly Wilderness Area. Most extensive valley lands of Northwestern California are found in the delta plain extending downstream from Rio Dell to the stream mouth. Interior valley lands of some significance are Laytonville Valley on the South Fork and Round Valley in the Middle Fork drainage.

The headwater portions of Eel, Middle Fork Eel, North Fork Eel, and Van Duzen Rivers are within Six Rivers and Mendocino National Forests. A significant acreage of public domain land and Indian land is located in Round Valley. The world-famous redwood groves are located in four State parks along the Redwood Highway (U. S. 101), which parallels the South Fork Eel. These parks comprise a total of 24,000 acres.

Grizzly State Park, another redwood grove with camping sites, is located adjacent to Van Duzen River. Privately owned lands make up most of the remainder of the drainage.

Average annual rainfall for the basin varies from about 40 inches along the coast to 70 inches in the upper South Fork. Far inland, areas of the Middle Fork and upper Eel River receive an average of 50 to 60 inches. Rainfall is seasonal, and heavy precipitation begins in October and increases to a maximum in December and then gradually decreases to a low in June, July and August.

Mattole River

The Mattole River drainage area is slightly larger than that of Redwood Creek, the smallest of the six principal streams given individual consideration.. Rugged ridges of the coastal range, with the peaks ranging up to 4,000 feet, separate the main stream from the ocean. Crest elevation seldom exceeds 2,500 feet. The drainage is extensively forested except for the slopes adjacent to the coastline, several small farm tracts scattered along the main stream, and lower portions of the drainage which are mostly in pasture.

Average annual rainfall for this basin ranges from about 60 to 90 inches, with the central part receiving the most. Rainfall is seasonal, with high precipitation occurring in late fall and winter. Snowfall has little effect upon spring runoff.

Economic Features

The most important industry of Northwestern California is lumbering. It accounts for 70 percent of all employment. More than 300 sawmills and numerous processing plants are distributed over the area. Agriculture, including livestock production and dairy farming, is another important basic industry. Recent appraisal of existing arable flat lands shows 132,000 acres with about 22,500 acres presently irrigated. Most of this land and about 300,000 additional acres of unforested lands are used for pasture.

Historically, mining was a much more important industry than at present. Extensive placer gold extraction was practiced along the Trinity River and other streams through the first quarter of this century. Sand and gravel mining comprises the mainstay of the present-day industry. Commercial and sport fishing rank high in importance to the area. Sport fishing and hunting are in many instances tied to other recreational pursuits such as the tourist attraction of the redwoods, other forests, State parks, and primitive mountainous areas.

Economically, the recreational industry of Northwestern California is second only to lumbering. Although other sources of income in Northwestern California have been reduced, expenditures for recreation, of which hunting and fishing are important components, are expected to show accelerated growth. The notable salmon and steelhead fishery would be subjected to greatly increased pressure during the peak of the tourist season and during the off-season periods. This area of

more than 13,000 square miles of forested, mountainous terrain, with several thousand miles of fishing streams, offers great potential for meeting much of the fishing and hunting needs in future years.

The population of Northwestern California is relatively sparse. Based on estimates by the California Department of Finance, the total population in 1955 was 132,500. This shows an increase of 38,000, or 40 percent since the 1950 United States census. Most of the population was designated as rural with about one-third being urban. The largest towns and greatest density of population are near Humboldt Bay. The Eureka-Arcata area accounts for most of the urban population. The rural population is widely scattered along the rivers and coastal fringe.

It is estimated that in 1955 the area received about 600,000 visitors who spent more than 4,000,000 days in the area. Interviews by the Forest Service and by the State Division of Parks have revealed that a high percentage of these persons list fishing as a first purpose for visiting the area.

Sport fishing for salmon, steelhead trout, and resident trout ranks high in its attraction to visitors. Current studies show that more than 300,000 fisherman-days are annually spent on the north coastal streams.

With scheduled improvement in the principal north-south U. S. Highway 101 and other roads and great increases in California's urban population, future visitation to this area is expected to be even more marked. Northwestern California is in a position to meet many of the increased

demands on fishing and hunting if favorable consideration is given to fish and wildlife resources in water development projects.

The area is served by a highway system, a railroad, and airlines. Redwood Highway (U.S. 101) is the principal north-south route, paralleling the coast north of Humboldt Bay. The highway leaves the coast south of Eureka and follows the South Fork of the Eel River. Paralleling the South Fork Eel River for 90 miles, Redwood Highway receives heavy traffic because of the attraction of numerous redwood groves and the proximity of tourist facilities. Travel from the north and south has almost doubled in the past ten years.

State or county roads give ready access to the lower Van Duzen and upper Eel Rivers and other points in the basin. Many towns of moderate size have grown in the delta plains. Eel River and tributaries are provided with better access than other drainages of Northwestern California.

U. S. Highway 299 serves both coastal and inland California, and U. S. Highway 199 connects the northern portion of the area with the interior of Oregon. State and county roads generally parallel streams and the remaining coastline and provide the numerous small towns and villages with access to main highway routes.

Northwestern Pacific Railroad connects Northwestern California with San Francisco by way of Santa Rosa. The main service is for transport of lumber products. A limited passenger service is provided from

Willits to Eureka. Pacific Air Lines serves the north coast area at Arcata. Connections are provided to San Francisco and Sacramento, California and Portland, Oregon. Several seaports, notably Humboldt Bay and Crescent City, provide dock facilities for ocean-going freight and fishing vessels.

FISHERY SECTION

General

The Fishes

Anadromous fish are an outstanding fishery resource in this north coastal area. Species of greatest importance, occurring in all of the more important streams, are chinook salmon, coho salmon, and steelhead trout. These fish form the basis for important sport fisheries in the streams of the area. Salmon are of first importance to the commercial and growing sport fishery in the ocean. The sea-run cutthroat trout also uses the ocean and freshwater during various stages of its life cycle and is of importance to the sport fishery in the northernmost streams. Sturgeons, shad, eulachon, long-finned smelt, and Pacific lampreys are also anadromous, returning principally to the Klamath and Eel Rivers. They contribute to small, yet distinctive, fisheries. Fishing for sturgeon is apparently of increasing interest on the main Klamath River in the vicinity of Orleans and elsewhere. Resident fishes support important fisheries in some streams and lakes, but are restricted in their distribution in the region. For convenience they are described only under the sport fishery headings, below.

Life Cycles of Anadromous Fishes

The life cycles of salmon and steelhead trout are similar in many ways. Adult fish return from the ocean waters to the streams of their origin to spawn. Selection of sites and preparation of redds is accomplished by the females. After the eggs are deposited and fertilized, they are covered by gravel in the redds. Pacific salmon die after the completion of spawning. Steelhead trout may live to return to the ocean and subsequently spawn again in fresh water, although many succumb to the rigors of migration and spawning. After the young have hatched and emerged from the gravel they remain for varying lengths of time in the stream. Young chinook salmon generally move oceanward soon after hatching with a variable amount of delay, particularly in the estuarine waters. Some young chinook salmon may remain for a year in fresh water but the number is thought to be insignificant. Almost all young coho salmon remain in fresh water about one year after hatching and migrate to stream estuaries or the ocean when about four to five inches in length. Young steelhead trout remain in fresh water for varying periods with a majority staying in fresh water for one or two years and a few may remain for three years.

The stages of the life cycle spent in fresh water are exacting in their requirements. Passage to spawning gravel must be permitted and proper flow, temperature, and water quality must prevail through the period of emergence of the young fish. Whereas most young chinook salmon migrate toward the ocean soon after spawning, the majority of coho salmon and steelhead trout are dependent upon suitable year-round stream conditions

if they are to mature and contribute to future runs and the important ocean and stream sport fisheries.

Populations of Anadromous Fishes

Studies were conducted on Eel River for a four-year period (1955-1958) to gain an understanding of the anadromous fish population of this stream (figures 1, 2). Knowledge gained was used in determining a population estimate for Eel River and for supporting population estimates made on other streams. A one-year study on the Klamath River and information already available for the Trinity River and at counting stations were valuable in determining the approximate population of this stream and for comparison with other streams. A summary of estimates is presented in table 1. This summary pertains to the study of recent years and is not indicative of the much larger runs of prior years. Recent trends in fish populations indicate a progressive decline. The populations and production of ocean-run species in these streams are impressive. Most coho salmon and steelhead trout populations of California are located in these north coastal streams. The number of chinook salmon originating from these waters is comparable to the number originating in the Sacramento River, the principal California producer outside of these north coastal streams.

Table 1. Estimates of Average Annual Salmon and Steelhead Trout Populations in Rivers of Northwestern California.

Drainage	Chinook Salmon	Coho Salmon	Steelhead 1/
Smith River	15,000	5,000	30,000
Klamath River	100,000	20,000	400,000
Redwood Creek	5,000	2,000	10,000
Mad River	5,000	2,000	6,000
Eel River	25,000	15,000	100,000
Mattole River	5,000	2,000	12,000
Other Smaller North Coastal Streams (Little R., Maple Cr., etc.)	4,000	10,000	25,000
Total	159,000	56,000	583,000

1/ These estimates include the so-called "half-pounders."

Spawning Habitat

One of the most important links in the life cycle of salmon and steelhead trout is the successful spawning of the adults. To achieve success, spawning runs of sufficient size must reach suitable spawning habitat where young fish may hatch and grow until they migrate to the ocean. Plans for dam development and water diversions are numerous for Northwestern California streams. Many streams would be blocked, inundated, and possibly dewatered by developments. It is considered essential in planning for the salmon and steelhead trout resources that preservation of existing spawning grounds be given every consideration.

Spawning bed surveys were made for all of the important streams of the area. Some of the studies involved assessment on the basis of assumed criteria such as velocity, stream depth, gravel composition, accessibility, and other factors considered important for production.

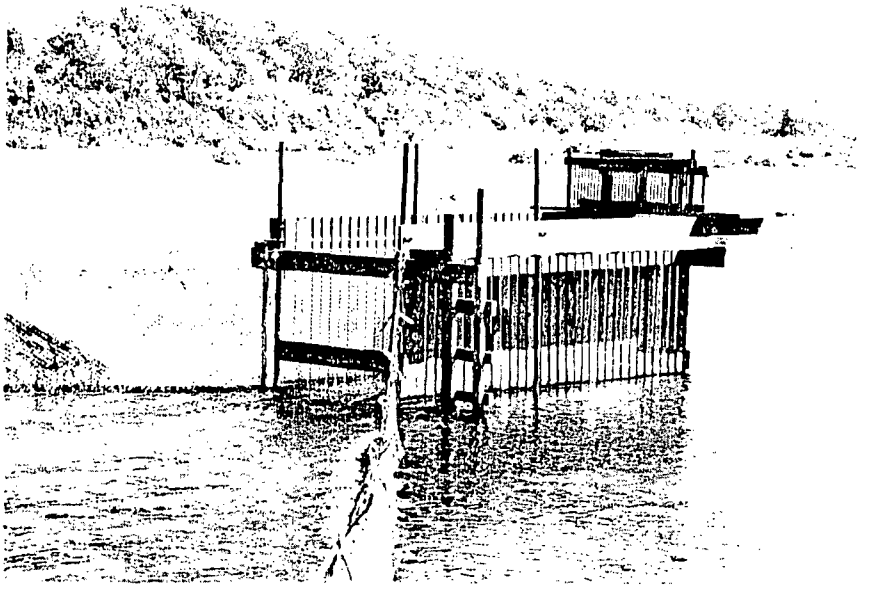


Fig. 1. Large runs of salmon and steelhead trout enter Eel River in the fall to spawn. The above-type weir was used to trap ocean-run fish for population studies.

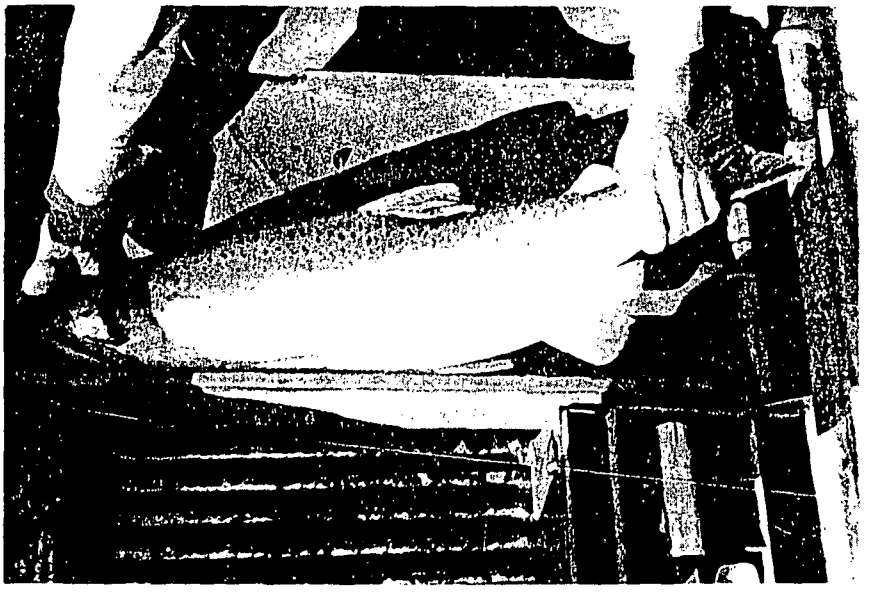


Fig. 2. Chinook salmon are of outstanding importance to Eel River fishery. This chinook and others were caught and tagged during a study to determine the size of spawning runs.

Other studies were based upon observations of redds and of salmon carcasses along streams following the peak spawning periods. Redds were measured to find the average nest area utilized by salmon in these north coastal streams and the average was then used to determine the total number of redds which could be accommodated in these various streams.

A summary of spawning gravels used by chinook salmon in recent years of this study is presented on plate II.

Based on stream surveys, it was estimated that all streams of Northwestern California could accommodate about 340,000 chinook salmon redds Spawning gravel for coho salmon and steelhead trout is widespread, with steelhead trout choosing the smaller streams and tributaries and coho salmon choosing these as well as areas used by chinook salmon. It is estimated that about 230,000 coho salmon redds and almost 800,000 steelhead trout redds could be accommodated in the numerous streams.

The Fisheries of Individual Streams

Smith River

Smith River drains about 720 square miles of rugged, mountainous terrain located in the northwestern corner of the area, confined largely to Del Norte County, California.

Smith River, with its two main tributaries, has one of the most dependable flows of the several coastal streams of the study area.

Forested slopes and geological characteristics provide for numerous springs and apparently account for prolonged flow even during summer and fall periods of little rainfall. Lowest seasonal flow extends from July through September. The minimum mean monthly flow recorded at Crescent City near the stream mouth is about 300 second-feet. Daily mean flow has seldom been less than 200 second-feet. The flow does not become low enough to prevent anadromous fish from entering the river. High stream flow rapidly follows high rainfall which typically begins during the latter part of October and continues to the end of March. The main stream and tributaries become turbid following frequent heavy rains but become clear within a few days after rainfall ceases.

There are no significant water development projects within this drainage. A small power diversion dam is located near the mouth of Patrick Creek, tributary of the Middle Fork Smith River.

Anadromous Fishes of Smith River. The Smith River commercial salmon fishery supported a local cannery beginning in 1878. Annual packs as high as 6,950 cases of chinook salmon and 3,000 cases of coho salmon were recorded during the first quarter of the century. Today, the river still accommodates important spawning runs of salmon, steelhead trout, and cutthroat trout. Smith River is third in importance among streams of the area in the contribution of these species to the sport and commercial fisheries.

Population estimates of the salmon and steelhead runs in Smith River were made by examining data collected in creel censuses, spawning ground surveys, and by comparison with the Eel River where detailed studies were made. Estimates give consideration to the stable flow and year-round habitat of this stream.

While only a fragment of the once important spring chinook salmon run remains, the fall run is estimated to number 15,000. Fish in the fall run begin entering the river in mid September, but the heaviest migration occurs in October. Peak spawning activity occurs through November and December in all major branches of the system. Smith River chinook salmon are noted for their large size in comparison to those caught in other California streams.

About 5,000 coho salmon are estimated to enter Smith River on their spawning migration in November and December. Spawning occurs from November to January. The sustained flow of Smith River provides optimum conditions for the growth and survival of juvenile coho salmon, steelhead trout, and cutthroat trout.

Smith River accommodates an estimated run of about 30,000 steelhead trout. Some steelhead trout migrate up the river all year, although peak spawning migration occurs during winter wet season. These fish are widely distributed throughout the system during their spawning activity in the early spring.

Smith River is the most important sea-run cutthroat trout stream in California. Most of these fish enter the river in September and

October and spawn in the late winter or early spring. Cutthroat trout spawn throughout the entire drainage in small tributaries often inaccessible to other anadromous species.

Fish Habitat of Smith River. Spawning areas accessible to anadromous fish runs occur in all of the tributaries as well as the main stem of Smith River. The major tributaries, which include the North, South, and Middle Forks, flow through deep rocky canyons. Usable spawning gravel is not abundant in these tributaries although well-distributed, long, deep pools provide excellent cover and resting habitat for adult salmon and steelhead trout. Gravel in the spawning riffles is predominantly large, interspersed with boulders.

The main stem of Smith River has broad flat riffles consisting mostly of small and medium gravel in the lower reaches. The upper section, above the Mill Creek confluence, has extensive bedrock exposed in the streambed with a scarcity of riffle areas. Rowdy and Mill Creeks are important spawning tributaries.

It is estimated that sufficient suitable spawning area exists to accommodate at least 22,500 chinook salmon nests in the total drainage. More than 73 percent of the riffles available for chinook salmon spawning are located in the main stem. The remaining riffles are located in the major tributaries. This includes 11 percent in the North Fork, 8 percent in the South Fork, and 8 percent in the Middle Fork. Several minor tributaries are heavily utilized by spawning chinook salmon. Most of the larger tributaries have bottoms with a

preponderance of boulders and large size gravel but still accommodate many spawning chinook salmon. The general distribution of available spawning area in Smith River drainage, based on existing chinook salmon redds is shown on plate II.

Several tributaries with suitable sized gravel are heavily utilized for spawning by coho salmon. It is estimated that more than 10,000 pairs of coho salmon could be simultaneously accommodated in this drainage. Steelhead trout find adequate spawning habitat in accessible headwater areas throughout the drainage. The present spawning runs number about 30,000 steelhead trout. Probably double this number could spawn in this drainage.

Barriers consist mainly of falls or cascades. Blocks formed by logging debris have not been as serious a problem in this system as in some other Northwestern California streams. This stream is characterized by a relatively high, stable flow during the late summer months when flows in other streams are usually low. Mining activity is minor and siltation is low.

High summer water temperatures during August 1957 in the lower stream sections varied from 67° to 72° F. for a period of 19 days. Water temperatures of the upper reaches ranged in the low 80's during the summer. Winter temperatures fell to between 43° to 50° F. Fertility of the waters in terms of bicarbonates is relatively low.

Sport Fishing of Smith River. Angler-use is similar to that of most other major Northwestern California streams with one important exception. Periods of roily high flow are short, and high, clear flow usually occurs at all seasons. No significant reduction of fisherman-use occurs during the winter and anglers are attracted to Smith River from other Northwestern California and Southern Oregon streams where turbid waters usually prevail for extended periods during the winter months.

The trout fishing season in the Smith River drainage extends from June through October with most fishing pressure occurring during July and August. Fishing for sea-run cutthroat trout is enjoyed especially by local residents in the lower South Fork and main river early in the season. With the sharp decline in numbers of tourists in the area after Labor Day, trout fishing pressure becomes light during the remainder of the fishing season.

Five U. S. Forest Service camps along Middle Fork Smith River and the large Jedediah Smith State Park on the main river attract many camper-anglers who usually stay for several days primarily to fish for trout in the adjacent river. Less intensive use occurs on the South Fork and on the less accessible upper reaches of the North and Middle Forks. Roadside tourist facilities and ready access provided by adjacent U. S. Highway 199 are important factors in the heavy concentration of angler-effort on the main stream and the Middle Fork. Posting is of little consequence, since most of the watershed is within a national forest.

On the other hand, poor roads give limited access to the upper North Fork, South Fork, and upper reaches of the Middle Fork. Those areas receive only a small part of the seasonal fishing effort.

Steelhead trout fishing extends from November through February, with the peak effort occurring in mid-winter. Steelhead trout fishing is concentrated along the main stem and Middle Fork upstream to the Patrick Creek confluence. Less fishing occurs on the lower South Fork and North Fork. Only a few early-run steelhead trout are caught in the lower river.

Fishing for chinook salmon begins near the mouth of Smith River as early as mid-August and extends through December. In October and November, most of the fishing occurs in the estuary. The estuary fishing follows that in the Klamath River by several weeks. Following the seasonal decline in the Klamath, anglers seek out the better salmon fishing in Smith River. As the run moves upstream, angling is distributed along the main stream until the run declines in December. During the latter period of the salmon run, steelhead trout contribute significantly to the catch. Fishing for chinook salmon in the estuary is done principally from boats, but upstream it is done from stream banks. A large proportion of the estuary fishermen are from Southern California, many of whom return to fish year after year.

Nonresident salmon and steelhead trout anglers usually live in motels or personal trailers. Most of the nonresident trout anglers camp along the streams in the summer, and smaller numbers use housing facilities in the area.

Combined fishing for adult salmon and steelhead trout is equivalent to the effort devoted to trout fishing in the Smith River drainage. About 27 percent of the anglers fishing during the winter season travel 100 miles or more to reach Smith River (figure 3).

Trout fishermen were almost four times as successful as steelhead trout or salmon fishermen on the basis of number of fish caught. However, on a poundage basis, a much higher value is shown for the salmon and steelhead catch.

The sport fishery of Smith River has a high value. It is estimated to have provided an average of 44,100 days of angling for the 1956 and 1957 seasons, of which 22,900 days were for trout, 8,700 for salmon, and 12,500 for steelhead trout. The catch was estimated at 32,400 trout, 3,400 salmon, and 4,400 steelhead trout.

Klamath River

This report gives consideration to that part of the Klamath River downstream from Copco Dam in California near the California-Oregon state line. Except for about 200 square miles mainly in the Jenny Creek drainage in Oregon, which contributes to the Klamath River downstream from Copco Dam, the area lies within California. For purposes of this report the area upstream from Copco Dam, lying principally in Oregon, is not considered. The lower Klamath River, with a drainage of 7,870 square miles, is the largest watershed in Northern California.

The Klamath River is a large stream, frequently exceeding a flow of 10,000 second-feet from November through June. Low flow occurs during the period of July through October. Highest flow occurs from January to May when monthly flow is frequently many times larger than the low fall flow.

The flow of the Klamath River is considerably influenced by operation of the California-Oregon Power Company facilities. Iron Gate Dam when completed will regulate severe changes in river level resulting from peaking-plant operations. Numerous irrigation diversions, occurring at several points along the Klamath, Shasta, Scott, and Trinity Rivers, have marked effects upon flows in these streams.

The Trinity River is by far the largest tributary of the Klamath River and has a drainage of 2,970 square miles. A 27-year record shows an average flow of 5,644 second-feet near Hoopa, California about 10 miles above the mouth. Flow from December through June frequently exceeds this amount. Lowest flow occurs from July through October with September showing the lowest average of about 461 second-feet. Lowest daily flow in September and October shows an average of 322 second-feet with a range from 162 to 574 second-feet. During the past, the Trinity River has been unregulated, but in the near future Trinity Dam and Lewiston Diversion will impound stream flow and divert water to the Sacramento Valley.

Shasta River has a drainage area of about 800 square miles. The flow on this stream has been regulated to some extent since 1928 by Lake

Dwinnell, located in the upper portion of the watershed near the western slopes of Mount Shasta. Large springs originate in this upper watershed, giving a reliable source and steadying effect to the flow below Dwinnell. However, irrigation diversions are numerous throughout its course, and significantly affect the downstream flow. Adequate flow for the support of fish usually occurs October through March. Storage and diversion result in serious reductions from April through September, with July showing the lowest monthly average of 33 second-feet during 1945 to 1956.

Scott River also drains about 800 square miles, which vary in topography from the rugged Scott Mountains in its upper limits, with elevations to over 7,000 feet, to the relatively flat Scott Valley, adjacent to the main stream. Many small irrigation diversions have an influence on the streamflow before it enters the narrow canyon portion of its lower reaches where it flows between the rugged Marble and Scott Bar Mountains. At the flow gage below Fort Jones, which is essentially below most of the diversions, the flow for 14 years of record has averaged 637 second-feet. High flood flow up to 38,000 second-feet, but most frequently of two to three thousand second-feet, may occur in any month from December to June. Lowest monthly flow occurs from July through September as a result of diversions and of seasonal reductions in runoff. The September average for the period of record is 65 second-feet in contrast to the annual average of 637 second-feet.

Salmon River drains about 750 square miles of some of the most rugged mountainous terrain in the Klamath watershed. Wooley Creek and the North Fork drain the south slopes of the Marble Mountains and portions of the Marble Mountain Wilderness Area with elevations ranging upward of 7,000 feet. This stream follows a tortuous course through deeply cut canyons which have only a narrow strip of valley land.

There are no significant storage reservoirs nor large diversions on the Salmon River. A water supply dam is present on the North Fork Salmon River near Sawyers Bar. Near its mouth, at Somesbar, this stream has had an average annual flow of 1,682 second-feet for 30 years of record. A high flow of 20,000 second-feet frequently occurs during December to March. Low flow similar to that in the drainages of the higher Klamath Mountains occurs from July through October. The lowest flow has almost consistently occurred in September, with an average for recent years of 216 second-feet. In spite of these extremes, Salmon River provides fine year-round habitat for anadromous and resident fish.

Anadromous Fishes of Klamath River. Salmon and steelhead trout which spawn in the Klamath River form an important segment of the sport and commercial fisheries of California. Chinook salmon of this stream supported an impressive commercial gillnet fishery until its closure in 1933. Two canneries were frequently operated near the town of Klamath. A pack of 18,000 cases was recorded in the 1912 season. Coho salmon were often taken in the gillnets but were not distinguished in the catch records.

Field studies in 1958 were conducted to determine the size and general distribution of the chinook salmon runs. A site near Ah Pah Creek on the lower river was selected as the base of operations for fish tagging. Several types of gear were used in the capture of salmon, including drift and set gillnets, fyke nets, a beach seine, and partial weirs. Most of the fish were captured in gillnets. All fish were tagged with plastic Peterson discs affixed below the anterior portion of the dorsal fin. Tagging began in mid-July and was concluded in mid-October. Counting stations operated by the California Department of Fish and Game were the principal source of recovery samples. A weir located below the site of the Trinity River Diversion Dam near Lewiston supplied the most substantial sample. Information from cooperative Indian fishermen at Hoopa and Pecwan was used to supplement the counting station data.

An aerial redd count on major spawning areas was made on October 30, 1958, the peak of the spawning activity, to furnish more comprehensive data on the runs. Streams included in this survey were the Trinity River mainstem above the North Fork, the South Fork Trinity downstream from Hyampom, Scott River, and Salmon River. The survey did not include areas above the Klamath and Shasta River counting stations. A ratio of redds to numbers of chinook salmon was secured above the Lewiston weir where a known number of fish had been transported. By applying this ratio to the other stream sections included in the survey, a population estimate was made. In addition to supporting the tagging study estimates, this survey provided information regarding population distribution.

Results of tagging studies by the California Department of Fish and Game on the Trinity River in 1955 and 1956 were valuable in making final population estimates.

Population estimates for coho salmon and steelhead trout were made on the basis of existing counting station records, creel census, and from information gained from the Eel River study. This information was also used to support estimates of the chinook salmon population. As a result of the tagging program, it was estimated that 42,500 chinook salmon comprise the escapement above Ah Pah Creek. Another estimate, derived from the aerial redd survey for the same area, totalled 38,750 fish. The average of these estimates, nearly 41,000, was accepted as a reasonable figure for the chinook salmon escapement above Ah Pah Creek in the fall run.

An estimated 4,000 chinook salmon comprise the late fall run that spawns in the tributaries downstream from the Trinity River confluence. Blue Creek is the principal contributor.

Sport fishermen normally take about 14,000 chinook salmon from the lower riffles and estuary according to creel census data. During the 1958 season, the take was estimated to be 7,000 fish, about one-half of normal. An estimate of the Klamath River adult chinook salmon population for 1958-59 includes a spawning escapement of 45,000 and a sports catch of 7,000 for a total 52,000 fish. This is considered an unusually small run. Estimates of 35,000 and 55,000 chinook salmon, one-third to one-half of the total Klamath drainage population, were

made for the Trinity River in 1955 and 1956 respectively. The adverse effects of flooding in December 1955 were perhaps partially responsible for the small run. Fish from the 1955 hatch would have returned as the three-year-old group so prominent in the Klamath salmon population. Runs of 100,000 to 125,000 fish are perhaps more commonly expected and are considered to be the present-day average.

Chinook salmon enter Klamath River on their spawning migrations in two main runs. The spring run enters from the ocean during March, April, and May. The summer or fall run is composed of two peaks. The run begins in July, peaks in August, tapers off through September, and peaks again in October and November. This latter component of the fall run spawns in the tributaries of the lower river.

Approximately 20,000 coho salmon spawn in the Klamath River. They begin entering the stream near the end of September, but their migration does not get well under way until late October and November. Coho salmon are believed to be widespread in their spawning distribution.

The steelhead trout population, including "half-pounders," is estimated to be approximately 400,000. "Half-pounders" are steelhead trout which have usually spent less than one year in the ocean before returning to fresh water. Creel census data and comparisons with information obtained from Eel River studies form the primary basis for this estimate.

Steelhead trout enter the Klamath River during all months of the year. There are three obvious migration peaks although steelhead migrations are often considered to consist of two major runs; the spring run and fall-winter run. Steelhead trout are spring spawners. Their migration to the spawning grounds from the ocean in some cases begins almost a full year before they become sexually mature. The early arrivals, referred to as the spring run, begin showing up in the river in April and May. These fish move through the lower river areas, remain in the headwaters near the gravel riffles, and spawn early the following spring.

An important migration in early-fall consists principally of "half-pounders." The bulk of these fish are 10 to 20 inches in length. There has been considerable controversy as to whether or not these fish are stimulated to migrate by sexual development. The results of gonadal examination of these fish in 1958 indicate that about 30 percent would probably mature sexually in time to spawn during the season of migration. Sexual development appeared to be positively correlated with size of the fish. Most of the fish that measured less than 17 inches in fork-length displayed no signs of sexual maturation.

Another wave of progressively larger fish begins to enter the river shortly following the ebb of the early-fall run. The peak of the later run occurs in late December and January. Fish continue to arrive on the spawning grounds through the late winter into early spring, when they spawn.

Sturgeons are known to migrate up the Klamath to Ishi Pishi Falls, a short distance above the confluence with the Salmon River. These fish migrate through the lower river in the spring and are found near Orleans where they support a sport fishery of increasing importance. They are not known to use the Trinity River to any extent.

Eulachon or candle fish are most familiar to the Indian residents in the vicinity of Pecwan. These fish migrate into fresh water in March and April. Little is known of the area used by these fish for spawning, but it is believed that they use the lower reaches of the system. Like salmon, eulachon die after spawning. Their prime importance in the Klamath River lies in their support of an Indian dip-net fishery. Spawned-out eulachon carcasses are considered an important food source for sturgeon.

Shad have been observed in increasing numbers in recent years. The extent of their range of migration on the Klamath River is not well defined. First observations of these fish in the vicinity of the Salmon River confluence were reported by residents in 1957. Indians, unfamiliar with the palatability of the species, have reported that these fish have entered their nets in "menacing numbers" in late years. The shad ascend the river in the spring to await suitable water temperatures before spawning.

Pacific Lamprey. According to the natives, the Pacific lamprey enters Klamath River in two apparent migration waves. The first wave enters the lower river following winter freshets in late December or January.

The second and largest group enters during March, April, and May. The Pacific lamprey is a spring spawner. It migrates to gravel riffles in the headwaters where it deposits its eggs. Like salmon, it dies after spawning. Large numbers of lampreys have reportedly spawned above the counting stations at Klamathon and Lewiston. Pacific lampreys are eagerly sought by Indians along the lower reaches of the drainage.

Fish Habitat of Klamath River. The relatively small run of spring chinook salmon uses spawning areas in the Trinity and Salmon River tributaries. The early portion of the summer or fall run is widely distributed throughout the drainage. The later portion of the run is confined largely to the tributaries below the Salmon River confluence, particularly Trinity River and Blue Creek.

Based upon spawning ground surveys, sixty percent of the chinook salmon spawning area is located in the Trinity River and its South Fork. The combined areas of the Shasta, Scott, and Salmon Rivers comprise 25 percent. The mainstem Klamath River, between the Klamathon Racks and Copco Dam, and miscellaneous tributaries make up the remaining spawning area. Minor spawning occurs on the Klamath River mainstem below the Shasta River confluence. In the Trinity River the bulk of the mainstem spawning area lies above its North Fork confluence. Extensive riffle areas in the lower Trinity are apparently little used by spawning salmon or steelhead trout. The distribution of available spawning area in the Klamath River drainage along with other drainages is shown on Plate II.

Surface water temperatures in the upper river often approach the critical point for fingerling salmon during the summer. Fertility of the waters is high, as indicated by measurements of carbonates and bicarbonates throughout the system.

Sport Fishing of Klamath River. Several characteristics differentiate the sport fishery of the Klamath River from that of other Northwestern California drainages. On the basis of overall use and catch, it is the most important stream in the region. The early-run steelhead trout or "half-pounder" fishery is the most valuable of this type in California and probably the entire Pacific Coast. The chinook salmon estuarine fishery is the most valuable of its type in California. The many natural lakes and streams in the several wilderness areas in this drainage support a valuable trout fishery.

Most of the mainstem of the Trinity River is readily accessible from U. S. Highway 299. The Klamath is accessible near its mouth via U. S. Highway 101, and the upper reaches via U. S. Highway 99. Access to the middle reaches is relatively poor although a graded and maintained road follows the river from its mouth upstream to U. S. Highway 99.

Most trout fishing occurs from June until November throughout the system with concentration of effort during July and August. Many of the anglers use the facilities provided by U. S. Forest Service camps, particularly along the South Fork Trinity, Salmon, and Scott Rivers.

The trout fishery, in streams accessible to anadromous fish, is supported mostly by juvenile steelhead trout, but resident rainbow trout in the

headwaters and moderate numbers of brown trout in the Trinity River drainage also contribute to the fishery. The early season anglers are largely local residents, and summer anglers are mostly nonresidents. The high fishing pressure in the upper reaches of the Klamath River during the first month following the opening of the season declines during summer. Trout fishing pressure is equal to that exerted on chinook salmon, but approximates only two-thirds the steelhead trout fishery. Alpine streams and lakes support an excellent sport fishery for eastern brook, rainbow, and brown trout. The California Department of Fish and Game maintains a planting program for most of these lakes.

Steelhead trout fishing occurs from July into early spring with a slack period between runs in October and November. Most fishing during winter is done along the accessible upper main Klamath River above the Scott River confluence and on the Trinity River from Willow Creek upstream to Lewiston. Fishing for early-run steelhead trout begins in the riffles just above tidewater and gradually extends upstream with the run. Highest fishing pressure occurs in the lower riffle areas below the Trinity River confluence. Less than 12 percent of the early-run steelhead fishermen of the lower river are local residents. A large portion are from Southern California, more than 800 miles away. Turbid winter flows often terminate fishing for periods of several weeks, especially in the mainstem.

The early-run steelhead trout angling effort (August-October) is five times the effort for late-run steelhead trout (November-February).

The early-run catch was found to be 13 times that of the late-run fishery.

The Klamath River salmon fishery begins during the summer as a boat fishery at the mouth of the stream. This fishing begins in July and peaks in August. Shortly after boat fishing starts near the mouth, salmon fishing develops upstream as the run moves toward the spawning areas. Angling effort reaches a climax in October in the upper reaches of the Klamath and Trinity. The bulk of the catch consists of chinook salmon but the proportion of coho salmon increases rapidly toward the end of the run in late September. Twenty percent of the salmon catch in the Klamath River estuary consists of coho salmon. Few coho salmon are caught in upstream areas.

Based on the 1956 and 1957 creel censuses, the Klamath-Trinity River fishery supports over 160,900 angler-days annually of which over 51,400 are for trout, 39,700 for salmon, and 69,800 for steelhead trout. Over 56,500 of the angler-days were for early-run steelhead trout. The estimated average catch was 21,100 salmon, 58,200 steelhead trout, and 104,000 trout.

Indian Fisheries of Klamath River. Anadromous fish runs were the principal food of a population of about 5,000 indians formerly inhabiting the lower Klamath River area. Much of the ritual and labor of these people was related to capturing and curing of these fishes.

The migration times of the various species were so distributed that the catch of fresh fish was possible at any season of the year. The fall

run of chinook salmon was most important to the Indians because low river flows and large numbers of fish provided optimum fishing conditions. In addition, the flesh was ideal for smoke curing for winter use. The spring chinook salmon, lamprey, sturgeon, and eulachon were also taken for the fresh and cured food supply. Steelhead trout were not considered desirable.

The Indians relied almost completely on wildplants and animals for their food, showing little inclination toward agriculture. The centers of heaviest Indian population were the areas of greatest fishing potential. Weirs were constructed annually at Hoopa and upstream from Pecwan near Capell Creek. The weirs were composed of a lace-work of saplings strung on parallel poles supported by wooden tripods driven into the gravel across the streams. At Capell, the fish were dipped from traps built at intervals across the dam, while at Hoopa, seines were used to take fish which concentrated below the weir. The Indians were conservation conscious, purposely permitting a part of the spawning run to escape upstream from the weirs. The weirs washed out each yesr with the first high flows in the fall, which permitted the remainder of the run to pass largely unmolested.

Seines, made from the fibers of the wild iris, were used to catch sturgeon as well as chinook salmon. Spring salmon and eulachon were taken in dip nets. Saplings, woven into funnel shaped baskets, were used to catch lampreys.

Today, only a fragment of the historical fisheries remains although the Indians still enjoy their fishing and hunting rights as set forth in treaties with the Federal Government. Restrictions have not been placed upon the methods used, but a considerable transition is evident. Gillnets have become the principal means of taking fish. The use of the Capell weir was discontinued shortly following the turn of the century and the Hoopa weir construction was abandoned within the past decade. Dip netting for spring salmon and smelt and the use of eel baskets are still common along the lower Klamath. In recent years shad have been taken in increasing numbers but these fish are usually discarded as trash. Only a few Indians are now dependent on the fish runs as an important supplement to their food supply. Most of them are occupied with other interests, primarily the lumber industry. Competition of industry and depletion of the fish populations have lessened the role of the fisheries in the lives of the Klamath River Indians.

Redwood Creek

Redwood Creek, one of the smaller of the major coastal streams of Northwestern California, drains about 280 square miles, all in Humboldt County. The stream is relatively narrow and straight, with few tributaries. Prairie Creek, about 14 miles in length and draining 30 square miles, is the most important tributary. It joins Redwood Creek a few miles above its mouth, near the town of Orick.

There are no water development projects on Redwood Creek. The greatest obstacles to fish utilization of the stream are the extremes in natural

flows. Low flow limits year-round habitat for resident species and migration of ocean-run fish. During summer, sand bars may be formed at the mouth which do not open until the first fall rains, thus limiting the migration of anadromous species for long periods. High flows result in turbid water and after recession fine sediments are deposited which adversely affect spawning habitat.

Anadromous Fishes of Redwood Creek. Redwood Creek supports runs of all anadromous salmonids common to California's north coastal region. An Indian village once located near the mouth of the creek was dependent upon these runs for food. During the first quarter of the century gillnetters operating in the tidal area shipped their catches to the canneries at Eureka and Klamath.

The fall run of chinook salmon is estimated to be 5,000. No spring run is known on Redwood Creek. The latter part of October and first of November mark the period of heaviest migration to the spawning grounds. Chinook salmon begin arriving on spawning grounds during the first week in November and new arrivals are noted following intermittent high water until January. December is the center of the spawning period.

Approximately 2,000 coho salmon spawn annually in Redwood Creek. Their entrance time and general distribution in the drainage is similar to that of chinook salmon. The peak of spawning activity lags about two weeks behind that of chinook salmon and continues into February. Similar to their selection of spawning areas in other drainages, coho salmon move

to the headwaters of the small tributaries to spawn.

Redwood Creek accommodates a winter run of steelhead trout numbering about 10,000. Their distribution is similar to that of coho salmon but extends higher into the headwaters. Spawning time is centered in March.

The creek has a large run of sea-run cutthroat trout. Prairie Creek accommodates the bulk of this species which spawns in early spring. Resident cutthroat are also believed to inhabit streams in Redwood Creek basin.

Fish Habitat of Redwood Creek. Redwood Creek is accessible to chinook salmon for about 48 miles of its lentth. It has a moderate gradient and there are no known complete barriers to the spawning runs. Most of the drainage area was heavily forested in the past but recent accelerated logging, especially in the headwater area, has resulted in heavy erosion with the deposition of much fine material in the streambed. The abundance of fine gravel and silt on the riffles is especially noticeable in the middle and lower reaches. Predominant gravel size in the riffles is medium in the lower reaches, small to fine in the middle reaches, and medium in the upper reaches.

The estimated available chinook salmon spawning area in the Redwood Creek drainage is considered sufficient to accommodate about 5,400 redds. Riffles judged to be of highest value to chinook salmon runs were observed in Prairie Creek and sections of the upper and middle reaches of the main stream. In the latter section, Lacks and Minor Creeks are tributaries of considerable importance. These streams do not have the

large amount of fine gravel and silt noted elsewhere in the drainage.

Coho salmon spawn in the same riffles used by chinook salmon in Prairie Creek. Cohos also utilize other portions of Redwood Creek. Steelhead trout spawn in accessible headwater areas throughout the drainage.

The range of water temperatures in this drainage is considered to approximate that of Smith River, a similar adjacent stream. Summer temperatures rarely exceed 80° F., and winter temperatures range from 40° F. to 50° F. Water in this drainage is moderately fertile, based on randum bicarbonate tests.

Sport Fishery of Redwood Creek. Because of limited access, trout fishing is confined mostly to Prairie Creek and the lower main stream. Juvenile steelhead trout comprise the bulk of the catch, but cutthroat trout are taken in the lower reaches in fair numbers, particularly in Prairie Creek.

The winter salmon and steelhead trout fisheries have been restricted by state regulation to the lower reaches of the main stream. Some chinook salmon are caught near the town of Orick in tidewater during the fall prior to high, roily flow. The extent of steelhead trout fishing is dependent upon flow conditions. Some steelhead trout may be caught during brief favorable periods in late winter.

The sport fishery of Redwood Creek is moderate in value compared to the more attractive and accessible streams. It is estimated to have provided

4,000 days of angling annually. About 2,500 man-days are attributed to trout fishing, 500 to salmon, and 1,000 to steelhead trout. The estimated annual catch is 6,000 trout, 600 steelhead trout, and 250 salmon.

Mad River

Mad River, located in Humboldt and Trinity Counties, drains about 500 square miles of the Coast Range, southward slopes of the South Fork Trinity Mountains, and coastal plain. Flow and annual rainfall records show a seasonal pattern with a dry period during August through October. The seasonal low flow for a day frequently has been 30 second-feet or less. The stream becomes very turbid, even with moderate rains. Presumably, extensive logging activity has had an aggravating effect on low flow conditions and has resulted in increased turbidity during rises in flow.

Sweasey Dam located 17 miles above the stream mouth has provided the source of Eureka's water supply since 1938. A little over five second-feet are diverted continuously at the dam, but otherwise the impoundment has little regulating effect upon the streamflow. The dam is equipped with a fish ladder where anadromous fish runs of chinook and coho salmon and steelhead trout have been counted for several years by the California Department of Fish and Game.

Anadromous Fishes of Mad River. Estimates of the size of salmon and steelhead trout runs on Mad River were made from California Department of Fish and Game tagging studies in 1954. These studies included Sweasey Dam fish counting records and spawning ground surveys.

According to these data, about 5,000 chinook salmon ascend the stream. The early fall entrance of these fish is usually blocked by a sand bar at the mouth of the river. Fall rains are required to flush a channel through the bar, normally by mid-October, before fish can enter. Approximately 2,000 coho salmon were estimated to comprise the average spawning population. The coho salmon migration follows that of the chinook salmon by about a month. About 6,000 steelhead trout were estimated in the annual run which begins in early fall and reaches a high in February and March.

The Mad River produces a sea-run cutthroat trout population of minor significance.

Fish Habitat of Mad River. The Mad River is accessible to runs of chinook salmon, coho salmon, and steelhead trout up to a 25-foot falls near Bug Creek, about 33 miles above the mouth. Sea-run cutthroat trout spawn in several tributaries of the lower reaches.

Low water bars in the lower reaches form partial barriers especially to chinook salmon during the initial part of the run when streamflow is low. Barriers in the tributaries consist mainly of log jams, similar to those on Lindsay Creek, or low water and natural falls like those on North Fork. Sweasey Dam becomes more of a barrier to salmon both when the flow is low and during flood stages. The gradient of the streambed is gradual in the lower reaches and moderate to high in the upper reaches. Numerous cascades and riffles with an abundance of large boulders occur below the high falls on the mainstem.

About 4,000 pairs of chinook salmon could find suitable spawning in the accessible reaches of the Mad River. Good populations of coho salmon and steelhead trout, similar to that of chinook salmon, could be accommodated for spawning in this drainage. Spawning by chinook and coho salmon is largely confined to reaches below Sweasey Dam. In contrast, most of the steelhead trout spawn above the dam.

Thermograph records of water temperature in the upper reaches of Mad River show a range of 70° to more than 80° F. during July and August. This drainage is moderately fertile in terms of bicarbonates.

Sport Fishing of Mad River. An exceptionally productive resident trout fishery in the upper reaches is probably the most distinctive feature of this drainage. Trout fishing is concentrated along accessible portions in the vicinity of the Ruth damsite where success is unusually high. During the 1957 season the catch per angler-hour was more than 1.4 fish for that stream as compared to a 0.8 fish-per-hour average for other streams in the region. The California Department of Fish and Game found similar success rates for the 1958 season. Relatively minor fishing effort is expended in the middle and lower reaches although good catch success in the less accessible portions is shown. Most of the catch in the upper reaches consists of resident rainbow trout. In the section below the barrier falls, juvenile steelhead trout and some cutthroat trout enter the catch. Cutthroat trout are taken primarily in the estuary and in lower tributaries. Local anglers concentrate in the upper area during the first month of the trout season. The proportion of nonresident anglers increases through

the remainder of the summer, but total angling pressure decreases markedly.

Angling effort for both salmon and steelhead trout is largely confined to the lower eight miles of stream. The early run of steelhead trout is negligible. The principal steelhead trout run begins in November. Fishing for this species runs from November through February. A high turbid flow during the winter may limit steelhead trout fishing to only a small portion of the season. Mad River was fishable for less than 40 percent of the 1957-58 winter season, which was considered typical. Such adverse conditions limit fishing for coho salmon as well as steelhead trout. Chinook salmon fishing is less affected since they make an earlier run when the flow is reduced and less turbid. Relatively few coho salmon normally are caught in Mad River.

Mad River presently receives about 7,600 angler-days of fishing annually, of which 3,800 are for trout, 1,000 for salmon, and 2,800 for steelhead trout. An estimated 12,400 trout, 200 salmon, and 1,100 steelhead trout are caught. Anglers travel an average of more than 134 miles to fish in Mad River.

Eel River.

The Eel River system, including its principal tributaries, the Van Duzen, and Middle and South Forks, drains an area of 3,700 square miles, and is the second largest drainage within northwestern California. It is next in size to the Klamath River in runoff as well as drainage area, although its extremes in flow are much more divergent. Its maximum

discharge is equal to that of the Klamath River.

Only in the upper Eel drainage does enough snow accumulate at the higher altitudes to affect the spring runoff. The flow in the Eel River averages about 6,600 second-feet annually. It has varied from a monthly average low of 91 second-feet in September 1955 to peak discharge of 540,000 second-feet during the following December. August to October are the months of lowest flow, with September showing an average of 125 second-feet. The Van Duzen shows a similar pattern of extremes with a September average of 14 second-feet. South Fork has a September average of about 46 second-feet. Middle Fork and North Fork Eel River have September average flows of 15 second-feet and 5 second-feet, respectively.

Besides the limitations placed on streamflow by natural conditions, Scott Dam, located 163 miles from the mouth, has a marked effect on the upper Eel. This dam is a barrier to anadromous fish. Van Arsdale Diversion Dam, located 12 miles downstream, is equipped with a fish ladder and also serves as a collecting and counting point for steelhead. Throughout the year, 200 to 300 second-feet of water are diverted at the Van Arsdale Dam and transported by a tunnel through the mountain to East Fork Russian River. During most months of the year Eel River is virtually dry for many miles downstream from this diversion point.

Benbow Dam is located on South Fork Eel River about 27 miles upstream from its mouth. The dam, still in existence even though power is no longer produced, is equipped with a fish ladder where upstream counts

of salmon and steelhead trout are made by the California Department of Fish and Game. Operation of the powerhouse at Benbow Dam formerly provided attraction water for the fish ladder. Under present conditions, attraction to the ladder is inadequate and probably less effective than when the powerplant was in operation.

Anadromous Fishes of Eel River. Eel River is the third largest producer of chinook salmon in California and is second only to the Klamath River in the production of coho salmon and steelhead trout. A commercial gillnet and seine fishery was supported by the Eel River salmon runs, beginning in the mid-nineteenth century and continuing until 1926. Most of the fish were salt- or smoke-cured. Cannery records beginning in 1877 indicate a peak of 15,000 cases in 1883.

Population estimates of anadromous salmonoids on the Eel River was a principal objective of a four-year study begun with the 1955-56 spawning season and concluded in 1958-59. Information gained from these studies was valuable in the appraisal of fish populations of other Northwestern California streams where specific studies were not made.

Population studies were carried out by tagging and subsequently collecting a portion of the annual migratory spawning runs. This study provided information for population estimates, distribution, timing of entrance to the stream, spawning, and speed of migration.

Weirs and gillnets were the most successful devices employed in the capture of fish for tagging. Fyke nets and seines were also used

and, although generally less effective, helped supplement the catch. A weir was used successfully to capture a large portion of the early part of the migration although it washed out when the fall freshets occurred. Gillnetting was then employed to obtain good tagging distribution. Gillnetting was the most successful method employed. This type of gear was used in all except extreme flow conditions. Various mesh sizes, ranging from 4- to 7-inch stretched mesh, were used to insure a representative cross section of all sizes and age groups of fish. Contrary to common belief, the mortality occurring from the careful use of gillnets was insignificant. Fish caught in the nets were detected at once by disturbances along the floating cork line and were freed instantly by cutting the webbing to prevent injury. Numbered plastic Peterson discs were attached with stainless steel pins to the fish below the anterior portion of the dorsal fin.

Upstream recovery samples were secured through counts at Benbow and Van Arsdale Dams and from spawning ground carcass counts.

Chinook salmon population estimates based on the results of the tagging are shown in table 2.

Table 2. Chinook Salmon Population-Estimates, Eel River.

Year	Total River Escapement	Limits of 95 percent confidence Lower	Upper
1955-56	38,045	26,504	46,638
1956-57	19,794	13,378	27,870
1957-58	25,104	17,190	34,994
1958-59	14,500	10,218	17,595

Stream populations include estimates of the fish caught by sport fishermen below the site of tagging. The small run of 1958-59 may have been partially caused by the adverse effects of the large floods of 1955 upon survival of young and, hence, a subsequent reduction in the spawning run of the important three-year-old group. The average number of chinook salmon in runs during the four-year study period was 25,000. This figure probably does not adequately indicate the historical or potential productivity of Eel River runs. A review of the counts at Benbow Dam (table 3) shows that chinook and coho salmon runs since the 1952-53 year have averaged less than half those recorded before this time. The precise reasons for this drastic reduction are not clear although a number of factors are probably involved.

Table 3. Fish Counts at Benbow Dam Ladder, South Fork Eel River. 1/

Year	Chinook Salmon	Coho Salmon	Steelhead Trout
1938-39	6,051	7,370	12,995
1939-40	3,424	8,629	14,476
1940-41	14,691	11,073	18,308
1941-42	21,011	13,694	17,356
1942-43	10,612	15,037	25,032
1943-44	7,264	13,030	23,445
1944-45	13,966	18,309	20,172
1945-46	12,488	16,731	13,626
1946-47	16,024	14,109	19,005
1947-48	13,160	25,289	18,225
1948-49	16,312	12,872	13,963
1949-50	3,803	7,495	13,715
1950-51	14,357	12,050	15,138
1951-52	12,476	11,441	13,774
1952-53	7,256	3,711	19,448
1953-54	7,948	3,052	15,425
1954-55	5,406	6,016	14,000
1955-56	3,974	6,054	11,443
1956-57	1,530	5,717	12,333
1957-58	3,050	5,432	7,910
1958-59	1,472	3,344	11,984

1/ Data furnished by California Department of Fish and Game.

Chinook salmon initially arrive on the riffles downstream from Fernbridge in the latter part of August. During late August and September they enter the lower pools and estuaries to await a large enough flow for their migration. Some of the early arrivals are ready to spawn upon entrance into the Eel River and are believed to spawn in streams of the lower portion of the system such as the Van Duzen River. These early fish are often delayed in their migration by shallow riffles. The bulk of the movement occurs in October and the first half of November. Variation in the time of the fall rains is a principal factor governing extent and time of spawning migration and distribution.

In years of extended low flow, most spawning is confined to the mainstem of the drainage. This phenomenon is considered rather precarious from the standpoint of productivity, since egg deposits so confined are more often vulnerable to destruction from a high flow than those more widely distributed throughout the tributaries. During years of ample flow, tributaries near the upper extremity of the system are heavily used. Spawning begins in late October, reaches a peak in November, and, in some years, continues through January.

The heaviest migration of juvenile chinook salmon from spawning areas to the lower estuaries is noted in June. Movement of these fish from the estuaries to the ocean occurs through July and August of the same year.

The results of three years of population studies of coho salmon are given in table 4.

Table 4. Coho Salmon Population Estimates, Eel River.

Year	Total River Escapement	Limits of 95 percent confidence Lower	Upper
1956-57	15,908	9,938	23,982
1957-58	22,094	12,094	36,787
1958-59	8,732	6,286	11,691

As in the case of chinook salmon, the small run of coho salmon in 1958-59 may have resulted from adverse effects of flooding during the 1955-56 season. Most coho salmon return to the streams to spawn when they are three years old, after spending about two years in the ocean.

The coho salmon migration begins in mid-October, reaches a high in November, and continues through December. Coho salmon are usually not confronted with low water obstacles because their migration coincides with high flows. The bulk of the run may pass in four to five days.

Steelhead trout are the most abundant salmonoid species in the Eel River. Population estimates obtained from a three-year study are given in table 5.

Table 5. Steelhead Trout Population Estimates, Eel River.

Year	Total River Escapement	Limits of 95 percent confidence Lower	Upper
1956-57	96,196	77,300	118,916
1957-58	106,693	73,919	147,453
1958-59	89,621	73,364	109,888

Steelhead trout enter the river in varying numbers during all months of the year. A small spring run enters during April and May and migrates to the upper reaches of the Van Duzen and the Middle Fork. Similar to the Klamath River, the Eel River receives a significant run of small steelhead trout in later summer and early fall. Summer and early fall steelhead trout migrations are often impeded by low water conditions. Large numbers concentrate in the pools near tidewater until an adequate flow allows them to move upstream. December and January mark the height of the migration.

Adult shad migrate 40 to 50 miles up the Eel River to spawn. The sturgeon population of the river is now negligible. At one time this species supported an important sport fishery as far upstream as Rio Dell. In late years, only an occasional green sturgeon has been seen in the lowermost part of the river. In some areas the Pacific lamprey is eagerly sought by local residents in the spring. It is particularly vulnerable to harvest during its ascent over Benbow and Van Arsdale Dams.

Fish Habitat of Eel River. Chinook salmon, coho salmon, and steelhead trout spawn in accessible areas throughout the system. The extent of suitable spawning habit available to salmon and steelhead trout is considerably limited by barriers, most of which are formed from logging debris. Low flow, especially during the initial part of the chinook salmon run, also greatly restricts the areas accessible to those fish. Salmon and steelhead trout distribution in this drainage is further affected by Benbow Dam on the South Fork, Scott Dam on the

mainstem, and natural falls and cascades on many tributaries. Pollution from sawmill wastes also affects fish habitat.

It is estimated that enough spawning habitat exists in the Eel River drainage to support more than 142,000 chinook salmon redds. Distribution of riffles judged to be usable is about as follows: Main Eel, 62 percent; South Fork, 16 percent; Middle Fork, 12 percent; Van Duzen River, 9 percent; and North Fork, 1 percent. Distribution of spawning chinook salmon in the Eel River in recent years is shown on plate II.

Small tributaries are selected for spawning by coho salmon in preference to mainstem streams. Tag recoveries at Benbow Dam show that 35 to 40 percent of the run spawn above Benbow Dam. Spawning ground surveys show that the Van Duzen River and South Fork are the most important Eel River tributaries for coho salmon.

About 40,000 coho salmon redds could be accommodated in the upper South Fork and lower mainstem tributaries, which are presently used by these runs. All areas observed to be used and those judged to be usable for the entire Eel River drainage are estimated to be sufficient for 80,000 coho salmon redds.

It is estimated that enough steelhead trout spawning habitat is present to accommodate 100,000 spawning pairs, or twice that of the present average runs.

Water temperatures vary considerably between the lower and upper reaches. For 14 days, during July and August, the range was from 70° to 73° F.

near the mouth and from 78° to 88° F. in the upper reaches. During the winter, water temperatures range from 40° to 50° F.

Sport Fishing of Eel River. Eel River supports the second largest sport fishery of Northwestern California streams. Fishing for chinook salmon and steelhead trout occurs during fall and winter months and trout fishing during spring and summer months. The fishery for spring-run steelhead trout occurs only in the Middle Fork and in Van Duzen River.

Trout occur throughout the Eel River drainage but fishing pressure is concentrated in the headwater area. Posted land limits accessibility to many sections of the stream. Heaviest angling pressure occurs during the month of June in the upper stream sections between Van Arsdale and Scott Dams. During the summer, many tourists fish the stream adjacent to highways or government forest camps. Fishing effort is particularly intense along the accessible South Fork Eel River. Fishing declines throughout the basin during the late summer months as flow decreases.

The first catch of salmon is made in the lower river from boats in August. Bank fishermen follow the upstream movement of salmon and steelhead trout. Fishing pressure continues until discouraged by high, muddy flows. Most fishing for early-run steelhead trout is concentrated in the tidewater area. Coho salmon are occasionally caught on the South Fork and the main Eel River downstream from the South Fork confluence.

The late-run steelhead trout fishery nearly coincides with the November peak of the chinook salmon run in the lower river when catches commonly include both species. During the winter, the high turbid flow may greatly reduce or terminate fishing for many days. During the 1957-58 season, the high flow reduced fishing to 40 percent of the normal time spent under better flow conditions.

Van Duzen River receives only light to moderate fishing pressure during the anadromous fish runs. The South Fork Eel River receives high angler-use for chinook salmon and late-run steelhead trout. Anglers concentrate at numerous access points along the stream up to Benbow Dam. Fishing pressure is reduced upstream from Benbow Dam. Anglers concentrate along the lower 30 miles of Eel River and in the vicinity of the confluence of the Middle Fork Eel River, upstream. Most of the area above the confluence of the South Fork Eel is inaccessible.

Angler effort on the Middle Fork Eel River during the winter season is light and access points are few. Anglers concentrate near the stream mouth and along the middle reach in the vicinity of the Eel River Ranger Station.

The Eel River sport fishery provided an annual average of over 80,600 angler-days in 1956 and 1957. Trout fishing comprised 45,400 fishermen-days, salmon fishing 6,900 days, and steelhead trout about 28,300 days. Average catch per year was 68,400 trout, 3,500 salmon, and 13,700 steelhead trout. Thus the sport fishery catch represents about 16 percent of the chinook salmon run and 13 percent of the

steelhead trout run.

Mattole River

Mattole River is located in the extreme southwest portion of the area under consideration. The North Fork, which joins the Mattole 5 miles above its mouth; Honeydew Creek, which joins the river at its mid-point; and Bear Creek, which is an upper tributary, are the principal tributaries.

Streamflow follows a pattern similar to rainfall, with a record high flow in December and January. Lowest streamflow occurs from July through October. During recent years, September flow in the Mattole River, below the North Fork confluence, has averaged about 55 second-feet with daily extremes severely limiting migration and the existence of fish life. When flow is low in the summer and fall, wave action frequently forms a sand bar across the mouth which closes the stream to direct contact with the ocean. This bar may remain intact for varying periods in the fall and block migration of anadromous fish to and from the ocean.

There are no significant water developments in this basin although several small tracts of irrigated land receive water from the Mattole River by means of pumps. Increased turbidity and reduced dry-season flow may have caused a reduction of freshwater habitat for anadromous fish. Accelerated ecological changes, caused primarily by recent logging activity on portions of the watershed, may have also caused changes in stream flow.

Anadromous Fishes of Mattole River. Mattole River salmon and steelhead trout population estimates were based on spawning gravel surveys and interviews with sportsmen and local residents.

Because of its relative inaccessibility, the Mattole did not provide a commercial fishery. Average chinook salmon runs presently number about 5,000 and coho salmon about 2,000. Steelhead trout are largely responsible for the present-day popularity of this stream. Annual runs of about 12,000 are estimated. The time of the migration runs of the Mattole River salmonoids is comparable to that of the Eel River.

Fish Habitat of Mattole River. The Mattole River is accessible to chinook salmon for about 45 miles. Coho salmon and steelhead trout ascend the river several miles above log jams and a restricted channel, which block chinook salmon migrants in the vicinity of Thorn.

In addition to the mainstem areas, several tributaries, including Honeydew Creek and Bear Creek, provide about 14 miles of stream suited for spawning chinook salmon. It is estimated that several times that amount is used by coho salmon and steelhead trout.

The gradient of the main stream and lower reaches of the main tributaries is low to moderate. The stream meanders extensively and channel division is prevalent in the lower several miles. Intensified logging in the Mattole River drainage began about 1952. Since that time, the amount of silt in the streambed has increased, and this accelerated siltation, especially in the lower portion, may be expected to continue.

Debris from logging operations has blocked many miles of formerly accessible spawning habitat in the tributaries.

It is estimated that this drainage can provide spawning habitat for over 7,900 pairs of chinook salmon. Usable gravel in this drainage probably would provide spawning space for not more than 10,000 pairs of coho salmon and a comparable number of steelhead trout.

Sport Fishing of Mattole River. The pattern of utilization of the Mattole River by sport fishermen is similar to that occurring on the Eel River. Prior to 1954, this stream had an exceptionally good winter steelhead trout fishery. The stream was turbid for periods of only a few days at a time until recent years.

Trout fishing in the Mattole River drainage is carried out largely by nonresident anglers. Most of the fishing is for juvenile steelhead trout in the lower reaches.

Although chinook salmon occasionally may be caught in the estuary area as early as October, most of the catch is made during November and December. Steelhead trout and, infrequently, coho salmon also are caught whenever water conditions are favorable. Before 1955, peak steelhead trout fishing activity occurred in January and February. Creel censuses for the 1956-57 and 1957-58 seasons showed negligible fishing effort in this drainage during those months because of the more prolonged turbid periods. There is little fishing for early-run steelhead trout.

It is estimated that the Mattole River sport fishery provided an annual average of 4,300 angler-days in the 1956 and 1957 seasons of which over 3,000 were for trout, 600 for salmon, and 700 for steelhead trout. The estimated catch was 400 salmon, 700 adult steelhead trout, and 8,000 juvenile steelhead trout. Anglers traveled an average of 172 miles to fish in this stream.

Smaller Streams.

Besides the six larger stream basins described in the preceding sections, there are several smaller ones which are important for their fish and wildlife resources. The principal smaller streams from north to south are Wilson Creek, lying north of the town of Klamath; Maple Creek, which flows into Big Lagoon; McDonald Creek, which flows into Stone Lagoon; Little River, which flows into the ocean near Crannell; Jacoby, Freshwater, and Salmon Creeks and Elk River, which flow into Humboldt Bay; and Bear River, which flows into the ocean at a pointabout midway between the mouths of the Mattole and Eel Rivers. All of these streams drain the western slopes of the Coast Range. They are subject to the climate of the coast including relatively large amounts of fog and high rainfall in the fall and winter. None of these st eams is outstanding but collectively they contribute significantly to the anadromous salmonoid populations of the area.

Anadromous Fishes of Smaller Streams. Most of these streams provide spawning habitat more suitable for steelhead trout and coho salmon than for chinook salmon. The estimated total number of fish for all of

these streams includes 4,000 chinook salmon, 10,000 coho salmon, and 25,000 steelhead trout.

The most significant streams in this group include the Little, Elk, and Bear Rivers.

The fall chinook salmon of Little River once supported a small commercial fishery supplying Eureka's fresh fish market. Local Indian tribes were dependent on these fish for their food supply. Now, only a small number of chinook salmon spawn in the stream; although it is still an important coho salmon spawning stream. Steelhead trout and sea-run cutthroat trout enter the river to spawn in the winter and early spring. Until recently, large runs of salmon and steelhead trout were known to spawn in Elk River. Bear River accommodates an impressive run of steelhead trout. Although Bear River appears suitable for coho salmon, this species was not observed.

Fish Habitat of Smaller Streams. Eight miles of the Little River is accessible to salmon runs. Usable spawning riffles, composed largely of small gravel, are found generally in the middle reaches of the main stream and in tributaries that join it along that section. Bedrock outcroppings and an abundance of boulders on the riffles characterize most of the lower reaches. The gradient is moderate and the streambed is well defined along most of its lentth. This watershed was logged off about 30 years ago, but regrowth has stabilized it so that erosion is slight. However, log jams continue to form barriers to anadromous fish, especially in the upper reaches.

Available spawning area in the Little River is considered sufficient for over 2,400 pairs of chinook salmon or 9,000 pairs each of coho salmon or steelhead trout.

Bear River is accessible to steelhead trout for about 15 miles below a large log jam which forms a complete barrier. An over-abundance of fine elements in the spawning gravels lowers their value for spawning. The gradient is low and riffles near the mouth are broad and shallow. Considerable evidence of meander and channel diversion was observed in the lower reaches. Logging activity, renewed several years ago, has had an adverse effect on this small drainage. It is estimated that the available spawning area of Bear River could accommodate about 5,000 pairs of steelhead trout or possibly coho salmon. Spawning habitat appears unsuitable for chinook salmon.

Tributaries to Humboldt Bay provide spawning habitat for moderate-sized runs of steelhead trout and small runs of coho and chinook salmon. Watershed abuse has had a highly detrimental effect on the spawning habitat of these streams. Spawning habitat in many riffles has been destroyed by heavy depositions of silt. Log jams and other barriers have made considerable lengths of stream inaccessible to salmon and steelhead trout.

Tributaries to Big Lagoon, Stone Lagoon, and Lake Earl also provide spawning habitat for small runs of coho salmon and steelhead trout.

Most of these streams were not surveyed, but evidence indicates that habitat improvement may benefit the runs of salmon and steelhead trout.

Sport Fisheries of Smaller Streams. As a group, these streams are important to the sport fishery. Runs of salmon and steelhead trout support fisheries similar to those of the larger streams, but emphasis is placed on the trout fishery which consists of juvenile steelhead trout and cutthroat trout. The sport fishery associated with these smaller streams produced an annual average of over 4,300 angler-days during the 1956 and 1957 seasons and an estimated annual catch of 450 salmon, 700 steelhead trout, and 9,100 trout.

The Sport Fishery

Introduction

Inland streams and lakes of Northwestern California and adjacent estuarine and ocean waters provide a great variety of fishing for the sportsman. The outstanding fisheries are dependent upon salmon and steelhead trout. As juveniles in the fresh-water portion of their life cycle, steelhead trout are indistinguishable from resident trout but are considered to comprise a preponderance of the catch. Sea-run cutthroat trout are important in the more northerly streams of the area. Other anadromous fish of lesser importance to the sport fishery in the streams are sturgeons, shad, and eulachon. Pacific lampreys are also of importance to the Indians of Northwestern California as a food source and are thus subjected to considerable fishing pressure.

In the headwater portions of the streams, rainbow trout are the common game fish. Eastern brook trout predominate in the mountain lakes, but brown and rainbow trout are also present. Other species occasionally

entering the sport catch in the Klamath River drainage are green sunfish, largemouth bass, yellow perch, and brown bullheads. Brown bullheads and green sunfish also occur in the Eel River drainage. Several other species, serving only as forage fish and not sought by fishermen, are black dace, other minnows, and suckers.

Ocean and surf or shoreline sport fisheries are growing attractions in this north coastal area but are still secondary in importance to the stream fisheries. Chinook and coho salmon are a major attraction and are frequently caught in or near the bays. Other species include lingcod, rockfish, and sole.

Inland Sport Fishing

Studies were made during 1956-1958 to determine the amount and distribution of fishing effort by stream and type of fishing in Northwestern California. Data also were obtained from the California Department of Fish and Game, the California Division of Beaches and Parks, and the U. S. Forest Service.

Results of these studies, covering all of the important streams of Northwestern California, are shown in table 6. The results showed that anglers traveled for considerable distance to fish in these north coastal streams (figure 3). On Smith and Klamath Rivers summer fishermen came from one-way distances averaging more than 300 miles. The Mad and Eel Rivers receive heavy fishing pressure from the densely populated local area. However, both streams are popular with California fishermen living at great distances.

Table 6. Average Angler-Day Use (effort) and Total Catch of Trout (1956; 1957), Salmon and Steelhead Trout (1956-1957; 1957-1958), Northwestern California Streams.

River	Salmon		Early-run Steelhead Trout (Aug.-Oct.)		Late-run Steelhead Trout (Nov.-Feb.)		Trout	
	Effort	Catch	Effort	Catch	Effort	Catch	Effort	Catch
SMITH	8,700	3,400	900	800	11,600	3,600	22,900	32,400
KLAMATH								
Lower (mouth upstream to Pecwan)	26,700	14,200	23,000	21,600	No Fishery		600	1,200
Middle (Pecwan to Salmon River confluence)	3,700	2,000	10,400	9,600	800	400	3,600	6,600
Upper (Salmon River to Copco Dam)	3,000	1,600	11,500	11,200	5,000	1,600	7,700	16,700
Trinity	5,000	2,600	8,000	7,100	5,300	1,700	19,700	42,500
Salmon	500	300	1,100	900	1,200	500	7,300	11,000
Scott	400	200	2,000	2,500	600	300	9,000	18,000
Shasta	400	200	500	600	---	---	9,000	20,000
Subtotal	39,700	21,100	56,500	53,500	12,900	4,500	51,400	104,000
REDWOOD CREEK	500	250	500	400	500	200	2,500	6,000
MAD								
Lower (mouth upstream to North Fork confluence)	1,000	200	300	300	2,500	800	400	1,000
Upper (North Fork confluence upstream)	No Fishery		No Fishery				3,400	11,400
Subtotal	1,000	200	300	300	2,500	800	3,800	12,400
EEL								
Lower (mouth upstream to South Fork Eel confluence)	5,000	2,500	4,800	4,200	12,600	4,300	5,900	10,400
Upper (South Fork Eel confluence to Scott Dam)	400	200	500	400	2,800	1,000	17,500	25,600
Van Duzen	200	100	200	300	500	200	7,400	10,700
South Fork Eel	1,000	500	1,000	800	4,000	1,400	11,600	17,400
North Fork Eel	100	50	100	50	100	50	1,500	2,000
Middle Fork Eel	200	150	300	300	1,400 1/	600	1,500	2,300
Subtotal	6,900	3,500	6,900	6,050	21,400	7,550	45,400	68,400

1/ Includes an estimated 650 angler-days from May 30-June 30.

Table 6. Average Angler-Day Use (effort) and Total Catch of Trout (1956; 1957), Salmon and Steelhead Trout (1956-1957; 1957-1958), Northwestern California Streams. (Continued)

River	Salmon		Early-run Steelhead Trout (Aug.-Oct.)		Late-run Steelhead Trout (Nov.-Feb.)		Trout	
	Effort	Catch	Effort	Catch	Effort	Catch	Effort	Catch
OTHER SMALLER STREAMS (Little, Elk, Bear R., etc.)	900	450	300	300	300	400	2,800	9,100
MATTOLE	600	400	200	200	1,500	500	3,000	8,000
Total	58,300	29,300	65,600	61,550	51,100	17,750	131,800	240,300

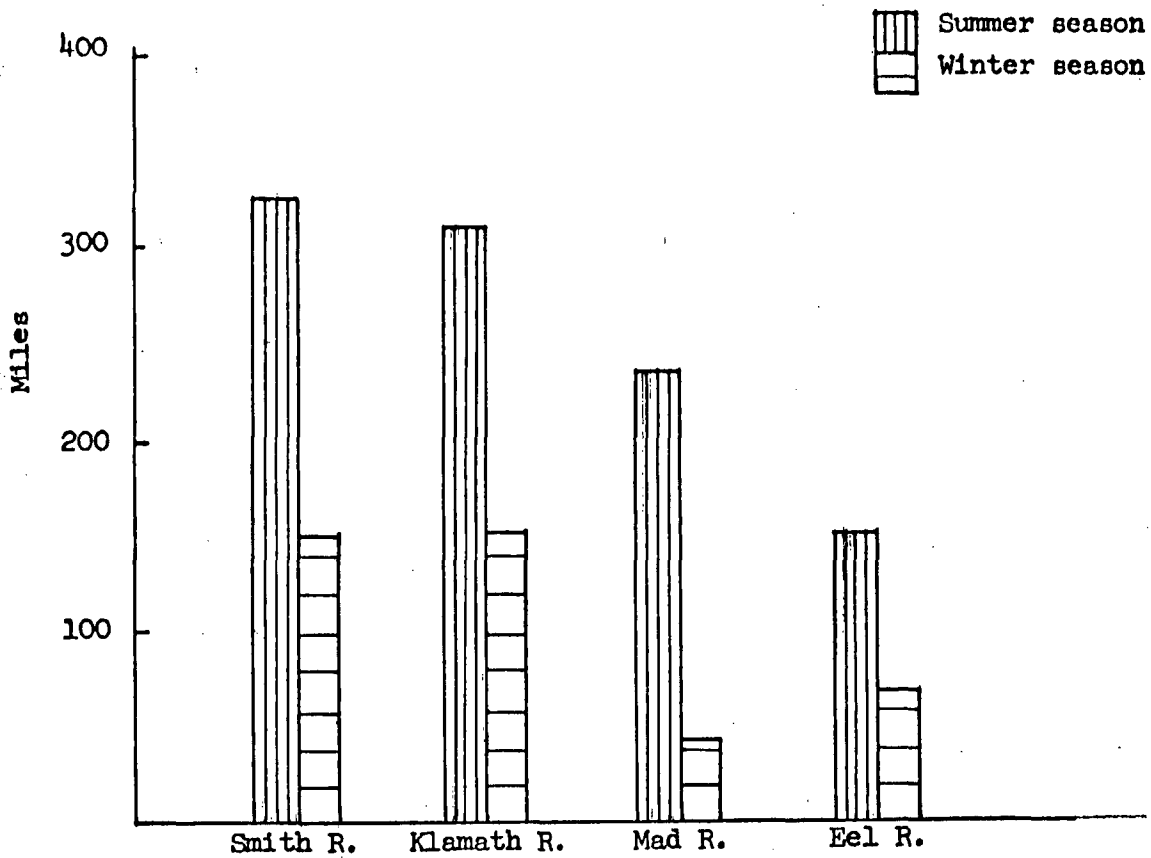


Fig. 3 One-way distances traveled by anglers to fish in major Northwestern California streams. (Based on 851 random angler-interviews in the summers of 1956 and 1957 and winters of 1956-57 and 1957-58.)

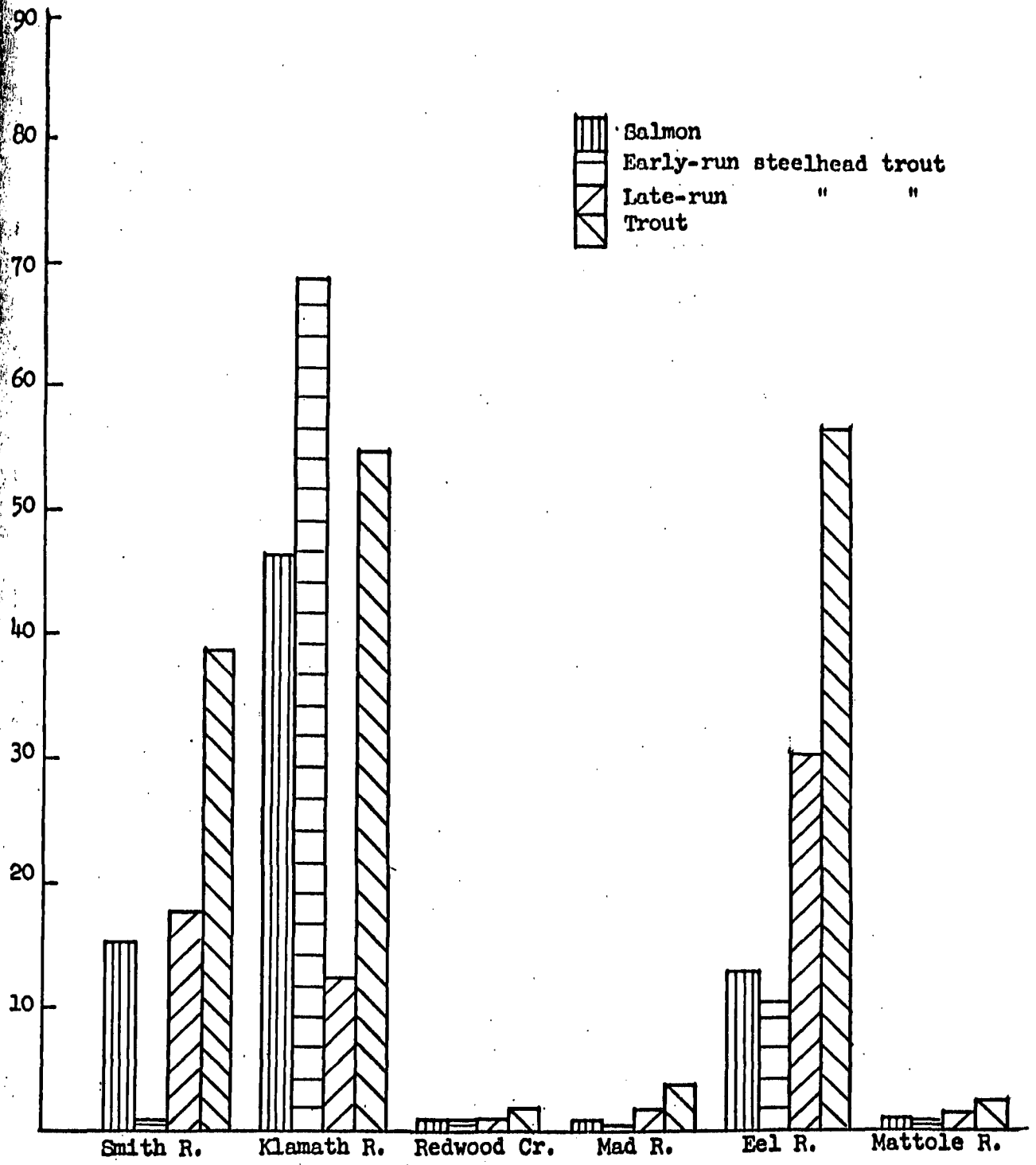


Fig. 4 The sport fishery effort in major Northwestern California drainages, summers of 1956 and 1957 and winters of 1956-57 and 1957-58.

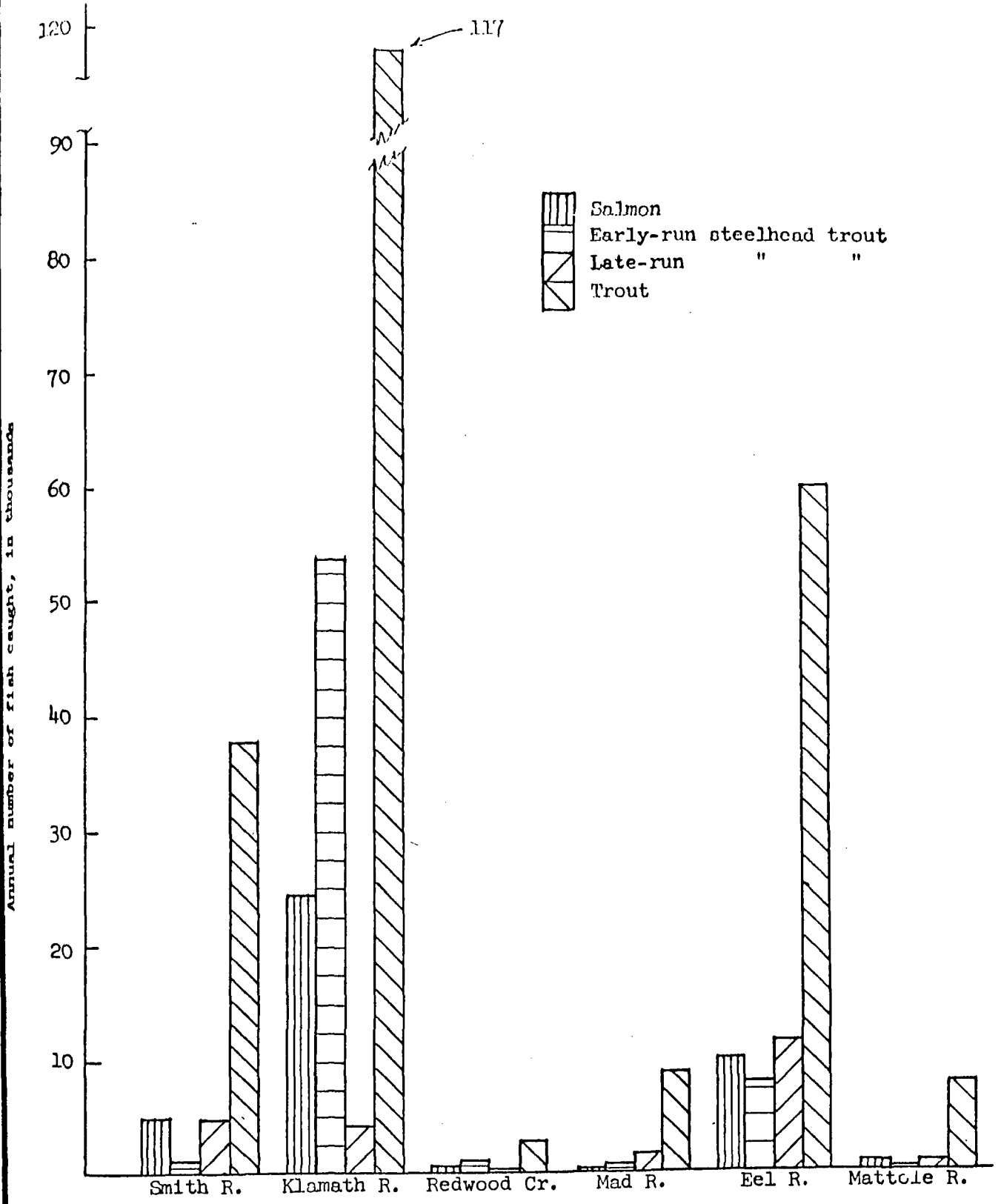


Fig. 5 The sport fishery catch in major Northwestern California drainages, summers of 1956 and 1957 and winters of 1956-57 and 1957-58.

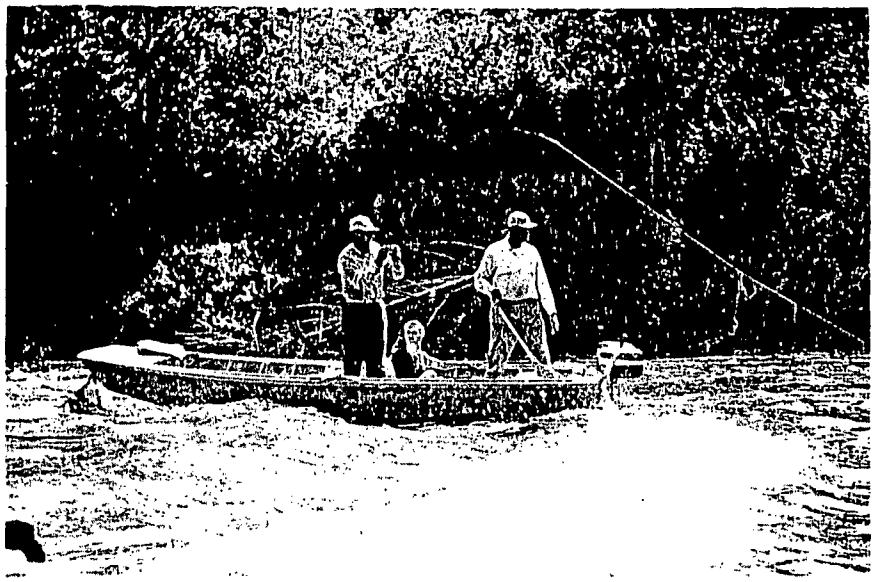


Fig. 6. Boats are commonly used by anglers when they fish for salmon and steelhead trout in the riffles and estuary of Klamath River.

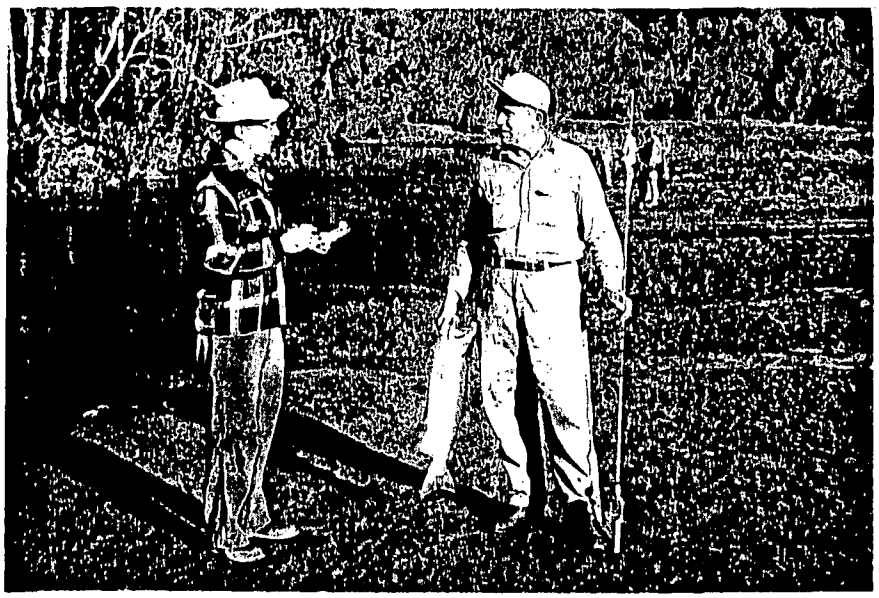


Fig. 7. Salmon and steelhead fishing in Mattole River attract many fishermen from nearby and distant areas.

The principal inland types of fishing that attract fishermen to these streams and the relative catch by numbers are presented graphically in figures 4 and 5. Some of the most notable fisheries include late-run steelhead trout in the Smith River, the salmon and early-run steelhead trout in Klamath River, and the salmon and late-run steelhead trout in the Eel River.

The amount of fishing pressure on salmon and steelhead trout is dependent upon the time and intensity of spawning migrations of these ocean-run fish. During the chinook salmon runs, anglers concentrate in the estuary and riffle areas (figures 6 and 7). Especially noteworthy are the estuary salmon fisheries of the Smith, Klamath (figure 8), and Eel Rivers. The anglers follow the runs upstream as the fish move toward the spawning beds. Although sizable runs of coho salmon ascend the streams, relatively few of these fish are caught by anglers. The short duration of the run and the accompanying high, turbid flow result in light stream fishing pressure on coho salmon.

Accompanying the chinook run, and occasionally preceding it, is a run of relatively small steelhead trout. As these "half-pounders" enter the rivers in late summer and early fall, fishermen congregate at accessible points along the main streams. The fishery for this run in Klamath River is outstanding. Fishing for larger late-run steelhead trout develops as the fish enter the streams in increasing numbers during the winter. A high, roily flow limits fishing during the winter season.

Trout fishing in many of the streams exceeds the effort expended, in terms of fishing days, to catch salmon and steelhead trout. However, much of the summer trout fishing is incidental to the general recreational activity of vacationists and tourists. Salmon and steelhead trout fishing in fall and winter, on the other hand, is done by anglers who visit the area for the prime purpose of fishing.

Inland drainages provide more than 2,000 miles of main fishing streams and tributaries and several times this amount of smaller tributaries. About two-thirds of the main streams are reasonably accessible although occurring largely in mountainous and rough terrain. During the creel study, more than 300,000 fisherman-days were annually expended on these streams to catch 347,000 fish. Much of the fishing occurred in the most popular and readily accessible stream sections and estuaries. Sport fishermen harvested about 17 percent of the 1956 salmon run and about 7 percent of the 1956 steelhead trout run. In addition to adult steelhead trout that return from the ocean, 200,000 juvenile steelhead trout were harvested.

Fishing on mountain lakes and reservoirs also is important. Alpine lakes provide good trout fishing although the number of fishermen-days is small. Man-made reservoirs (Van Arsdale, Benbow, and Lake Pillsbury on Eel River) support moderate fishing for warm water species and trout.

A series of brackish water lagoons bordering the ocean support trout fishing primarily. Coho salmon and cutthroat and steelhead trout

provide fishing in Big and Stone Lagoons, and Lake Earl. Sport fishing in lagoons is largely restricted to a period of several weeks following the opening of the fishing season near the end of May. However, it serves as a valuable complement to the stream and estuary fisheries.

An angler survey, conducted by California Department of Fish and Game in 1956, and additional studies by the Bureau of Sport Fisheries and Wildlife indicated that most of the river-caught salmon and the majority of the steelhead trout that are caught by sports fishermen in the Department's Region 1 are taken from the streams of the northwest coastal area. Region 1 includes the Sacramento River in Shasta and Tehama Counties as well as most of the northwestern California streams.

Income from recreational trade is important to the economy of the north coastal area. Fishermen expenditures are an important part of this recreational trade. Personnel of California Division of Beaches and Parks, interviewing campers and visitors in Northwestern California parks in 1957, found that 25 percent of those interviewed, fished in nearby streams during their visits. The Forest Service noted a 200 percent increase in the number of recreational visitors to the Six Rivers National Forest from 1953 to 1956. More than half of the visitors stated that their first purpose in visiting National Forests was fishing, principally in the streams within the forest boundaries.

Ocean and Coastline Sport Fishing

A variety of fish and shellfish are sought by sportsmen along the northern California coastline. Deep sea fishing, surf casting, clam digging, and skindiving are all increasing in popularity.

Of these fisheries, ocean trolling for chinook and coho salmon is the most important. This sport fishery extends along the entire northern California coast. Principal concentration points are in the vicinity of Humboldt Bay and Trinidad Head. Fewer anglers fish offshore from Crescent City and Shelter Cove.

Private small boats and licensed party boats are used for this sport fishing. Most anglers fish from private boats. Party-boat use has increased in recent years.

Fishing intensity and success in the ocean along the coast have varied greatly from season to season during recent years. The proportion of chinook salmon to coho salmon in the catch has also varied. In contrast with the sport fishery for other ocean-caught species in waters of Central and Northern California, the catch of salmon has shown a marked increase.

The total sport catch of chinook salmon in Northwestern California in 1956 is estimated to have exceeded 44,000 fish. Of this total, about 30,000 were caught in the streams and 14,000 in ocean waters. The estimated sport catch of coho salmon was 18,000 fish; about 16,000 were caught in the ocean and 2,000 in the streams.

Other sport fisheries along the coast are supported by deep-water species as well as those living in the shallow and intertidal areas. Many fish other than salmon are caught by boat fishermen while fishing for salmon in the ocean. Although salmon are of principal interest to the boat fishermen, such fish as lingcod, rockfish, hake, and sole are taken in large numbers.

Most fishing from the beach is done along the flat sandy stretches and from several rocky promontories for such species as surf smelts, sea-perch, kelp greenlings, rockfish, and lingcod. Sport fishing by net for surf smelts is concentrated at points along the shoreline where these fish congregate to spawn (figure 9).

Various kinds of shellfish are taken in several different habitats. Capers, soft-shell, and Washington clams abound in protected bays. Razor clams are found on sandy, flat beaches exposed to the pounding surf. Along rocky sections of the coast, abalone and scallops may be taken by wading or skindiving. Crabs are netted by sportsmen in the more protected waters. The value of the razor clam sport fishery is illustrated by a single day's count of over 2,000 clam diggers along a one-mile section of Clam Beach.

Fig. 8. Intensive fishing for salmon occurs in Klamath River Estuary during the annual spawning runs.

Fig. 9. Smelt fishing with "A" frame nets near Trinidad Head -- one of the many sport fishing activities which occurs along the coast.

The Commercial Fishery

Introduction

The commercial fishery is a basic industry of Northwestern California. The income received by the commercial fishing industry is exceeded only by that of the lumbering industry, the tourist and recreational trade, and agriculture. The ports of Northwestern California with their fishing fleet of approximately 500 vessels manned by 1,000 commercial fishermen represent a thriving and active industry (figure 10). Besides the direct value to the fisherman, more than a dozen plants are engaged in processing fishery products. In addition, construction and maintenance of fishing vessels, sales and service of fishing equipment, and dock facilities for fishermen represent sizable businesses in themselves.

Fishing Ports and Fish Landings

The five fishing ports receiving most of the fish landings of Northwestern California are Crescent City, Trinidad Head, Eureka, Fields Landing, and Shelter Cove. These ports, with the exception of Shelter Cove, have fish landing equipment with harbor facilities (figure 10). A variety of sport fishing facilities is also available at these various ports.

In the period 1935-1940 a significant shift of trawlers from San Francisco to the north coast occurred with greatly increased trawling in these ocean waters.

Fig. 10. This Eureka troll fishing fleet, Humboldt Bay, is indicative of the valuable commercial fishing industry of Northwestern California.

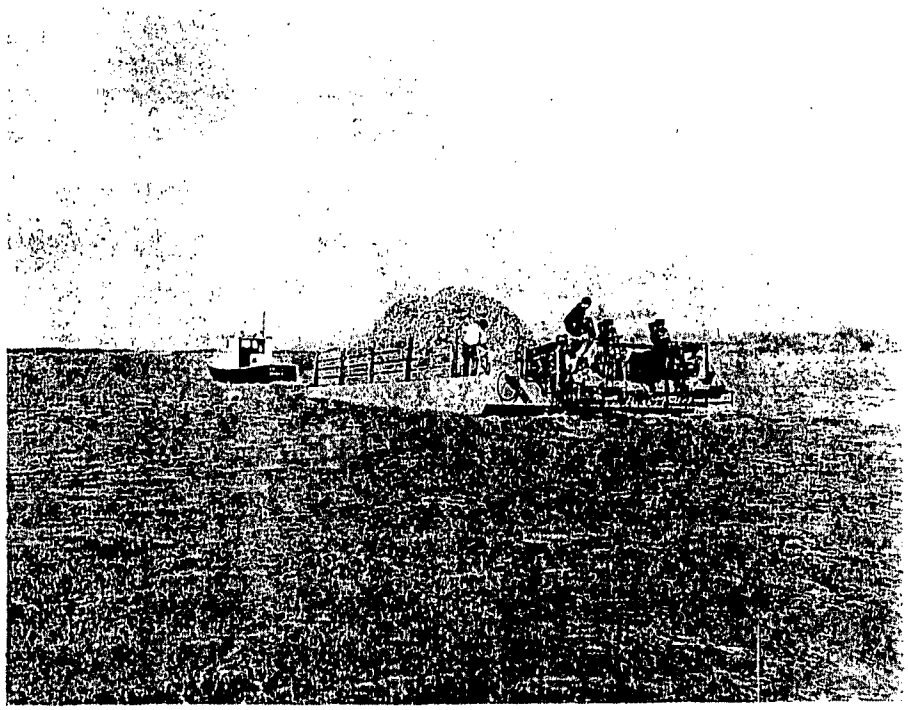


Fig. 11. The oyster fishery of Humboldt Bay is an important and growing industry of this coastal area.

Since 1955 the giant Pacific oyster, planted and cultured in Humboldt Bay, (figure 11) has risen to considerable commercial importance. Shrimp fishing is also of importance off Crescent City coast with landings at this port amounting to more than a half-million pounds in recent years.

Table 7 presents a summary of the annual average landings in these California ports for the period 1947 through 1956. During this period the annual landings averaged more than 32,000,000 pounds and had a value of almost $2,500,000 to the fisherman. Crab, salmon, sole, and albacore have had the highest values totalling more than $2,000,000 annually.

Table 7. Average Annual Fresh Fish and Shellfish Landed by Commercial Fishing Fleet for Period 1947-1956, Northwestern California Ports

Species	Crescent City Weight	Crescent City Value	Trinidad Head Weight	Trinidad Head Value
Crab	2,499,213	$336,445	613,062	$83,731
Sole 1/	453,080	26,684		
Salmon 2/	785,519	217,753	37,982	9,557
Albacore	82,608	14,586	2,705	512
Rockfish	81,285	3,444		
Sablefish				
Halibut 3/				
Lingcod	106,078	8,295		
All Other Species 4/	358,290	29,733	7,792	1,139
Total	4,366,073	$636,940	661,541	$94,939

Species	Eureka Weight	Eureka Value	Fields Landing Weight	Fields Landing Value
Crab	1,798,828	$ 234,850	~~6,433,193~~ 843,239	$105,780
Sole	8,075,733	402,385	2,245,421	131,365
Salmon	1,113,600	320,488	91,231	24,298
Albacore	767,075	131,005	28,718	4,742
Rockfish	1,681,068	66,147	764,242	27,814
Sablefish	453,544	41,043	165,457	10,609
Halibut etc.	133,102	18,246	126,609	3,245
Lingcod	307,609	24,057	117,121	8,962
All Other Species	933,861	65,528	445,814	42,158
Total	15,264,420	$1,303,749	~~12,417,806~~ 4,827,932	$358,973

Species	Shelter Cove Weight	Shelter Cove Value	Total by Species Weight	Total by Species Value
Crab			~~13,344,296~~ 5,754,422	$ 760,806
Sole			10,774,234	560,434
Salmon	134,786	$33,220	2,163,118	605,316
Albacore	4,608	700	885,714	151,545
Rockfish			2,526,595	97,405
Sablefish			619,001	51,652
Halibut etc.			259,711	21,491
Lingcod	4,842	409	535,650	41,723
All Other Species	2,979	267	1,748,736	138,825
Total	147,215	$34,596	~~32,857,055~~ 25,267,181	$2,429,197

1/ This includes the total for rex, petrale, English and Dover sole.
2/ See also table 8 for detailed landings covering 10-year period 1947-1956.
3/ This is a total for Pacific, arrowtooth halibut, and sand dab.
4/ Includes sporadic shark and skate fishery extending through 1952. Hake landings important since 1954.

The Ocean Salmon Fishery

The commercial salmon catch in the ocean off Northwestern California consists primarily of two species: chinook and coho salmon. Coho salmon landings in Northwestern California ports in 1952, the only year of available records, accounted for 48 percent of the total weight. Steelhead trout may not be legally landed in California ports.

Past reports show the river fisheries on the Eel, Klamath, Smith, and Mad Rivers have been of great importance. As early as 1857 the records show 2,000 barrels of cured salmon and 50,000 pounds of smoked salmon prepared from Eel River catches. In early years, a variety of gear was used on the rivers, including seines, gillnets, and traps. The Mad River was closed to commercial fishing in 1919, Eel River in 1922, and Klamath and Smith Rivers in 1933.

Commercial trolling for salmon had moved into the ocean waters of Northwestern California by 1916. During earlier years, total river catches exceeded that of the ocean but the troll fishery grew rapidly. The present-day salmon trolling boat (figure 10) usually has four poles and six lines with four hooks each. Most boats now use power gurdies which greatly facilitate the landings. Since 1919 annual landings have ranged from one to more than three million pounds (table 8). In 1956, the highest year of record, 3,695,000 pounds were landed. Salmon landings in ports of Northwestern California indicate the importance of the salmon industry in this area and also suggest the contributions these north coastal streams are making to the total ocean salmon catch.

Table 8. Commercial Salmon Landings, 1947-1956, Northwestern California Ports. 1/

Year	Crescent City Weight	Crescent City Value	Trinidad Head Weight	Trinidad Head Value	Eureka Weight	Eureka Value
1947	1,153,916	$ 245,207	95,515	$20,297	1,673,151	$ 355,545
1948	733,744	198,844	71,450	19,363	976,003	264,497
1949	465,499	110,510	37,436	8,887	902,352	214,218
1950	819,450	192,817	56,654	13,331	435,473	102,467
1951	412,494	107,125	22,340	5,918	703,705	182,752
1952	877,206	210,705	15,734	3,779	526,471	126,458
1953	380,522	92,793	26,172	6,375	689,042	167,851
1954	814,077	247,886	25,324	7,711	1,057,322	321,955
1955	985,831	342,227	29,201	9,906	1,772,344	619,322
1956	1,212,460	429,418			2,400,142	849,824
Total	7,855,199	$2,177,532	379,826	$95,567	11,136,005	$3,204,889
Average (10 yr.)	785,519	217,753	37,982	9,557	1,113,600	320,489

Year	Fields Landing Weight	Fields Landing Value	Shelter Cove Weight	Shelter Cove Value	Totals Weight	Totals Value
1947	172,170	$ 36,607	549,154	$116,695	3,643,906	$ 774,351
1948	203,190	55,064	364,083	98,666	2,348,470	636,434
1949	45,956	10,910	178,321	42,333	1,629,564	386,858
1950			42,891	10,092	1,354,468	318,707
1951	29,184	7,579	103,247	26,813	1,270,970	330,187
1952					1,419,411	340,942
1953	178,527	43,489			1,274,263	310,508
1954	210,089	63,972	27,886	8,491	2,134,698	650,015
1955	73,197	25,356			2,860,573	996,811
1956			82,273	29,115	3,694,875	1,308,357
Total	912,313	$242,977	1,347,855	$332,205	21,631,198	$6,053,170
Average (10 yr.)	91,231	24,298	134,786	33,220	2,163,118	605,317

1/ Extracted from California Department of Fish and Game Fish Bulletins.

Ocean Salmon from Streams of Northwestern California

The importance of the contribution of Northwestern California streams to the ocean salmon fishery has not been clearly determined. It is recognized that these streams contribute significantly not only to the salmon fishery of the California waters but also to the Oregon and Washington ocean fisheries. Efforts to determine the contribution of these streams have been made by tagging ocean fish and subsequently recapturing tagged fish in their native streams and by marking immature salmon in streams of their origin and noting their occurrence in the ocean catch. Both of these methods offer many difficulties statistically, including an assumption of random mixing and adequacy of tag returns either in the ocean or the stream.

Studies by the California Department of Fish and Game and by California Department of Water Resources are enlightening on some aspects of the problem. These studies show that chinook salmon move great distances from the coastal streams of their origin. One of the studies showed that most of the chinook salmon produced in the Sacramento River were caught in the commercial troll fisheries off the coast of Oregon and Washington. Only 7.3 percent of the total contribution of Sacramento River to the California commercial catch was made in Northwestern California coastal waters. The results of that study suggest that while Northwestern California streams may contribute to catches made in Oregon-Washington coastal waters they generally contribute to only relatively nearby waters. On the other hand, coastal streams of Oregon are known to contribute significantly to the coho salmon catch in the ocean off Northwestern California.

For purposes of this report, a reasonable estimate of the contributions of the Northwestern California streams can be made on the basis of the spawning escapement of both coho and chinook salmon. The use of a ratio of escapement to total catch is tempered by the known or estimated commercial and sport catch during recent years and by ratios used for other streams.

During recent years a spawning escapement of 56,000 coho salmon has been estimated for these north coastal streams (table 1). It is also estimated that twice as many fish contribute to the total commercial and sport catch. Of the total catch, about 2,000 coho salmon are taken in Northwestern California streams, and the remainder, 106,000, are taken in the ocean. The ocean sport catch of coho salmon off Northwestern California in recent years amounted to about 16,000 fish, and total commercial landings off the Eureka region have been about 137,000. These streams are credited with a contribution to the total ocean catch which equals about two-thirds of the catch of coho salmon in the Eureka offshore area.

The number of chinook salmon originiatng in Northwestern California streams is greater than that of coho salmon. Assuming a catch-to-spawning-escapement ratio of 2.5:1, the average annual catch attributable to these streams is 330,000. A catch-to-escapement ratio of 3:1 frequently has been assigned to the salmon of Sacramento River and other California streams. Even larger catch-to-escapement ratios have been recorded for individual tributaries of the Columbia River. About 7,000

chinook salmon have been caught annually in the ocean sport fishery and 27,000 in the stream sport fishery in recent years. The remaining 296,000 salmon, or approximately 3,582,000 pounds, are assigned to the commercial troll fishery. This estimate of the commercial catch of chinook salmon originating in California north coastal streams is equivalent to about 45 percent of the average annual chinook salmon landings of California over the past ten years.

WILDLIFE SECTION

Cover Types

The redwood belt in Northwestern California extends along the coast in a narrow strip about 35 miles wide ranging in elevation from sea level to 2,000 feet. In this belt summers are mild but foggy, and winters are wet. Redwoods are usually found in association with Douglas-fir, except on valley flats where stands are essentially pure. Western hemlock, western red cedar, madrone, California bay, grand fir,and red alder are found intermixed in the redwood forest. Some of the more common shrubs forming a low understory in the redwood association are California and red huckleberry, blue blossom, wax myrtle, salal, and thimbleberry. Sword fern, deer fern, redwood sorrel, and a vast array of shade-loving herbs are also components of this understory.

The Douglas-fir forest is located inland and at elevations above the redwood belt but below 4,500 feet. However, Douglas-fir is also common in places near the coast where it is in association with redwoods and tanbark oak. In some areas light mixtures of western hemlock, grand fir,

or Sitka spruce are found. Hardwoods occuring in the Douglas-fir forest are madrone, California bay, red alder, and tanbark oak. Shrubs characteristic of the area are California huckleberry, manzanita, white thorn, tobacco bush, buck brush, deer brush, blue blossom, flowering currant, thimbleberry, and salmonberry.

Ponderosa pine forests are scattered at higher elevations in the eastern part of the area. Other conifers in this forest are Jeffrey, sugar, and western white pine and red and white fir. Shrubs of this forest area include manzanita, tobacco bush, buck brush, ceanothus, western serviceberry, California hazel, poison oak, and mountain-mahogany. White alders occur along streambeds. A variety of herbs and grasses are found, including bracken fern, lupine, hop clover, bur clover, yellow star-thistle, wild oat, and vetch.

The woodland-grass association is discontinuous. The woodland consists of stands of white oak and California black oak. The grass understory is composed mostly of California oatgrass, Pacific reed grass, and velvet grass. Characteristic shrubs of the woodland-grass area are buck brush, deer brush, coffeeberry, western mountain-mahogany, and various species of manzanita.

Chaparral occupies large areas in the southeastern part of Northwestern California and is also found in scattered small stands in other parts of the area. Shrubs of the chaparral community are mostly evergreen. Usually they are extensively branched, have a dwarfed habit of growth, and a large root system which accounts for their endurance during hot,

dry summers. Chaparral is found in association with ponderosa pine, Douglas-fir, California black oak, and digger pine. The chaparral includes chamise, buck brush, western mountain-mahogany, scrub oak, and various species of manzanita.

Big Game

The Columbian black-tailed deer is found in large numbers in some areas of Northwestern California. Deer numbers north of the Klamath River in Del Norte County are low. Low soil fertility leading to an absence of proper nutrients in forage plants has been suggested as a possible explanation for the low population.

Deer herds along most of the coast use the same range all year. However, deer migration does occur in the headwaters of most of the drainages. It consists for the most part of a down-mountain drift when snow forces the animals out of higher elevations (plate III). Although migrations in the Trinity Alps are the most extensive, they are also widespread in the Marble, Scott Bar, and Trinity Mountains. Winter migration of deer in the Mattole River basin is practically non-existent. Winter migration in the Eel River occurs principally in the higher regions adjacent to Lake Pillsbury and the Middle Fork of the Eel.

In the dense stands of coniferous forest, especially redwood and Douglas-fir, populations of game animals are low. When the stands are opened by logging or fire, shrubs invade the area, provide more browse, and deer populations increase (figure 12).

A variety of plants are browsed by deer. Western mountain-mahogany, buck brush, and deer brush are heavily utilized. Other plants eaten in moderate amounts are chamise, blue oak, scrub oak, and black oak. Incense cedar and manzanita are eaten in smaller amounts. Grasses serve as green feed during late winter and early spring.

During late winter and early spring, large numbers of deer are lost due to infestations of stomach and intestinal worms. This condition usually occurs during years of heavy rainfall, when deer winter in grassy areas where grass constitutes a major portion of their diet.

National forest lands are generally accessible for hunting, though in some areas scarcity of roads exists. Much of the private lands are extensively posted against public hunting. About 25,000 acres of public domain have been withdrawn by the State for deer hunting and other recreational purposes in the Kings and Queens Peaks area of the Mattole River drainage. One large ranch, opened on permit basis in 1957 and 1958, provided considerable public hunting in the Mad River area. The average annual kill in Northwestern California from 1927-1957 was 6,521 deer (table 9).

Roosevelt elk are found in Humboldt, Del Norte, and Siskiyou Counties. They are established in two main areas: the Big Lagoon-Maple Creek area and the Prairie Creek-Gold Bluffs area. Small herds of elk are found in Del Norte County, in the vicinity of the Bald hills, and in Humboldt County in the vicinity of Freshwater Creek, Kneeland, and Elk River (plate III). The elk population in Humboldt and Del Norte Counties

is estimated to be 1,000 to 1,500 animals. Elk hunting is not permitted at the present time.

These elk are non-migratory and occupy relatively small areas throughout the year. Their movements are geared to the abundance of food. Grasses, forbs, and ferns are the most important forage plants for these elk. Shrubs are utilized during the fall and winter in certain areas.

The black bear population in Trinity and Humboldt Counties is the largest in the state. Populations in the other counties are considerably smaller. In 1957, a total of 254 bears were killed in Northwestern California, most of these in Trinity, Siskiyou,and Humboldt Counties. Black bears may be taken at any time in Humboldt County. Mountain lions occur in moderate numbers in Humboldt, Trinity, Mendocino, and Siskiyou Counties.

Table 9. Deer Kill in Northwestern California. 1/

County	Yearly Average					
	1927-1952	1953	1954	1955	1956 2/	1957 3/
Del Norte	30	33	46	55	63	57
Humboldt	1,255	2,323	3,055	3,408	3,393	3,631
Trinity	911	1,220	1,242	1,242	1,811	1,633
Lake	281	429	508	496	406	317
Mendocino	1,173	2,187	2,616	2,294	2,025	1,924
Siskiyou	571	556	807	844	1,130	879
Glenn	323	303	344	390	425	405
Total	4,544	7,051	8,618	8,729	9,253	8,846

1/ Corrected kill presented for Lake, Mendocino, Siskiyou, and Glenn Counties since only a portion of these counties fall within Northwestern California.

2/ 1956 Regular Deer Season Report, California Department of Fish and Game.

3/ 1957 Regular Deer Season Report, California Department of Fish and Game.

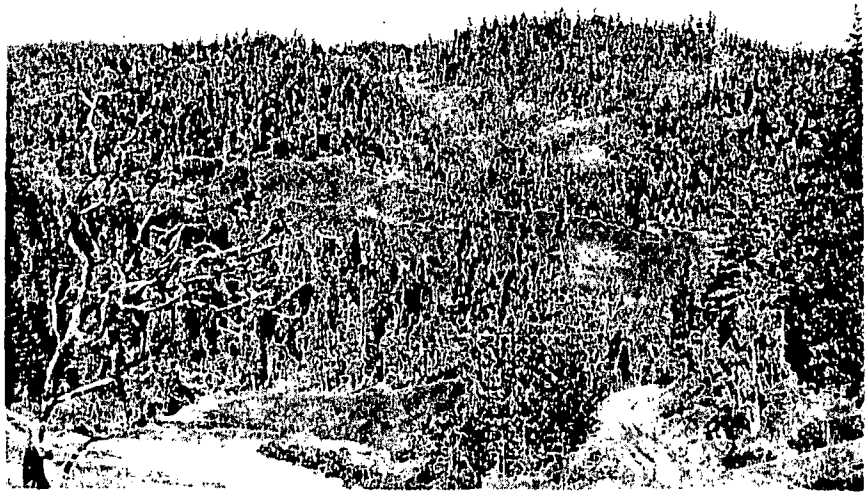


Fig. 12. Deer and upland game find abundant food and cover in this mixed forest of the Eel River drainage.

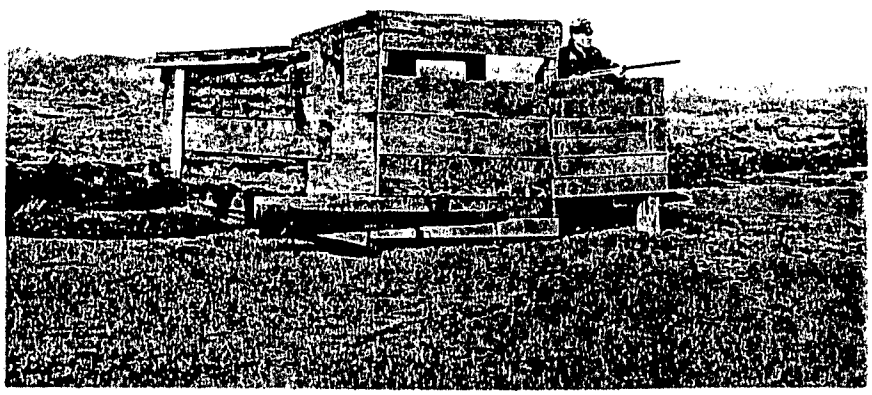


Fig. 13. The wood frame blind is commonly used when hunting black brants and ducks. Pictured area is on South Spit, Humboldt Bay.

Upland Game

Blue and ruffed grouse are found in low density throughout the area. Blue grouse inhabit Douglas-fir forests in all counties of the area. Ruffed grouse are found at lower elevations in Del Norte, Humboldt, western Siskiyou, and western Trinity Counties. This species inhabits forests composed of Douglas-fir, western red cedar, red alder, madrone, and tanbark oak. Ruffed and blue grouse are hunted for only two days in Del Norte, Humboldt, Siskiyou, and Trinity Counties.

California and mountain quails are common to the area. California quails are widespread in their distribution, preferring brushy stream bottoms and cut-over areas. Mountain quails are distributed from the upper part of the California quail range to the higher mountainous areas of the Smith, Eel, Klamath, Salmon, and Trinity River drainages, preferring the oak-pine country.

The California quail is hunted more than the mountain quail. The rugged country inhabited by the mountain quail and its unwillingness to take to the wing are largely responsible for the low hunting pressure. Mendocino and Humboldt Counties are good quail producing areas, but hunting pressure is limited because of extensive posting on private lands.

Small populations of ring-necked pheasants inhabit the Loleta-Ferndale and Arcata bottoms, and Scott and Round Valleys. Scott and Round Valleys consist principally of irrigated grain and alfalfa fields. Pheasants were abundant in Humboldt County thirty years ago when grain was the

major crop. However, grain has been replaced by permanent pasture, and pheasants have become scarce. Pheasants have been planted by the California Department of Fish and Game in selected areas from time to time to provide hunting.

Band-tailed pigeons are found throughout the area. During their southward migration, band-tailed pigeons are numerous on the Kneeland Prairie, lower Eel, and upper South Fork Eel, with concentrations along the Trinity River near Hoopa, Helena, and Junction City and the Klamath River near Orleans. Heavy concentrations also occur in the lower Mattole River drainage. They inhabit the ponderosa pine and oak association of the mountains. In Northern California the highest pigeon kill occurs in Humboldt County, where about 5,000 birds are harvested annually.

Mourning doves occur throughout the region in woodland-grassland areas, except at the higher elevations. They concentrate in the Round Valley-Covelo area and the Klamath-Scott area. Doves are subjected to light hunting pressure in Northwestern California.

Gray squirrels inhabit the Douglas-fir and pine belt areas and were quite abundant many years ago. Gray squirrel populations encountered a low point in the thirties and are now apparently increasing. At the present time, hunting pressure is light.

Snowshoe hares are found in western Siskiyou and Trinity Counties and inhabit the higher mountains along streams in the timbered regions of the

red fir forest. Brush rabbits are found throughout most of the coastal forest belt and brushy areas. Hunting pressure for rabbits in this area is light.

Fur Animals

Northwestern California supports a variety of fur animals. Minks, river otters, and beavers are the commercially important fur animals of the area. Ring-tailed cats, gray foxes, coyotes, muskrats, and bobcats are seldom harvested because of poor demand for their pelts. Pine martens and fishers are found in small numbers in the higher mountains. Both species are protected in California. Raccoons, weasels, badgers, spotted skunks, and striped skunks are also found in the area.

The number of licensed fur trappers is small; their number is largely determined by the market demand for fur. Most trapping is done on a part-time basis for sport by individuals who wish to augment their regular incomes.

Waterfowl

Concentrations of migrating waterfowl are found along the coast in the winter. Humboldt Bay is the most important resting area in the north coast area. Small concentrations are found in Lake Earl, Big Lagoon, and Stone Lagoon and in even fewer numbers along the rivers and streams.

Humboldt Bay and adjacent areas provide one of the most important wintering grounds for black brants (table 10). The bay is important because it supports a stand of approximately 3,000 acres of eelgrass,

so vital in the brant's diet. Probably no other waterfowl species is so closely associated with one food. In years when eelgrass does not thrive, brants will feed in pasture lands and salt marshes near the bay.

Brants arrive in the bay in October and some remain in the area until they start their northward migration. The greatest concentrations occur in March and April with the influx of migrants from southern wintering areas, although the migration northward from the bay begins in late January or early February.

Brants are eagerly hunted by local sportsmen. In South Humboldt Bay, wooden framed blinds (figure 13), built especially for brant hunting, line the western shore. According to banding data, more brants are taken in Humboldt Bay than in any other area. It has been reported that 3,200 brants were killed or crippled in Humboldt Bay in 1959.

Table 10. Winter Counts 1/ of Black Brants, Humboldt Bay.

Year	Number	Year	Number	Year	Number
1932	29,415	1942	48,000	1951	36,000
1933	5,000	1943	18,000	1952	25,000
1934	18,860	1944	2,500	1953	28,000
1935	115,000	1945	16,000	1954	7,500
1936	50,000	1946	No data	1955	11,870
1937	22,500	1947	25,000	1956	19,010
1938	45,000	1948	27,120	1957	18,800
1939	29,000	1949	27,505	1958	11,300
1940	56,375	1950	32,500	1959	4,850
1941	50,000				

1/ 1932-1941 are February inventories by California Department of Fish and Game. (Moffet 1943.) 1942-1959 are January inventories by the U. S. Fish and Wildlife Service.

The principal migrant surface ducks visiting the area are American widgeons, pintails, and mallards. The more abundant diving ducks are scaups, scoters, and ruddys. Other species occurring are gadwalls, green-winged teals, shovelers, wood ducks, redheads, canvasbacks, ring-necks, goldeneyes, buffleheads, and mergansers. Canada geese and whistling swans are occasional visitors. Coots and Wilson's snipe also winter in the area. Large numbers of shorebirds inhabit the tidelands of Humboldt Bay and coastal shoreline.

A number of western Canada geese spend the winter on Castle Island, a small, rocky, wooded island one mile off the coast near Crescent City. In 1955 it was estimated that 80 of these geese were on the island. Castle Island appears to be the southern extent of their winter range.

Mallards are the most common summer resident. They nest along sloughs of the bays and rivers. A small number of cinnamon teals and wood ducks nest in the area during the summer.

A number of years ago, migrant waterfowl depended heavily on grain planted in the bottom lands which are now utilized for pasture. The birds now depend to a great extent on natural foods including pondweeds, bulrushes, pasture grasses, salt grass, and eelgrass. The presently small acreage in grain provides summer food for a few local birds.

Most waterfowl hunting is done in Humboldt Bay and adjacent areas. The two principal methods of hunting are sculling and hunting from blinds. In sculling, a specially designed boat with a low silhouette is used.

The sculler lies on his back in the boat and propels it with a single oar that extends through a hole in the stern. The sculler approaches the birds downwind and attempts to flush them into position for an overhead shot. In the second method, decoys are placed in the water in front of a blind and the hunter attempts to lure the birds within shooting range. Wooden-frame blinds, located on the beach, stilt blinds, and floating blinds are used.

Other Wildlife

Several species of whales were economically important until recent years. A whaling station was once operated at Fields Landing on Humboldt Bay; however, scarcity of whales in offshore waters forced cessation of this activity.

Northern sea lions and harbor seals reproduce in the coastal waters. Alaska fur seals and gray whales annually migrate along the coast en route to their breeding grounds, the Alaska fur seals going to the Pribilof Islands in the Bering Sea and the gray whales to the waters of lower Baja California. Other aquatic mammals occasionally appear along the coast but are rarely seen close to shore as are the gray whales and Northern sea lions.

Castle Island and other islands along the coast are inhabited or visited by harbor seals, Northern sea lions, and several species of birds including puffins, gulls, auklets, murres, and murrelets. They provide considerable interest, since they can be observed from the harbors and coastline roads.

FISH AND WILDLIFE PROBLEMS AND NEEDS

Exploding human populations, conflicting philosophies on the use of land and water, improved roads and means of transportation, and many other pressures of modern living have brought about a multiplicity of problems to fish and wildlife managers throughout the country. These areas of concern are equally if not more pronounced in Northwestern California. This section of the report presents measures needed for the preservation and enhancement of fish and wildlife resources in order to meet hunting and fishing demands in Northwestern California. Solutions to the problems and needs are obvious in certain instances; no measures are readily apparent to reverse downward trends in fish and wildlife populations in other situations. The list of problems and needs is not intended to present priority categories, but merely to show where emphasis should be placed in any program affecting fish and wildlife resources.

a. Preservation and enhancement of fish and wildlife in water development planning. This subject will be treated in greater detail in the section on Fish and Wildlife in Relation to Water Development Planning.

b. Control of Pollution in estuarine areas and streams. Plans for industrial development in the Humboldt Bay area alone include paper pulp mills, an atomic power plant, hydroelectric plants, and numerous other industries that present hazards to water quality throughout the area. Strict control should be assured to prevent damage to the estuarine nursery grounds for many forms of important fish and sea foods as well as certain waterfowl and fur animals. Streams which provide migration

routes for anadromous fish and habitat for resident species should be kept free from industrial and municipal pollutants.

c. Establishment of a management area for the protection and improvement of habitat conditions for the black brant. There is paramount need for setting aside a portion of Humboldt Bay to develop feeding and resting habitat for the black brant. Concentrations as great as 25 percent of the entire Pacific Flyway population frequent the Humboldt Bay area during the winter migration. Eelgrass beds along this section of the coast provide food that is essential to the diet of the black brant.

d. Control of sedimentation and blocking streams. Removal of gravel for industrial use, mining activities, highway construction, lumbering, and many other human activities contribute to stream deterioration. Frequently, gravel removal is directly responsible for muddy and roiled water conditions that cause loss of fish spawn. Log jams created by careless lumbering practices present barriers to migrating fish. Use of stream beds as a source of highway fill or for actual road location destroys fish habitat. Mining activities often disturb stream beds, destroy food-producing and fish spawning habitat, and release certain pollutants in the stream. All these activities need close coordination with fish and wildlife planning.

e. Maintenance of desirable streamflow. The flow in Northwestern California streams is inherently low during the summer and fall and is high during the winter and spring due to the rainfall pattern of the region. The characteristic low flow has been greatly accentuated in many streams by diversions or by watershed practices that accelerate

runoff during periods of high water conditions. Water storage in headwater areas is needed to supplement natural flow. Logging practices which denude steep slopes of their vegetation should be modified and provision should be made to leave protective cover over highly-erodable areas. Clearing to provide agricultural land should follow a designed pattern to prevent excessive removal of all vegetative cover over extensive areas.

f. Improvement of access for hunting and fishing. Private land in the region is extensively posted, and, as a result, hunting and fishing are prohibited in large areas which are actually accessible by roads. Access to the large National Forest areas is likewise frequently blocked by posted private holdings. Improvement of access is generally needed to equalize hunting and fishing pressure which can be expected to show steady increases in future years.

PLANS FOR WATER DEVELOPMENT

Northwestern California comprises 8 percent of the total area of California and about 37 percent of the water resources originate there. As the demand for water increases in the highly populated portions of the Central Valley and Southern California, plans for export of excess water from Northwestern California are becoming more apparent. Demand for water by local communities and industries has also increased. Floods are common in these north coastal streams during the winter periods of heavy rains. In 1955, winter floods occurred throughout Northwestern California causing great damage to agricultural lands and property. Various plans for water development to meet the many needs are underway by the State of California,

the Federal Government, and local groups.

Three major water development projects and a few minor ones are already in use or under construction. These include Copco power dams, far upstream on the Klamath River, and Pillsbury storage reservoir and Scott Dam on the upper Eel River which provide for interbasin diversion to the Russian River for hydroelectric and conservation purposes. Trinity Dam and Lewiston Diversion Dam, under construction by the Bureau of Reclamation will develop Trinity River water for export to Sacramento River through a system of tunnels to supply water for Central Valley Project. Power development will also be a major purpose. Other smaller reservoirs, providing storage for local use, are Dwinnell Reservoir on the Shasta River and Sweasey Reservoir on the Mad River.

The California Water Plan presented in 1957, has become recognized by the California legislature as a guide for water development in the state. It presents a master plan for the control, distribution, and use of water for the present and future needs in all areas of the State. The plan is intended to supplement existing water developments and to provide for coordination of all planning entities. It provides a broad and flexible framework for development in an orderly sequence throughout the State. It allows for the development of individual projects to meet various needs and anticipates alterations and improvements in project plans. It clearly suggests that developments should be fitted into the framework of the plan. It further describes the California Aqueduct System, a program including interbasin transfer facilities and water development projects to meet local requirements.

In outlining features for local development, California is divided into hydrographic areas, one of which is the North Coastal Area. This covers the coastal drainages from the Oregon-California state line, inclusive of the Mattole River, whereas the Water Plan area includes also the Noyo, Navarro, Garcia,and Russian Rivers lying in the south of the Mattole River. The State Water Plan discusses development features for these north coastal streams and, although differing considerably in detail from other plans, has great similarity in the objective of local storage and water transport.

The U. S. Army Corps of Engineers is studying the feasibility of flood control projects for various streams of Northwestern California and for harbor improvement.

The Humboldt Bay Municipal Water District is moving forward with the development of Ruth Dam on the Mad River and the distribution of water to new industries and towns of the Humboldt Bay area.

These numerous projects will all effect fish and wildlife resources but are not discussed in this report. This chapter gives emphasis to the effect on fish and wildlife of tentative water development projects by the Bureau of Reclamation.

The Bureau of Reclamation has developed plans similar to the California Water Plan to meet local water needs and to transport water outside Northwestern California. Projects proposed for initial construction (plate I), in probable order of development, would be the Upper Eel River, Middle Fork Eel River, and Upper Trinity and Adjacent Streams.

Ultimate development would include the Lower Eel River and Klamath River Extension.

The Upper Eel River project would include a dam 475 feet high at the English Ridge site on the Eel River which would impound 1,490,000 acre-feet of water. About 370,000 acre-feet would be diverted annually from the reservoir into a short tunnel through the ridge to the East Fork of the Russian River. Water diverted to the Russian River would be used for irrigation of lands in Mendocino, Marin, Lake, Napa, Solano, and Yolo Counties, and the remaining unused water would then be diverted through Clear Lake and Cache or Putah Creeks to Sacramento River.

A second project would include a system of storage reservoirs and diversions from the Middle Fork Eel River to Stony Creek, a tributary of Sacramento River. A 420-foot dam is considered for the Middle Fork Eel at the Etsel-Short site. A second dam on Short Creek would prevent water from overflowing a saddle between Short Creek and the Middle Fork Eel River. A dam at the Jarbow Ridge site, a short distance downstream from Etsel-Short damsite, would impound Middle Fork streamflow and divert it through a proposed tunnel to Grindstone Creek. The diverted water would be stored in proposed reservoirs at the Stony Creek site on Stony Creek and at the Newville site on the North Fork of Stony Creek. Power installations would be operated by release from these two reservoirs and at the proposed Black Butte Reservoir farther downstream. Engineering data for these several reservoirs are summarized in table 11.

Table 11. Reservoir Data, Middle Fork Eel River - Stony Creek Project.

Item	Reservoirs				
	Etsel-Short	Jarbow Ridge	Stony Creek	Newville	Black Butte 1/
Height of dam	428	162	260	250	125
Full Pool:					
Elevation (MSL)	1,703	1,237	850	830	510
Capacity (1,000 acre-feet)	1,425		1,125	1,045	375
Area (acres)	9,500	1,000	13,700	9,900	7,100
Minimum pool:					
Elevation (MSL)	1,350	1,153	775	760	467
Area (acres)	300	300	7,900	5,600	3,900
Fluctuation (feet)	353	84	75	70	43

1/ Under construction by the Army Corps of Engineers.

It is tentatively planned by the Bureau of Reclamation that Etsel-Short and English Ridge Reservoirs would be operated to provide a flow of 60 second-feet during late fall and at least 30 second-feet at other times in the Eel River at Dos Rios, ten miles downstream from the Jarbow damsite.

The proposed Branscomb Dam and Reservoir on the South Fork of the Eel River, six miles below Branscomb, is being considered for conservation purposes. Improvement of fish habitat in the stream below the dam is also under consideration. This dam would impound enough water to provide a streamflow of 150 second-feet and a minimum recreation pool. Part of the streamflow would be used to meet future irrigation and industrial needs in the Lower Eel-Van Duzen area.

Another transbasin diversion proposal is included in the Upper Trinity and Adjacent Streams project, which would involve not only Trinity River but also Mad and Van Duzen Rivers. This entire development would consist of a total of eight reservoirs on streams of Northwestern California. The project would annually transport to Sacramento River Valley about two million acre-feet of water. By a system of tunnels and pump lifts, water would be made available to Helena Reservoir for transport through the Trinity Mountains to storage reservoirs for uses in the Central Valley. Helena, Burnt Ranch, and Ironside Mountain Dams would impound water at successive points downstream from Lewiston Diversion Dam, presently under construction. A tunnel through the Trinity Mountains at an upstream point on Helena Reservoir would transport waters to Clear Creek, a tributary of Sacramento River. Dinsmore Dam on the Van Duzen River, Pilot Ridge Dam on the Mad River, and Eltapom Dam on the South Fork Trinity River would provide additional storage for eventual transport by way of Helena Reservoir to the Sacramento River (plate I).

Ruth Dam, to be located on the Mad River upstream from Pilot Ridge Dam, in combination with the Essex Diversion, is being planned by the Humboldt Bay Municipal Water District. Impounded waters would be used for municipal and industrial purposes in the Eureka area. In the current planning of the Bureau of Reclamation, Butler Valley Dam would be constructed on the Mad River downstream from Maple Creek. The resulting impoundment would supply water to areas previously planned for irrigation by waters impounded by Ruth Dam and would also serve presently irrigated lands. Ruth Reservoir could then receive emphasis for recreational use in

addition to providing another source of water during extremely dry years. Releases to maintain stream flow and to meet downstream demand for municipal and irrigation needs would have to be made from the dams on the Van Duzen, Mad, and South Fork Trinity Rivers.

The lower Eel River project would probably be constructed in the distant future. It would consist of three reservoirs on the lower Eel River: Indian Springs, Willow Creek, and Sequoia. Water from Indian Springs Reservoir, the uppermost of these reservoirs, would be delivered to Stony Creek by gravity tunnel, following the same general course as the water derived from Jarbow and Etsel-Short Reservoirs.

Klamath River Extension project would eventually include a series of four large reservoirs on Klamath River: Red Cap Creek, Happy Camp, Hamburg, and Ah Pah. Water collected in these reservoirs could be diverted through the divide to Ironside Mountain Reservoir on the Trinity River and then lifted by pumps to the proposed Helena Reservoir for diversion by a tunnel to the Sacramento River as described above for the Upper Trinity project (plate I).

Table 12. Reservoir Data, Upper Trinity and Adjacent Streams Project. 1/

Item	Reservoirs						
	Dinsmore	Ruth	Pilot Ridge	Eltapom	Ironside Mountain	Burnt Ranch	Helena
Maximum Pool:							
Elevation (MSL)	2,635	2,697	2,543	1,565	1,100	1,345	1,837
Area (acres)	3,300	2,200	3,700	5,600	1,700	3,700	16,000
Capacity (1,000 acre-feet)	465	126	480	1,000	180	600	2,831
Minimum Pool:							
Elevation (MSL)	2,522	2,600	2,345	1,355	1,000	1,300	1,657
Area (acres)	1,900	500	800	2,300	700	3,100	6,900
Capacity (1,000 acre-feet)	165	14	86	200	65	440	836
Fluctuation in pool (feet)	113	97	198	210	100	45	180
Height of dam (feet)	305	172	483	377	460	475	558
Streambed elevation (MSL)	2,340	2,535	2,070	1,200	650	880	1,285
Yield (1,000 acre-feet)	192	72	252	521	327	160	642

1/ Data supplied by Bureau of Reclamation June 1959.

Discussion, Fish and Wildlife Aspects

All of these developments would have significant and far-reaching effects upon fish and wildlife resources. Spawinng runs of salmon and steelhead trout would be seriously affected by most of the projects. Wildlife habitat in the reservoir areas would be adversely affected but would generally be benefited in the irrigation lands. The implied uses of

water for industrial development suggest that secondary problems of first importance to fish and wildlife would arise.

Under the supposition that these major projects will be constructed, detailed consideration will have to be given to alleviate their effects on fish and wildlife. English Ridge Dam on the main Eel River and Etsel-Short and Jarbow Dams on the Middle Fork Eel would block important spawning runs of salmon and steelhead trout. Branscomb Dam would block a large portion of the coho salmon runs from their spawning areas. It would inundate the most valuable coho salmon spawning area in the Eel River. All of these dams would result in significant losses of deer winter range and inundate established migration routes in this important basin. Measures to alleviate project effects on habitat need to be carefully considered to arrive at reservoir operation and features of greatest advantage to fish and wildlife.

The lower Trinity development contemplates a series of three dams in addition to the Lewiston and Trinity Dams presently under construction. This newly proposed development would inundate most of the remaining spawning areas on the Trinity. The Eltapom Dam on the South Fork Trinity River would block most of the spawning habitat in this important tributary.

Construction of all proposed dams on both the Klamath and Trinity Rivers would virtually eliminate existing spawning areas utilized by anadromous fish in this drainage should passage facilities prove infeasible. Spawning habitat improvement downstream from the proposed Klamath River dam-

sites would offer only slight compensation for loss of spawning area. The drastic losses of spawning area would necessitate hatchery propagation, use of articicial spawning channels, and intensification of use of the remaining accessible stream sections to maintain salmon and steelhead trout runs. Without due consideration for restitution, the loss of spawning area in the Klamath River drainage is expected to severely reduce the salmon and steelhead trout populations of Northwestern California.

Dams proposed for the Trinity River would result in a continuous chain of reservoirs for a large portion of the river. These reservoirs would result in inundation of important deer winter range. Winter concentrations in this area are several times greater than those of the summer. During heavy winter snows, the deer migrate down the slopes to lower elevations for winter browse. Deer migrate from the north-facing slopes toward the river and thence to the south-facing slopes. These routes would be blocked by reservoirs which would usually be held at high levels during winter migration periods. Eltapom would have similar effects upon deer habitat and migration routes in the South Fork Trinity.

Reservoirs would eliminate a moderate amount of upland-game habitat but would improve conditions for waterfowl. On newly irrigated lands, conditions would be improved for certain upland game species. Slight benefit would be expected for fur animals although some species would be more favored than others.

Construction of a storage dam near Ruth and a diversion dam at Essex has been planned by the Humboldt Bay Municipal Water District for

municipal and industrial use. The Ruth site is well above the limit of salmon and steelhead trout migration, but the water to be stored will improve stream habitat through increased flow and will provide a reservoir trout fishery. At the Essex Diversion, satisfactory facilities and flow releases would be necessary for fish passage.

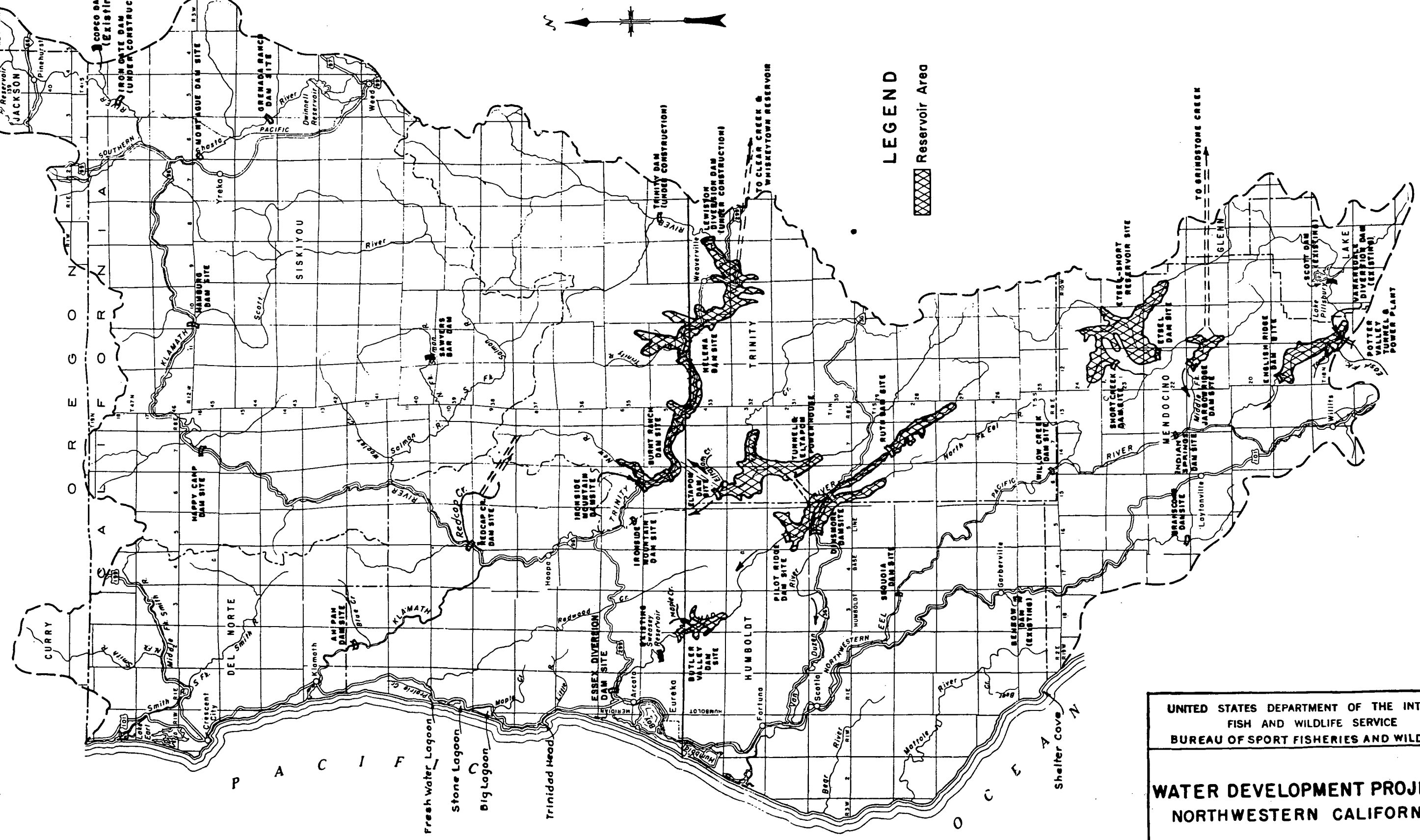
Water development plans of the Bureau of Reclamation include Pilot Ridge Dam which would provide storage for transport of water to Trinity River impoundments and the proposed Butler Valley Dam which would be developed to store water for local use. The Butler Valley Dam on the Mad River would reduce spawning habitat for anadromous fish. Spawning habitat used by many steelhead trout and coho salmon would be lost. Loss to chinook salmon would be small since few chinook salmon spawn above the damsite. Pilot Ridge Dam would not affect habitat presently used by anadromous fish.

Pilot Ridge and Butler Valley Reservoirs would inundate important deer winter range and disturb winter migration routes. Some upland-game and fur-animal habitat would be lost in the reservoir areas. Improved upland-game habitat would be created on irrigated lands and fur-animal habitat along streams below the dams would be improved. Because of their location near Humboldt Bay and river mouths, Butler Valley and Pilot Ridge Reservoirs would receive considerable usage by resident waterfowl as resting areas.

Proposals are not included in the Bureau of Reclamation's plans for transport of water from the Smith River, Redwood Creek, Mattole River, and

other smaller drainages. However, to meet local municipal and irrigation needs, plans contemplate use of water derived from wells and stream diversions. Dependent upon the extent of stream diversions, time of year, and point of diversions, these local developments would have varying adverse effects on stream and streamside habitat for both fish and wildlife.

PLATES

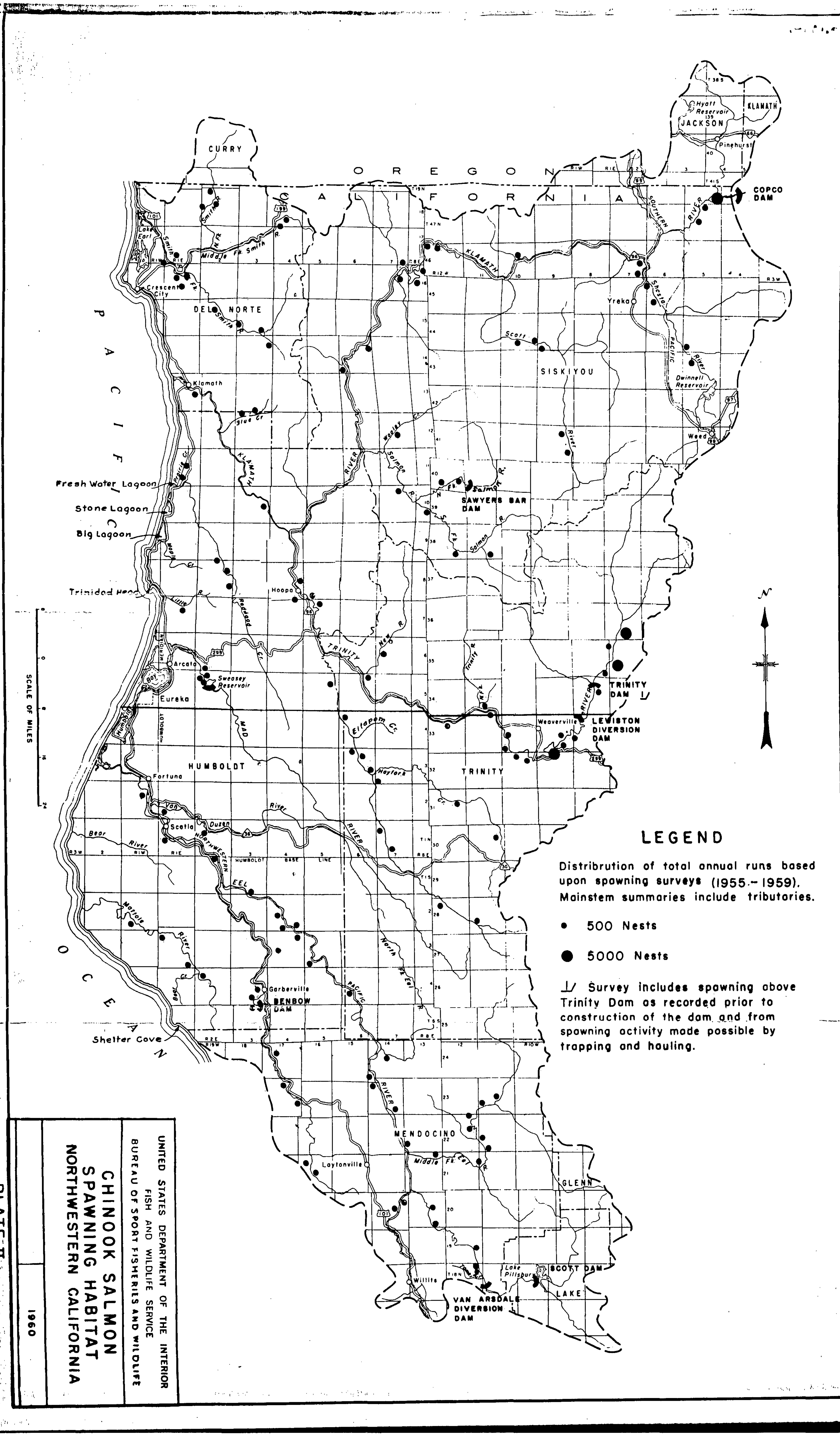


UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

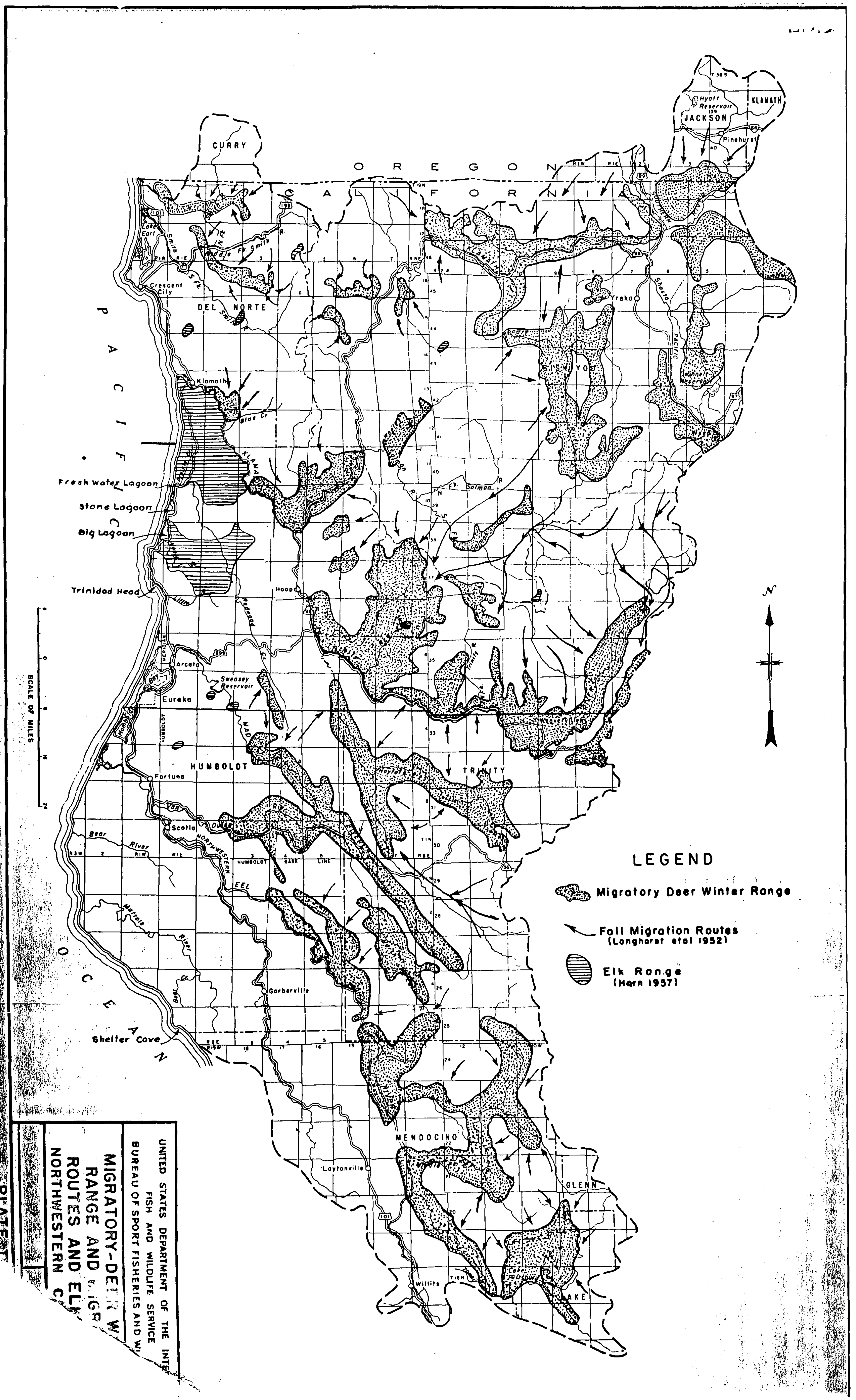
WATER DEVELOPMENT PROJECTS
NORTHWESTERN CALIFORNIA

1960

PLATE I



UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
CHINOOK SALMON
SPAWNING HABITAT
NORTHWESTERN CALIFORNIA
1960
PLATE II
LEGEND
Distribution of total annual runs based upon spawning surveys (1955.-1959). Mainstem summaries include tributaries.
500 Nests
5000 Nests
1/ Survey includes spawning above Trinity Dam as recorded prior to construction of the dam and from spawning activity made possible by trapping and hauling.
SCALE OF MILES
0
8
16
24
OREGON
CALIFORNIA
PACIFIC OCEAN
CURRY
JACKSON
KLAMATH
Hyatt Reservoir
Pinehurst
COPCO DAM
DEL NORTE
SISKIYOU
HUMBOLDT
TRINITY
MENDOCINO
GLENN
LAKE
Crescent City
Lake Earl
Klamath
Yreka
Weed
Dwinnell Reservoir
Fresh Water Lagoon
Stone Lagoon
Big Lagoon
Trinidad Head
Hoopa
Arcata
Eureka
Sweasey Reservoir
Fortuna
Scotia
Weaverville
Garberville
BENBOW DAM
Shelter Cove
Laytonville
Willits
SAWYERS BAR DAM
TRINITY DAM 1/
LEWISTON DIVERSION DAM
VAN ARSDALE DIVERSION DAM
Lake Pillsbury
SCOTT DAM
HUMBOLDT BASE LINE



UNITED STATES DEPARTMENT OF THE INTE
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND W
MIGRATORY-DE R W
RANGE AND GR
ROUTES AND EL
NORTHWESTERN C
PLATE

APPENDED MATERIAL

(Letter of Concurrence California Department of Fish and Game)

EDMUND G. BROWN
GOVERNOR

W. T. SHANNON
DIRECTOR

STATE OF CALIFORNIA
Department of Fish and Game
722 Capitol Avenue
Sacramento 14

September 19, 1960

Harry M. Goodwin, Chief
Division of Technical Services
U. S. Fish and Wildlife Service
P. O. Box 3737
Portland 8, Oregon

Dear Mr. Goodwin:

Your letter of September 12, 1960 requesting concurrence in the report entitled "A Survey of Fish and Wildlife Resources of Northwestern California" is hereby acknowledged.

We have discussed several of the more important comments regarding this report made in our earlier letter to you with River Basins personnel here in your Sacramento office.

With the exception of two minor suggestions made to them we concur in the report. May we also suggest that Plate II be retained since it provides immediate observation of the spawning areas used by chinook salmon in one easily available source. We have reviewed the plate with some care and find that it reflects counts made by this Department during the 1955-59 period.

Again we wish to express our appreciation for the opportunity to review the report.

Sincerely,

Director