

THE FISH AND FISH HABITATS OF THE
COAST REDWOOD REGION IN MENDOCINO,
HUMBOLDT, AND DEL NORTE COUNTIES IN CALIFORNIA

Final Report

by

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INTRODUCTION

As a part of a broad survey of the ecological status of redwood forest areas in north coastal California, an investigation of the fish fauna and fish habitats of the region was undertaken in the fall of 1963. This investigation consisted of field observations on current conditions, a survey of published literature, and an examination of field notes taken by the writer over a period of 15 years.

The purpose of this report partly is to identify the common fishes and to describe their distributions, general abundance and importance, and ecological status in the redwood forest region in Mendocino, Humboldt, and Del Norte Counties. It is also for the purpose of describing the general nature, extent, and condition of fish producing waters in this region.

A discussion of the main fish and stream protection problems of the present and the future is presented. Especial emphasis is given to the problem of protecting fish species peculiar to the redwood region and their habitats.

FISH HABITATS

The aquatic habitats of redwood forest areas in Mendocino, Humboldt, and Del Norte Counties include many small streams that arise in these areas and either flow directly to the ocean or into lagoons, or are tributaries of larger streams. A number of medium-sized and larger streams have their origins farther inland, but their lower reaches contribute to the aquatic habitats in the redwood region. A few small reservoirs and small lakes, coastal freshwater or brackish-water lagoons, and an

occasional pond further enrich the region's aquatic environment. Figure 1 shows the general distribution of the coast redwood (Sequoia sempervirens) and the location of the main bodies of water in the redwood region.

Most of the streams arising within stands of virgin redwood are very small, clean and cool. They are of moderate gradient and are characterized by sand and gravel bottoms and alternating pools and shallow riffles. These small streams are not usually subject to great changes in volume of flow, water temperature, or chemical quality. However, many go dry near their mouths or become intermittent in the summer. Many are so small that they remain unnamed.

There are many medium-sized and a few larger streams flowing through the redwood belt. Most of the medium-sized streams are of about the same ecological character. They have ordinary summer flows ranging from about 5 to 50 c.f.s. (and are herein defined to have annual runoffs of between about 50,000 and 1,000,000 acre-feet). Seasonal fluctuations in flow are typically large. The lower sections of some of them often go dry near their mouths in the summer, even though upstream flows may be considerable at the same time. For example, on August 11, 1951, Turwar Creek, a tributary of the lower Klamath River, was dry from its mouth to a distance of about 4 miles upstream. About 100 yards above the point where the flowing water completely disappeared beneath the gravel of the stream bed the volume of flow was around 15 c.f.s.

The medium-sized streams are of moderate gradient. For example, Prairie Creek, a tributary of lower Redwood Creek and a more or less "typical" medium-sized redwood forest stream, has an average slope of

-3 OREGON

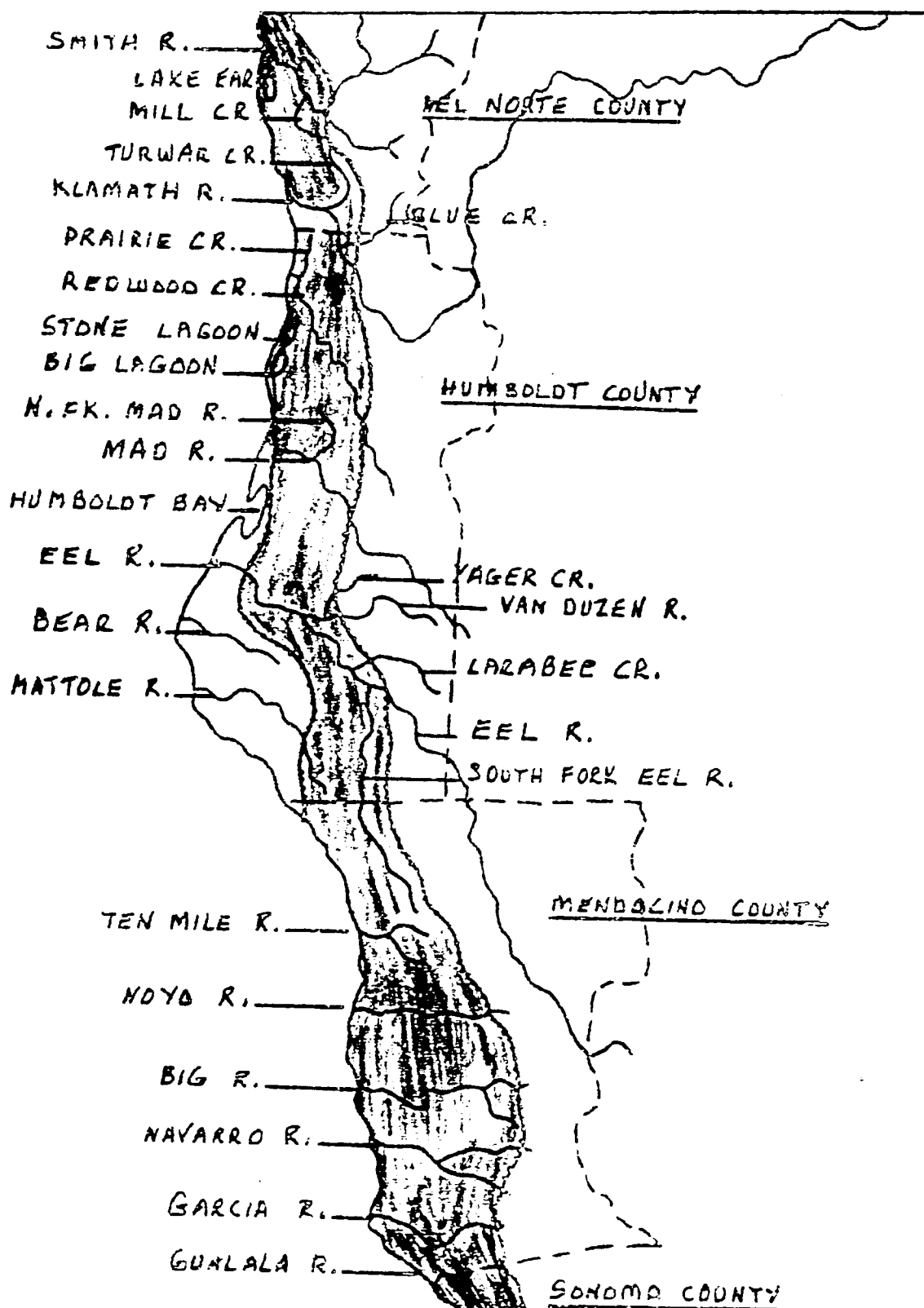


FIGURE 2. THE PRINCIPAL RIVERS OF WATER IN THE REDWOOD REGION IN DEL NORTE, HUMBOLDT, AND MENDOCINO COUNTIES. GENERAL AREAS OF REDWOOD ARE SHOWN IN RED.

about 60 feet per mile. Prairie Creek, as with most of the streams in its size-class, is characterized by long pools frequently interrupted by shallow riffles with sand, gravel, and rubble bottoms. The water is clear and fairly cool.

The larger streams (herein defined as having annual run-offs of over 1,000,000 acre-feet) in the region vary considerably in character. Mattole River and Mad River are similar in many physical and biological respects. They are streams of moderate gradient and they consist mainly of long pools and shallow riffles with sand, gravel, and rubble bottoms. As with redwood area streams in general, rooted aquatic vegetation is sparse, but bottom growths of algae often are lush in the summer. Both are subject to great fluctuation in volume of flow and they clear slowly after heavy rainstorms. Flows are greatly reduced in the summer and autumn, but the water is clear and fairly cool at these times. Smith River (shown in Figure 2) is considerably larger than these two rivers and while it also is subject to considerable fluctuations in flow, after heavy rainfall and resultant high and muddy water, it clears relatively rapidly. During periods of lower flow the water is exceptionally clear in this river. Summer time flows in Smith River are seldom less than 200 c.f.s. The (average?) suspended sediment load per unit of stream flow is lowest in Smith River and next to the highest in Mad River among the larger redwood area streams (Humboldt County Water Requirements and Water Resources, report to the Board of Supervisors, 1963).

Eel River, the second largest redwood area stream, parallels the coastline over much of its length. The south fork of the Eel is only about 8 miles from the ocean at a point about 90 miles upstream. Thus,

the lower Eel and the south fork are entirely in the redwood belt. Some of the highest stream temperatures known in the redwood region occur in the south fork. Maximum temperatures upstream near Garberville are as high as 88°F. Such temperature conditions are unsuitable for salmonids, but some survive the summer by remaining where cool water enters the river from tributaries or underground sources. Water temperatures in most headwater areas and in the lower Eel are lower and within the general range of tolerance of local salmonids.

Klamath River (shown in Figure 2) is by far the largest stream flowing across the redwood belt even though the maximum recorded instantaneous rate of flow for Eel River is larger than for the Klamath. It is distinct from other study area streams in a number of ways, both physical and biological. The heavy volume of flow in the relatively narrow channel produces a stream with few shallow riffles and few quiet pools. Many Eel River riffles for example, easily can be waded in late summer, but few if any in the lower and middle sections of the Klamath can be waded safely. The volume of flow in the Klamath during summer and early fall remains high and fairly constant compared to the other larger redwood area streams. Minimum summer flows near the mouth of the river are in the neighborhood of 5,000 c.f.s. The Klamath is the only Northcoast stream that is normally turbid (with suspended plankton organisms) during much of the summer and autumn. Unlike any other study area stream its characteristics appear to be affected very considerably by lakes and reservoirs in its headwater areas.

Even the smallest streams, with minimum flows of only a few gallons per minute (g.p.m.) to a few cubic feet per second (c.f.s.), typically

FIGURE 2. SMITH RIVER AT HIOUCHI BRIDGE (ABOVE) AND KLAMATH RIVER NEAR MOUTH (BELOW).

are important fish breeding and nursery areas. Along the coast from lower Eel River northward, streams of this class serve as breeding and nursery areas for the coast cutthroat trout (Salmo clarki clarki). Northward from Eel River such streams progressively farther inland, but still generally within the redwood belt as far north as Klamath River, are utilized for these purposes by cutthroat. In the Smith River drainage cutthroat are commonly found well inland of the redwood forest. The apparent absence of coast cutthroat from upstream areas of many streams and from streams south of Eel River possibly may be due in part to higher summer water temperatures in these areas than in downstream or more northerly areas.

Streams with minimum flows of around 5 c.f.s., or more, throughout the redwood region typically serve as breeding and rearing grounds, or as migratory routes for cutthroat trout, steelhead, rainbow trout (Salmo gairdneri gairdneri), silver salmon (Oncorhynchus kisutch), king salmon (Oncorhynchus tshawytscha), and Pacific lamprey (Entosphenus tridentatus). The lower sections of the larger streams primarily serve as upstream and downstream migration routes for migratory species. Generally, the spawning areas for these fishes are farther upstream out of the main areas of redwood, but in the case of Eel River for example, some of the principal upstream spawning grounds of king salmon are bordered by large stands of redwood.

The larger streams from Mad River north also serve as breeding and nursery areas for the migratory culechon (Thaleichthys pacificus). The American shad (Alosa sapidissima), another anadromous fish, commonly is found in Eel River and in Klamath River. Green sturgeon (Acipenser

medirostris) occasionally are seen in Eel River and are fairly common in Klamath River.

Some small streams entirely within redwood forests, and upstream sections or the tributaries of many larger streams contain resident rainbow trout (Salmo ^gairdneri). Populations of resident rainbow or cutthroat occasionally are found above impassable barriers (to upstream migration). While below the barriers they appear to be mainly of the migratory type. In 1951, above a falls on Ah Poh Creek, a tributary of the lower Klamath, the only salmonid known to be present was the cutthroat, while just below the falls in that part of the stream accessible to migratory species, rainbow were more common than cutthroat.

Both larger and many small streams contain a few additional species of strictly freshwater fishes of relatively little importance. The lower reaches of the larger streams entering the ocean are commonly visited by a number of normally marine or brackish-water fishes.

The brackish-water lagoons in the redwood area often contain a wide variety of marine and brackish-water fishes, including temporary visitors from the open sea, and upstream or downstream migrant salmon and trout originally produced in the tributaries of lagoons. Lakes, ponds and reservoirs in the redwood study area typically contain either native or introduced trout plus a few non-game fishes.

The smaller and medium-sized streams arising in redwood forest, or other streams situated largely within these forests are, of course, considerably influenced by the forests and the activities taking place in them or that have taken place in them. Larger streams, such as Klamath River, with only a small fraction of their length in areas of redwood

forests, ordinarily would be little influenced by these forests, or the activities in them. Thus, one can take the view that only those streams situated entirely or largely within redwood forests are truly a feature of these forests. Certainly any other streams ordinarily would be more greatly influenced by conditions outside redwood forests.

A large number of redwood forest streams, particularly the highly vulnerable smaller streams, have already been altered, some severely, by man's activities. Logging and road building have been the cause of most of the changes that have occurred. New damage is occurring at a high rate. In 1962 alone in redwood forest areas on the Northcoast at least 28.6 miles of stream were severely damaged by logging. An additional 9.2 miles were "less severely" damaged (see Table 1). These activities have resulted in disruption of stream banks and bottom materials, in increased siltation and turbidity, and in increased flooding, and possibly reduced summer flows in these streams. Any of these conditions can be detrimental to the well-being of populations of many valuable fishes. Logging often has produced log and debris jams that serve as barriers to migration of adult fish to the spawning grounds. Siltation often has ruined riffles as spawning grounds for salmonids (see Figure 3). Long sections of the original beds of many streams are several feet below the present "temporary" beds produced by logging and road-building debris. Such temporary beds often are composed of aggregate quite different from that found in normal beds and normally utilized by spawning salmonid fishes (see Figure 3). Sub-surface flows are common in small stream beds composed of temporary "fill" material.

There is little doubt that the temperature and flow patterns of many

TABLE 1 - STREAMS IN REDWOOD FOREST AREAS DAMAGED BY LOGGING ACTIVITIES IN 1962¹.

<u>Stream</u>	<u>County</u>	<u>Degree of damage</u>	<u>Miles damaged</u>
1. Dutch Charley Cr.	Hendocino	Severe	0.3
2. Cold Springs Cr.	Hendocino	Severe	1.7
3. New Canyon Cr.	Hendocino	Severe	0.7
4. Buckeye Cr.	Sonoma	Severe	2.0
5. Indian Cr.	Hendocino	Severe	10.0
6. N. Fork Indian Cr.	Hendocino	Severe	0.1
7. Pepperwood Cr.	Sonoma	Severe	3.5
8. Sprout Cr.	Humboldt	Severe	5.0
9. Tactah Cr.	Humboldt	Severe	5.0
10. Wheatfield Cr.	Sonoma	Severe	<u>1.0</u>
Subtotal, miles severely damaged			<u>28.6</u>
11. Mass Cr.	Hendocino	less severe	0.2
12. Redwood Cr.	Hendocino	less severe	0.5
13. Two Log Cr.	Hendocino	less severe	3.0
14. Usat Cr.	Hendocino	less severe	5.0
15. S. Fork Guadalupe R.	Sonoma	less severe	0.25
16. Hollow Tree Cr.	Hendocino	less severe	<u>0.25</u>
Subtotal, miles less severely damaged			<u>8.2</u>
Total miles of stream damaged			<u>36.8</u>

¹ Taken from Logging Damage to California Streams - 1962, Dept. of Fish and Game Inland Fisheries Admin. Report No. 63.2, 1963, by Alex Colburn and Charles Sealey.

FIGURE 3. HEAVILY SILTED SPANNING RIFFLE ON NORTH FORK OF
MAD RIVER (ABOVE) AND UNNAMED CREEK FLOW OVER
LOGGING DEBRIS AND ERODED "FILL" MATERIALS
(BELOW)

smaller streams have been considerably changed by extensive removal of redwood trees and other vegetation along these streams. Most of the changes that are apt to occur are not those that would usually favor the maintenance of healthy populations of the most desirable native fishes inhabiting these streams. Some of these changes might, however, favor the production of less valuable species.

On cursory examination, the lower sections of many streams where they flow through virgin redwood forest appear to be unaltered when observed at times of low flow, but on closer observation, particularly after rainstorms, their condition indicates upper watershed or upper stream bed disruption.

There apparently are no major stream pollution problems (other than siltation possibly) in the redwood region and none are expected to develop in the near future.

A fairly large number of small streams exist in still undisturbed stands of redwood. Some of these are in state parks where most are expected to receive a large degree of continued protection. Most of the others in redwood areas may be expected to be altered in the not to distant future by logging activities.

Table 2 lists medium-sized streams (with important watersheds that are at least partly forested by redwoods) and the condition of their watersheds with respect to the general extent the timber has been logged. Only very few such streams have watersheds with important stands redwood that are still in largely a virgin condition. A large stand of virgin redwood remains on the watershed of Mill Creek, a tributary of Smith River; most of the south fork section has been logged. Turwar Creek, a

TABLE 2 - MEDIUM-SIZED STREAMS IN THE REDWOOD REGION WHOSE WATERSHEDS CONTAIN STANDS OF REDWOOD, AND THE GENERAL DEGREE OF ALTERATION OF THEIR WATERSHEDS BY LOGGING.

<u>Stream</u>	<u>Tributary to</u>	<u>Proportion of watershed covered with redwood</u>	<u>Condition of timber stands</u>
Mill Creek	Smith River	large	considerably cut-over
Wilson Creek	Ocean	large	largely cut-over
Hunter Creek	Klamath River	large	largely cut-over
McGarvey Cr.	Klamath River	large	partly cut-over
Turner Cr.	Klamath River	large	largely virgin
Blue Creek	Klamath River	moderate	partly cut-over
Ah Poh Cr.	Klamath River	large	largely cut-over
Tectah Cr.	Klamath River	large	considerably cut-over
Prairie Cr.	Redwood Creek	large	considerably cut-over
Redwood Cr.	Ocean	large	considerably cut-over
Maple Cr.	Big Lagoon	large	largely cut-over
Little R.	Ocean	large	largely cut-over
H. Fk. Mad R.	Mad River	small	largely cut-over
Freshwater Cr.	Humboldt Bay	large	largely cut-over
Elk R.	Humboldt Bay	large	largely cut-over
Salmon Cr.	Humboldt Bay	large	largely cut-over
Van Duzen R.	Eel River	moderate	largely cut-over
Yager Cr.	Van Duzen River	large	partly cut-over
Lorabee Cr.	Eel River	small	partly cut-over
Gull Cr.	S. Fk. Eel River	large	partly cut-over
Ten Mile R.	Ocean	large	largely cut-over
Moyo R.	Ocean	large	largely cut-over
Big R.	Ocean	large	largely cut-over
Navarro R.	Ocean	large	largely cut-over
Garcia R.	Ocean	large	largely cut-over
Gualala R.	Ocean	large	largely cut-over

tributary of the lower Klamath, is one of the largest streams in the redwood region whose watershed contains important stands of redwood and other timber in a relatively undisturbed condition. Blue Creek, another and larger tributary of Klamath River, drains a large watershed in which logging has just recently begun. However, much of the upper watershed is very rugged and does not support redwood. The lower Redwood Creek watershed (shown in Figure 4) has large stands of redwood and a number of small tributaries in good condition, but the upper watershed has been extensively cut-over and the conditions in the main stem of the creek give indication of this. Yager Creek, a tributary of the lower Van Duzen River, has large stands of virgin redwood, but the stream itself shows the effects of the considerable amount of logging that has occurred.

THE FISHES

The freshwater and anadromous fish fauna of streams of the redwood forest region is poor in variety. Only 14 species occur commonly; at least another 19 are of restricted occurrence (see Appendix A and B). The most characteristic fishes are salmon and trout (see Figure 5).

Only one of the common species, the Humboldt sucker (Catostomus humboldtianus) may be considered peculiar to the redwood region. All other common species have a wider distribution. However, in California, the coast cutthroat and the eulachon also are found only in the redwood region.¹ Figure 6 shows the known general distribution of the latter three species in this region.

¹Except for some cutthroat known from upper Elliott Creek (Siskiyou County, California) which is a tributary to the Applegate River in Oregon.

FIGURE 4. LOWER REDWOOD CREEK LOOKING NORTHERLY

Figure 5. SOME CHARACTERISTIC SALMONIDS OF THE REDWOOD REGION. FROM TOP TO BOTTOM: SILVER SALMON, KING SALMON, STEELHEAD, RAINBOW TROUT, CUTTHROAT TROUT.

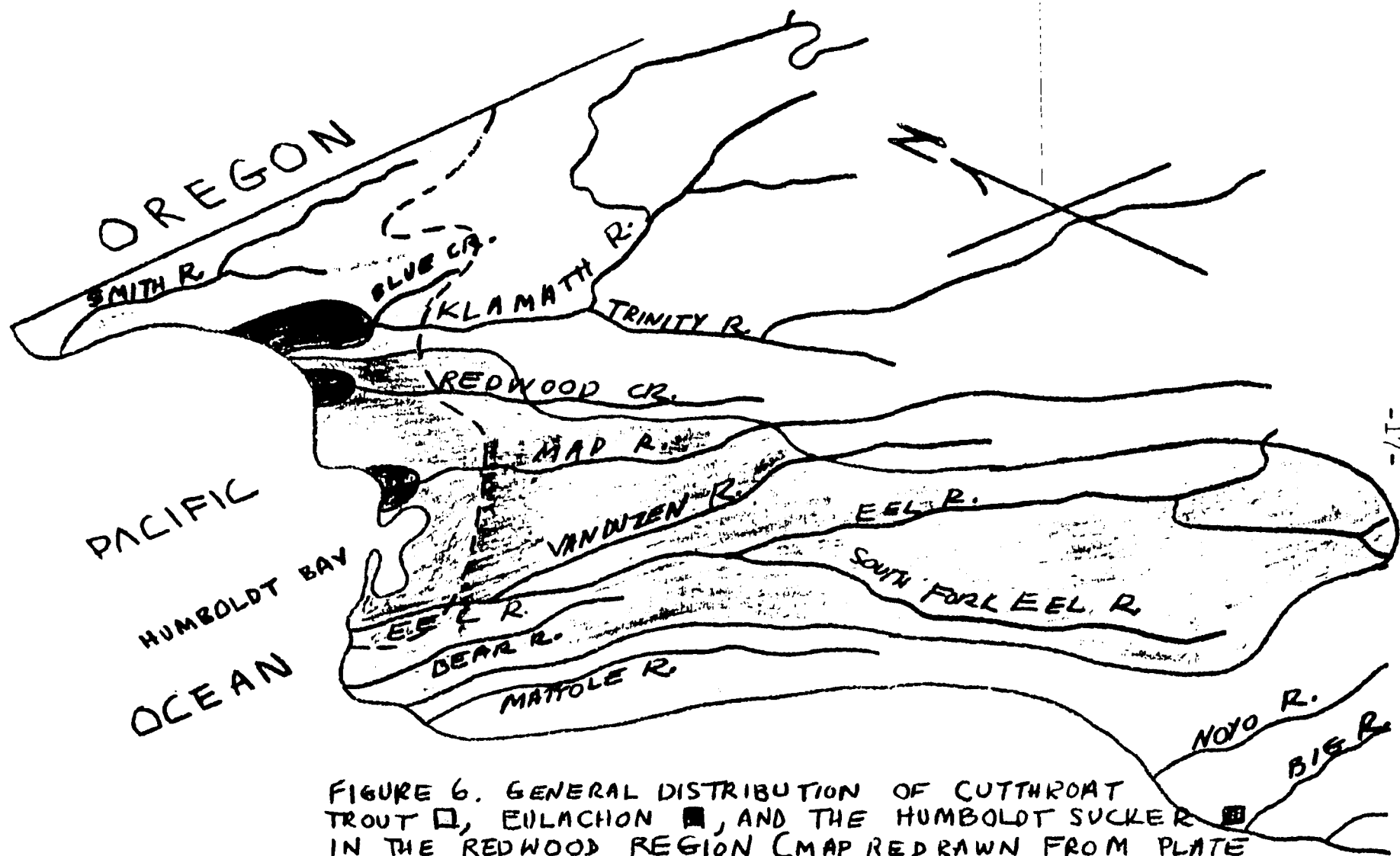


FIGURE 6. GENERAL DISTRIBUTION OF CUTTHROAT TROUT □, EULACHON ■, AND THE HUMBOLDT SUCKER ■ IN THE REDWOOD REGION (MAP REDRAWN FROM PLATE II, PREVIEW OF BULLETIN NO. 136, DEPT. WATER RESOURCES, STATE OF CALIFORNIA, 1963)

The Humboldt sucker is common in at least Bear River, Eel River (and tributaries such as the Van Duzen River), Mad River, and Redwood Creek.¹ It attains a maximum length of around 18 inches and is occasionally taken on hook and line, but is not considered a sport fish. Little is known about its life history and ecology.

In California the coast cutthroat, a popular game fish, is found in most streams and lagoons along the coast from the Oregon boarder to as far south as Eel River (DeVitt, 1954). A number of small streams and the upper sections of some larger streams contain only the resident form of the cutthroat. This form usually does not attain a length much greater than 8 or 10 inches in the smaller streams. The sea-run form is fairly abundant in lower Klamath River and in Smith River and it is known from the lower sections of many other streams. Sea-run fish enter the streams mainly in the fall and winter. Spawning of both forms occurs in the winter or spring, often in the very smallest tributaries. Most juvenile "sea-run" individuals spend 1 to 4 years in freshwater before migrating to salt water. Since they remain in salt water only a few months as a rule, they are not large when they return to the rivers for spawning. Sea-run fish are usually about 11 to 15 inches in length.

The cutachon, also known as the candlefish, is a popular food-fish of the smelt family, Osmeridae. It is known from lower sections of Mad River², Redwood Creek², and Klamath River. In California, only the

¹This fish apparently has not been previously reported from this stream.

²This fish apparently has not been previously reported from these streams.

Klamath has regular runs of substantial numbers of these small fish. It is possible that the eulachon that have been seen only occasionally (but sometimes in considerable numbers) in Mad River and Redwood Creek primarily are strays from Klamath River. The spawning runs, which extend not more than a few miles upstream, occur in late winter and early spring. The young fish apparently go to sea shortly after hatching.

Two other species of fish are found only in the redwood region, but their distribution apparently is very restricted (Snyder, 1908). They are the Navarro roach (Hesperoleucis navarroensis) and the Gualala roach (Hesperoleucis parvignis) from the Navarro River and the Gualala River, respectively.

The most important fishes of the redwood region are the steelhead rainbow, the silver salmon, and the king salmon. These fishes occur in fairly large numbers in most of the larger streams. Table 3 shows the estimated sizes of runs of steelhead and salmon in the major streams from Mattole River northward. One form of the rainbow trout, the so-called "half-pounder", which may be considered a small sexually immature steelhead, is more or less peculiar to redwood areas of the north coast of California. Only in Klamath River, among all West Coast streams, do they regularly occur in large numbers. Eel River and Mad River have regular, but relatively minor runs of these fish.

Half-pounders have the general appearance of large steelhead fresh from the sea. No thorough study has been made of their life history, but an analysis of scale patterns indicates that they enter the sea after about two seasons in the river as do many large steelhead. On their return to the stream they range from about 10 to 15 inches, although a few

TABLE 3 - THE MAJOR STEELHEAD AND SALMON PRODUCING STREAMS IN THE REDWOOD REGION FROM MATTOLE RIVER NORTH AND THE ESTIMATED SIZES OF THE ANNUAL RUNS OF THESE FISHES INTO THESE STREAMS.¹

<u>Stream</u>	<u>King salmon</u>	<u>Silver salmon</u>	<u>Steelhead²</u>
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
Others ³	4,000	10,000	25,000
<u>Totals</u>	<u>159,000</u>	<u>56,000</u>	<u>583,000</u>

¹ Data from U. S. Department of Interior, 1960 (see list of references).

² Includes "half-pounders".

³ The other (smaller) streams north of Mattole River, collectively.

"large half-pounders" attain a length of about 18 inches. Judging from their size as well as the growth patterns on their scales, the 10 to 17-inch fish spend only a few months in the sea. Half-pounders in this size-group are sexually immature and there is no reason to believe that the runs in general are spawning migrations (Murphy and DeWitt, 1951).

In the Klamath, half-pounders begin appearing in substantial numbers in August. The main runs pass through the lower part of the river in September and October. Some fish migrate far upstream in the Klamath. Few fish are caught or seen by late winter, but it is not known whether this is because they have returned to the sea or have distributed themselves widely over the drainages.

Before their migration to the sea, young steelhead are considered trout by anglers, and many of them are caught in large and small streams throughout the redwood region during summer and fall months. The catch mainly is of fish in their second year of life when most are 5 to 6 inches in length. In the summer of 1951 fishermen caught about 11,000 such fish in that short section of Eel River from its mouth to the confluence of the Van Duzen River (Murphy and DeWitt, 1951).

There are at least two distinct races of steelhead that enter North-coast streams for the purpose of spawning. Small numbers of "summer" steelhead move into Eel River, Mad River, and Klamath River in the spring and remain there over the summer in deep holes until spawning time in the fall or winter. "Winter" steelhead run in nearly all streams, large to small along the entire Northcoast. The average weight of these fish is about 8 pounds. Upstream migration may begin as early as September and continue through March or later. These fish spawn mainly

in early spring, often in small tributaries. A significant number of "spawned-out" fish survive to return to the sea for additional growth and for subsequent spawnings in one or more later seasons.

King salmon occur only in the larger streams and in a few medium-sized streams. Prairie Creek is one of the smallest streams in the redwood area that has regular runs of small numbers of these fish. A few "spring" salmon enter Smith River and Klamath River in the spring, remain all summer in the stream, and spawn in the autumn or fall. Klamath River is unique among redwood area streams in that it has a large run of king salmon that enters the river beginning in July and extending through September (Snyder, 1931). Spawning occurs well upstream for the most part, in October and November.

The main runs of king salmon in the other streams are not well underway until October or later and they may continue through January. For example, toward the end of January, 1964, considerable numbers of large king salmon apparently fresh from the sea were observed not far above the mouth of Smith River. Spawning occurs in the main stems or the larger tributaries, mainly in November and December. Most mature adult king salmon weigh between 10 and 30 pounds.

Juvenile king salmon migrate to the ocean mainly during the first summer, fall, or early winter in Northcoast streams. At this time they are from about 3 to 5 inches in length and small numbers are caught as "trout" by anglers.

Silver salmon, like steelhead, enter most redwood area streams, large and small. The main runs occur from November through January. Spawning often occurs in very small tributaries throughout the length of

many larger streams. The young migrate to the sea for the most part in the spring a full year after hatching. On the downstream migration they are large enough to be caught by anglers, but late fishing season opening dates prevent all but a minor catch of these fish. Usually after 1 or 2 seasons in the ocean they return for a single spawning then die as do all Pacific salmon. The average adult weights around 9 pounds.

Steelhead and salmon populations on the Northcoast have been on the decline for some time as evidenced by the annual counts of such fish running to the counting racks on Klamath River and over dams on Mad River and on the South Fork of Eel River (Table 4).

Resident fishes are, of course, present in redwood region waters at all times of the year in one life stage or the other. Short upstream or downstream movements, perhaps in response to changes in water temperature, food supplies, or sexual maturity may be made by some species such as the sculpins and stickleback (Shapovalov and Taft, 1954).

The September (1951) population of resident and anadromous fishes collected by poisoning and seining from a 779-foot section of lower Prairie Creek was as follows: sculpins (Cottus sp.), 699 fish; silver salmon (Juveniles), 144 fish; rainbow trout or steelhead (Juveniles), 83 fish; stickleback, 21 fish; cutthroat trout, 9 fish; king salmon (Juveniles), 3 fish; plus an unrecorded number of larval lampreys seen in the section. The total number of fish collected was 959, or about 6500 fish (excluding lampreys) per mile of stream.

DISCUSSION

The north coastal California redwood forest region is well-endowed with large and small streams. The streams that are "truly" characteristic

TABLE 4 - RUNS OF STEELHEAD AND SALMON AT COUNTING STATIONS IN
NORTHERN CALIFORNIA¹

Year	S. Fr. Est R. (Benbow Dam)			Mad River (Greasy Dam)			Klamath R. (Klamathon racks)	Total
	King salmon	Silver salmon	Steel- head	King salmon	Silver salmon	Steel- head	King Salmon	
1943 ²	7,264	13,030	23,445	1,236	259	4,921	-	-
1944	13,966	14,309	20,172	-	-	-	-	-
1945	12,488	16,731	13,626	-	-	-	-	-
1946	16,024	14,109	19,005	1,181	415	5,106	-	-
1947	13,160	25,289	18,225	717	510	3,582	-	-
1948	16,312	12,872	13,963	672	515	3,139	5,821	53,294
1949	3,803	7,495	13,715	484	512	4,074	11,504	41,587
1950	14,357	12,050	15,138	1,505	149	4,539	21,564	69,322
1951	12,476	11,441	13,774	1,519	414	5,608	17,857	63,089
1952	7,256	3,711	19,448	401	72	5,568	6,591	43,047
1953	7,948	3,052	15,425	853	92	3,959	6,267	37,596
1954	5,406	6,016	14,000	403	59	2,372	2,042	30,296
1955	3,974	6,054	11,443	390	2	148	14,946	36,957
1956	1,530	5,717	12,333	129	21	2,717	6,770	29,217
1957	3,050	5,432	7,910	495	11	1,957	2,436	21,291
1958	1,472	3,344	11,984	478	3	1,780	1,950	21,011

¹Data from California Department of Fish and Game.

²Refers to counting year 1943-44, etc.

of redwood forests are for the most part small or medium-sized streams arising entirely or largely within these forests. Other streams flow through the redwood belt, but their characteristics may be expected to reflect conditions outside redwood forests more than in these forests.

No large stream, except perhaps Smith River, remains largely undisturbed by the activities of man. A few medium-sized streams are still in about their original condition; their watersheds have not yet been extensively logged or otherwise disturbed. Only some of the smaller streams, a number of which are located entirely within stands of virgin redwood, have completely escaped disturbance.

A gradual reduction can be expected in the number of streams remaining in their original condition as new areas are logged and as other watershed activities expand. In a matter of a few years there may be no streams, except some very small ones situated entirely within state parks, left unchanged in the entire redwood region.

Aside from being eliminated as ecologically "virgin" streams, the streams in redwood region watersheds extensively logged often become less suitable for the most valuable fishes and for some recreational uses such as angling. Insofar as fish are concerned some of the main adverse effects on streams of logging have been increased turbidity, siltation, flooding, and creation of barriers to migration.

If the problem is the perpetuation of representative redwood area ecological units, including streams in their essentially original ecological condition, perhaps only Turner Creek and Blue Creek watersheds, and few smaller watersheds such as that of Prairie Creek, can provide bases for a solution.

Some larger watersheds such as Redwood Creek and Yager Creek have some of the most extensive remaining stands of virgin redwood, but considerable logging has taken place in them and this is reflected in stream conditions.

Stands of virgin redwood in the lower sections of some watersheds have streams flowing through them whose characteristics have been considerably affected by logging activities upstream. An outstanding example of this condition is in the Bull Creek (tributary of the South Fork of Eel River) watershed. Obviously, as evidenced by Bull Creek, the protection of downstream areas of virgin timber will not assure protection of any stream in these areas from the effects of upstream activities, past, present, or future.

The fish fauna of the north coastal redwood region is relatively poor in numbers of species. One common species, the Humboldt sucker, and two uncommon species, the Navarro roach and the Gualala roach, are peculiar to the region. In California, the coast cutthroat trout and the eulachon are found only in this region. On the West Coast, a type of small steelhead, the "half-pounder", occurs in large numbers only in this region. All other listed species occur outside, either in California or elsewhere, as well as within the redwood region.

The protection of redwood forests would probably do more to protect the cutthroat trout than any other species of fish in the redwood region since it spawns in the smallest streams. Small streams are apt to be among the first to be disturbed, and usually are disturbed to the greatest degree by the activities of man.

The protection of the cutthroat trout could be extended to prevent the stocking or penetration of rainbow trout, steelhead, or salmon into stream sections containing only or largely cutthroat. It is believed that the introduction of rainbows into cutthroat waters often has been to the detriment of cutthroats (see for example, Madsen, 1936).

Apparently rainbows generally are better competitors. Some of the "purest" populations of cutthroat in California are resident in redwood forest area waters that may not receive the protection from competition that may be needed for their continued existence if these waters are opened to steelhead or salmon by removal of stream barriers to the upstream migration of these fishes.

There is not much reason to believe that the other five fishes (in California restricted to the redwood area) would suffer much from additional redwood logging activities. The eulachon is important only in the lower Klamath where logging activities in redwood areas probably would have relatively little influence on conditions the eulachon is exposed to. The Humboldt sucker might not be harmed by many of the stream conditions produced by logging roadbuilding. Many of these conditions probably would not be harmless to the production of "half-pounders", but as the principal half-pounder stream is the Klamath and as conditions in redwood forests would be expected to have relatively little effect on the main half-pounder habitat in the Klamath, continued logging of redwood would probably not have great influence on the main population of half-pounders.

As resident rainbow trout, steelhead, and salmon use nearly all redwood area streams as spawning and nursery areas, additional redwood

area logging activities in general may be expected to contribute to further declines in the numbers of these fishes in the redwood region.

With one notable exception, there apparently is little need for great concern about the possible effects of planned and proposed major water development projects (as described in Preview of Bulletin No. 136, Department of Water Resources, State of California, 1963) on redwood area fish and fish habitats. Almost all of these projects are proposed to be located well upstream of the redwood forest zone. The only exceptions are the Branscomb (South Fork of Eel River) project and the Humboldt Dam and Reservoir project (on Klamath River).

The Branscomb project as presently proposed is small and was designed partly to enhance fishery resources. The Humboldt Dam is proposed to be located on the lower Klamath River a few miles from its mouth near Ah Poh Creek. A high dam at this site would completely block all upstream migration of fish and thus nearly completely eliminate the very large and valuable runs of steelhead and salmon in the Klamath. The overall effect of the dam on the populations of the other anadromous fishes cannot be accurately predicted. The reservoir formed by Humboldt Dam would inundate important stands of redwood and many miles of the main stem of the Klamath and its tributaries. It is difficult to imagine any single water development project that could have a more drastic effect on the anadromous fisheries resources of the Northcoast.

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APPENDIX A

LIST OF THE COMMON FRESHWATER OR ANADROMOUS FISHES OF
THE COAST REDWOOD REGION
IN KENDOCINO, HUMBOLDT, AND DEL NORTE COUNTIES
OF CALIFORNIA¹

PETROMYZONTIDAE-lamprey family

1. Entosphenus tridentatus (Richardson)-Pacific lamprey

ACIPENSERIDAE-sturgeon family

2. Acipenser medirostris Ayres-green sturgeon

CLUPEIDAE-herring family

3. Alosa sapidissima (Wilson)-American Shad.²

OSMERIDAE-smelt family

4. Thaleichthys pacificus (Richardson)-eulachon

SALMONIDAE-salmon and trout family

5. Oncorhynchus kisutch (Walbaum)-silver salmon
6. Oncorhynchus tshawytscha (Walbaum)-king salmon
7. Salmo clarki clarki Richardson-coast cutthroat trout
8. Salmo gairdneri Richardson-rainbow trout
9. Salmo gairdneri gairdneri Richardson-steelhead rainbow trout

CATOSTOMIDAE-sucker family

10. Catostomus humboldtianus Snyder-Humboldt sucker

COTTIDAE-sculpin family

11. Cottus gulosus (Girard)-rifle sculpin
12. Cottus asper Richardson-prickly sculpin
13. Cottus aleuticus Gilbert-Aleutian sculpin

GASTEROSTEIDAE-stickleback family

14. Gasterosteus aculeatus Linnaeus-threespine stickleback

¹The common and scientific names used are in general agreement with those listed in Shapovalov, Dill, and Cordone, 1959.

²Introduced into California.

APPENDIX B

LIST OF THE FRESHWATER OR ANADROMOUS
FISHES OF RESTRICTED OCCURRENCE IN THE REDWOOD REGION^{1,2}

ACIPENSERIDAE-sturgeon family

1. Acipenser transmontanus Richardson-white sturgeon

OSMERIDAE-smelt family

2. Spirinchus dilatus Schultz and Chapman-longfin smelt
3. Hypomesus olidus (Pallas)-pond smelt³

SALMONIDAE-salmon and trout family

4. Oncorhynchus gorbuscha (Walbaum)-pink salmon
5. Oncorhynchus keta (Walbaum)-chum salmon
6. Oncorhynchus nerka kennerlyi (Suckley)-kokanee salmon³

CATOSTOMIDAE-sucker family

7. Catostomus rimiculus Gilbert and Snyder-Klamath smallscale sucker
8. Catostomus snyderi Gilbert-Klamath largescale sucker

CYPRINIDAE-minnow family

9. Cyprinus carpio Linnaeus-carp³
10. Gila bicolor (Girard)-Klamath chub
11. Siphateles bicolor (Girard)-tui chub
12. Hesperoleucis navarroensis Snyder-Navarro roach
13. Hesperoleucis parvipinnis Snyder-Gualala roach
14. Rhinichthys osculus klamathensis (Evermann and Meek)-Klamath speckled dace

Ictaluridae-catfish family

15. Ictalurus catus (Linnaeus)-white catfish³
16. Ictalurus nebulosus (LeSeur)-brown bullhead³

POECILIIDAE-topminnow family

17. Gambusia affinis affinis (Baird and Girard)-western mosquitofish³

PERCIDAE-perch family

18. Perca flavescens (Mitchill)-yellow perch³

CENTRARCHIDAE-sunfish family

19. Lepomis cyanellus Rafinesque-green sunfish³

¹Excluding a few euryhaline species occasionally found in freshwater.

²The common and scientific names used are in general agreement with those listed in Shapovalov, Dill, and Cordone, 1958.

³Introduced.