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STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF FISH AND GAME

AN EVALUATION OF THE FISH AND WILDLIFE RESOURCES OF THE MAD RIVER AS EFFECTED BY THE U. S. CORPS OF ENGINEERS MAD RIVER PROJECT WITH SPECIAL REFERENCE TO THE PROPOSED BUTLER VALLEY RESERVOIR

JANUARY, 1968

California Department of Fish and Game report prepared under the provisions of the U. S. Fish and Wildlife Coordination Act (48 Stat. 401, as amended, 16 U.S.C. 661 et seq.)

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INTRODUCTION

Industrial growth of the Humboldt Bay area depends largely upon the development of an adequate supply of water. The Mad River presently provides about 75 million gallons of water a day for municipal and industrial purposes through the operation of the Ruth Dam project, constructed by the Humboldt Bay Municipal Water District in 1961. By 1970 this supply will be insufficient to meet the expected requirements of the area. Since only 25 percent of the runoff of the drainage basin is controlled by the existing Ruth project, there remains a potential for additional water development within the Mad River basin.

The U. S. Corps of Army Engineers is presently investigating the potential for further multi-purpose development of the Mad River Basin for flood control, water supply, and recreation. Included as a part of the study is a large reservoir at the Butler Valley site, 28 miles upstream from the ocean and a municipal and industrial diversion downstream on the Mad River near Essex. The Butler Valley development would be designed to control runoff from about 71 percent of the Mad River drainage basin. The project would have a significant effect upon fish and wildlife resources.

This report presents an evaluation of the effects of the proposed Butler Valley Project upon fish and wildlife resources of the Mad River drainage basin. The recommendations contained herein for the protection of fish and wildlife values are based largely upon knowledge that has been accumulated through the management activities of the Department of Fish and Game.

CONCLUSIONS

We conclude that average annual spawning escapements of 4,500 steelhead, 1,500 king salmon, and 500 silver salmon would be affected by the loss of spawning and rearing habitat upstream from the proposed Butler Valley Dam. In order to compensate for this loss, fish hatchery facilities should be provided to incubate 13,500,000 eggs and rear 450,000 steelhead (8 per pound) 25,000 silver salmon to yearling size, and 2,000,000 king salmon fingerlings.

A portion of the blocked steelhead population are summer run fish which migrate upstream in the late spring or early summer and spend the summer in the deep pools. These fish do not survive well in hatchery holding facilities. To hold these fish in the river a deep pool will have to be provided below the Butler Valley Dam outlet.

A fish barrier dam with trapping and loading facilities would be required to handle the spawning escapements of anadromous fish affected by the dam. These facilities should be located immediately below the Butler Valley Dam outlet. Successful operation of the fish trap will depend upon the quality of water used for attraction of fish to the trapping facility. Estimated construction and operating costs of all fish trapping and propagation facilities are presented in the report.

The preservation of fish life in the Mad River will require that minimum flows be provided in accordance with the schedule contained in the recommendations.

If the diversion of water near Essex requires construction of a dam, there will be interference with anadromous fish movement in the lower river and adequate fish passage and screening facilities would be needed. If a surface diversion without a dam is used, only screening facilities would be needed. Cost estimates of these facilities cannot be determined at this time.

Degradation of water quality or adverse changes in the present flow pattern of the Mad River could have a profound effect upon the fishery resources below Butler Valley Dam. Minimum flow provisions for fishery maintenance below the dam and multiple level outlets for controlling water quality will be needed.

Butler Valley Reservoir is expected to provide a poor environment for trout or warm water game fish due to temperature problems, turbidity, and severe annual and seasonal fluctuations in water surface level. Consequently, angler use is expected to be low. A reservoir fishery management program cannot be formulated at this time due to the lack of precise engineering and operational data.

Butler Valley Dam would reduce downstream transport and replacement of sand and gravel in the Mad River which is presently being exploited by large commercial operations. Construction of the dam could force these operations to move to other areas in the river as supplies of aggregate became depleted. Further destruction of salmon spawning areas in the river could result.

Wildlife, dependent upon habitat destroyed by the project, will be displaced when the reservoir fills. Resident terrestrial species will be displaced to adjacent lands which are already supporting maximum populations. Here they may perish by a spectacular die-off, or as most often the case by a longer more subtle process involving reduced reproduction brought about by stress and malnutrition. Unless alternative carrying capacity equal to that destroyed is created and maintained, the displaced animals will be lost.

To preserve the stream spawning areas from exploitation by gravel extractors and to mitigate for the loss of wildlife habitat destroyed by the Butler Valley Project it will be necessary to acquire and develop the channel of the Mad River and certain adjacent land extending from the dam site downstream to the Mad River Fish Hatchery.

About 1,800 acres of land, exclusive of river channel, will be needed. The area is shown on the appended map. These lands should be acquired in fee title or leased for the life of the project. Wildlife habitat improvement to accommodate the displaced animals will require development of two major types: (1)development of riparian habitat within the river channel, and (2)development of the upland area. Maintenance of these habitats will be required during the life of the project.

RECOMMENDATIONS

We recommend that:

1. Full mitigation of fish and wildlife losses resulting from the construction of the Butler Valley Project be the responsibility of the U. S. Army Corps of Engineers. The extent to which these obligations are passed on or assigned to local agencies should be the subject of agreement between the Corps of Engineers, the Department of Fish and Game, the Bureau of Sport Fisheries and Wildlife and the local agency.

2. To preserve the spawning gravels and mitigate wildlife habitat loss, the Mad River channel with a 100-foot strip of land above the high water mark on each side of the river and 1,800 acres of adjacent land be acquired in fee title or leased for the life of the project by the U. S. Army Corps of Engineers. The area would extend from the Butler Valley Reservoir downstream to the Mad River Fish Hatchery, a distance of about 12 miles. (See appended map.) It is further recommended that sufficient funds be provided as project costs for the administration, development, operation and maintenance of these lands, and that money specified for development be provided from project construction funds so that development can proceed concurrently with project construction. It is estimated that fee title acquisition and development costs would be approximately $370,000, exclusive of timber costs. The annual operation and maintenance costs are estimated to be $15,000.

3. A detailed fish and wildlife management plan be developed and implemented by the Corps of Engineers in cooperation and consultation with the California Department of Fish and Game and the Bureau of Sport Fisheries and Wildlife.for all lands acquired for mitigation of fish and wildlife habitat losses related to the Butler Valley Project. This plan should be completed and agreed upon prior to initiation of construction. Actual management of the fish and wildlife resources will be carried out by the California Department of Fish and Game.

4. Federal project lands and waters, leased or acquired in fee title, be open to public use for fishing, hunting, and related uses except for sections reserved for safety, efficient operation, or protection of public property and except for certain areas or periods where restrictions may be found necessary by the Corps of Engineers, Bureau of Sport Fisheries and Wildlife, and California Department of Fish and Game to protect the fish and wildlife resources.

5. Control programs employing chemicals on project lands or waters be developed in cooperation with the Public Health Service, Federal Water Pollution Control Administration, Bureau of Sport Fisheries and Wildlife, and the California Department of Fish and Game.

6. A fish barrier dam, and fish trapping and loading facilities be constructed below the Butler Valley Dam outlet works for handling runs of adult fish that would be blocked by the dam. The adult fish would be hauled to the State's proposed Mad River Hatchery and held until spawned. Adequate fish propagation facilities be constructed at the Mad River Hatchery to produce 450,000 yearling and/or 2 year old steelhead, averaging 8 per pound, 25,000 yearling silver salmon, and 2,000,000 fingerling king salmon in addition to the present planned capacity of the hatching of 13,500,000 salmon and steelhead eggs would be required.

The construction, operation, maintenance, and replacement costs of these facilities should be project costs. These facilities will need to be in operation by the time dam construction activities block the upstream migration of fish.

It is estimated that the initial capital costs of the fish mitigation facilities would be about $2.5 million. The annual operation, maintenance and replacement costs would be about $84,000.

7. Minimum flows in the Mad River be provided for fishery preservation in accordance with the following provisional schedules:

Releases from Butler Valley Dam

Period	Flow
October 16 - April 30	300 cfs. (116,900 AF)
May 1 - June 30	200 cfs. (24,200 AF)
July 1 - October 15	100 cfs. (21,400 AF)

Flows to Pacific Ocean Downstream from Diversion Near Essex

Period	Flow
October 16 - April 30	300 cfs. (116,900 AF)
May 1 - June 30	150 cfs. (18,100 AF)
July 1 - October 15	45 cfs. (9,700 AF)

These flows are subject to revision upon completion of current studies by the U. S. Fish and Wildlife Service and the California Department of Fish and Game. These flows are over and above existing downstream water rights.

8. If a diversion dam near Essex is constructed, adequate fish passage and screening facilities be provided. If the water is diverted without a dam, only screening facilities would be required. These facilities should be constructed, maintained and operated at project cost for protection of anadromous fish.

9. Multiple level outlets be included in Butler Valley Dam to control water quality and temperature in the Mad River for fishery preservation purposes.

10. A large, deep pool be excavated and maintained below Butler Valley Dam Outlet to provide a holding area of cool water for summer steelhead. This pool should be about 375 feet long, 120 feet wide, and 30 feet deep.

11. The Department of Fish and Game be advised of any changes in engineering plans so that a new or supplemental report can be prepared if necessary.

PROJECT DESCRIPTION

The proposed Butler Valley Dam would be designed and operated to provide flood control, recreation, and water for municipal and industrial purposes.

According to the Corps of Engineers' preliminary draft of the feasibility report, Butler Valley Dam would be rock and earth fill structure about 350 feet high. The reservoir would have a gross storage capacity of about 460,000 acre-feet and a surface area of about 3,300 acres at maximum flood pool elevation at 633 feet above sea level. The reservoir would provide storage for a minimum pool of 20,000 acre-feet for recreation and reservoir fishery; 80,000 acre-feet for sediment deposits; 225,000 acre-feet for flood control; and up to 10,000 acre-feet for water conservation for municipal and industrial uses and 50,000 acre-feet for fish mitigation releases. A maximum of 25,000 acre-feet of storage has been designated as dual use for flood control and water conservation. Normal fluctuation of the reservoir's surface elevation during the recreation season would be about 35 feet below the normal water conservation pool. At other times the drawdown could be up to 100 feet. The outlet works would consist of a tunnel through the right abutment of the dam from which controlled releases would be made to satisfy the various downstream purposes.

It may be necessary for the project to have some type of diversion structure downstream near Essex to recover municipal and industrial releases. The Corps of Engineers feasibility report does not include this structure in the project.

EXISTING PROJECTS

The first significant water development project on the Mad River was Sweasey Dam, constructed in 1938 by the City of Eureka, to supply up to 7.74 cfs of water, by continuous diversion, for municipal use. The 45-foot high concrete dam, located 18 miles from the mouth of the Mad River, is still in place, but no longer active, since the City now purchases water from the Humboldt Bay Municipal Water District. The capacity of Sweasey Reservoir (3,400 acre-feet) has been displaced entirely with alluvial deposits.

Salmon and steelhead runs have probably been affected adversely by Sweasey Dam because at times it imposes stress upon adult fish by impairing upstream movement. The diversion intake was not screened to prevent losses of juvenile salmonids. A 38-step fish ladder was provided, as part of the project for fish passage to upstream spawning areas.

From counts of adult fish that passed over the dam during the first 10 years of operation the ladder apparently functioned quite well. However, as counts of fish at Sweasey Dam began to decline, the ladder became the object of much criticism. The effectiveness of the ladder was evaluated (Murphy, 1951). Murphy concluded that the ladder is basically a good one and that it would continue to function adequately if properly maintained. The fact that a record run of silver salmon passed over the dam in 1962 strongly supports this conclusion. The City provides for maintenance of the ladder.

Ruth Dam was constructed in 1961 by the Humboldt Bay Municipal Water District to provide water for municipal and industrial purposes within the Humboldt Bay area. The dam is an earth fill structure 120 feet in height, located 79 miles upstream from the Pacific Ocean in Trinity County. Ruth Reservoir has a storage capacity of 51,800 acre-feet and a surface area of 1,180 acres. The Humboldt Bay Municipal Water District has a water right to appropriate up to 200 cfs. and 120,000 acre-feet annually from the Mad River. Water is released into the Mad River from Ruth Reservoir and recovered by pumping from well fields located in the river channel near the community of Essex about five miles upstream from the mouth. Water is pumped continuously from the well fields by five Ranney pumping units.

The Ruth project has been designed and operated to augment the flow of the Mad River with releases from Ruth Dam during the summer and early fall when the natural flow would normally be insufficient to recharge the well fields and satisfy the pumping demands at Essex. Supplemental flow releases from the dam are reduced as winter runoff increases, allowing water to be stored in the reservoir for use during the next season. According to the terms of its water use permit the District is required to release a minimum flow of 5 cfs. at all times for maintenance of the trout fishery immediately below Ruth Dam. The permit also contains the following clause for the protection of anadromous fish in the Mad River downstream from the Ranney pumps near Essex:

> "During the periods herein specified, bypass or release into the natural streambed of Mad River immediately below Essex diversion, the following minimum flows or the natural flow of Mad River as regulated by diversions now in existence, whichever is less:
>
> | | |
> |---|---|
> | October 1 through October 15 | 30 cfs. |
> | October 16 through October 31 | 50 cfs. |
> | November 1 through June 30 | 75 cfs. |
> | July 1 through July 31 | 50 cfs. |
> | August 1 through August 31 | 40 cfs. |
> | September 1 through September 30 | 30 cfs. |

DESCRIPTION OF THE PROJECT AREA

The Mad River drains about 496 square miles of mountainous terrain in Humboldt and Trinity Counties, and flows into the Pacific Ocean a few miles north of Humboldt Bay. The headwaters and about 159 square miles of the watershed are within Trinity County. The total length of the main stem is slightly over 105 miles. Principal tributaries to the Mad River are the North Fork Mad River, Lindsay, Canon, Maple, Boulder, Bug, and Pilot Creeks. These streams drain about 30 percent of the total watershed area. The Mad River is situated in a steep V-shaped canyon bordered by northwest trending ridges including South Fork Mountain, Eight Mile Ridge, Mad River Ridge, and others. Chinquapin Butte, the highest peak in the drainage basin, is 6,070 feet above sea level. The river flows in a northwesterly direction throughout most of its course, maintaining an average gradient of 30 feet per mile. In the headwaters the gradient increases to about 100 feet per mile. In the lower 12 miles, where the river meanders across the Mad River flood plain, the gradient is about 8 feet per mile. The lower river takes the form of a tidal estuary about 1-1/2 miles from the mouth.

The Mad River watershed annually receives from 40 inches of rainfall near Arcata to 90 inches in the inland mountains. Although trace amounts of rainfall occur infrequently during the summer throughout the drainage basin most precipitation occurs during the months of October through May.

Summer temperatures in the interior portions range from about 40 degrees F. to over 100 degrees F. Although freezing temperatures are common during the winter, winter temperatures in the interior parts of the drainage basin average from 42 to 49 degrees F. Near the coast, in the vicinity of Blue Lake,

summer temperatures usually varies from 44 degrees F. to 85 degrees F. Winter temperatures near the coast average about 50 degrees F.

Vegetation in the Mad River watershed is typified by the dominance of forest trees, although grasslands, oaks, and other hardwoods occupy a significant portion of the total area. Douglas fir is present throughout the entire watershed and is predominant in the headwaters. Dense stands of coast redwoods, concentrated within the lower portions of the watershed, comprise about 20 percent of the total area. Most of the watershed has been logged for redwood and fir, and the timber stands now present are mainly second growth.

Soils within the Mad River watershed are unstable. Sedimentation and turbidity in the river have increased since logging and road building disturbed the watershed. The U. S. Geological Survey has determined that the Mad River may carry over one million tons of suspended sediment to the ocean in a single season. During the 1963-64 water year 1,235,266 tons of suspended sediment was transported by the river past the U.S.G.S. gaging station near Arcata.

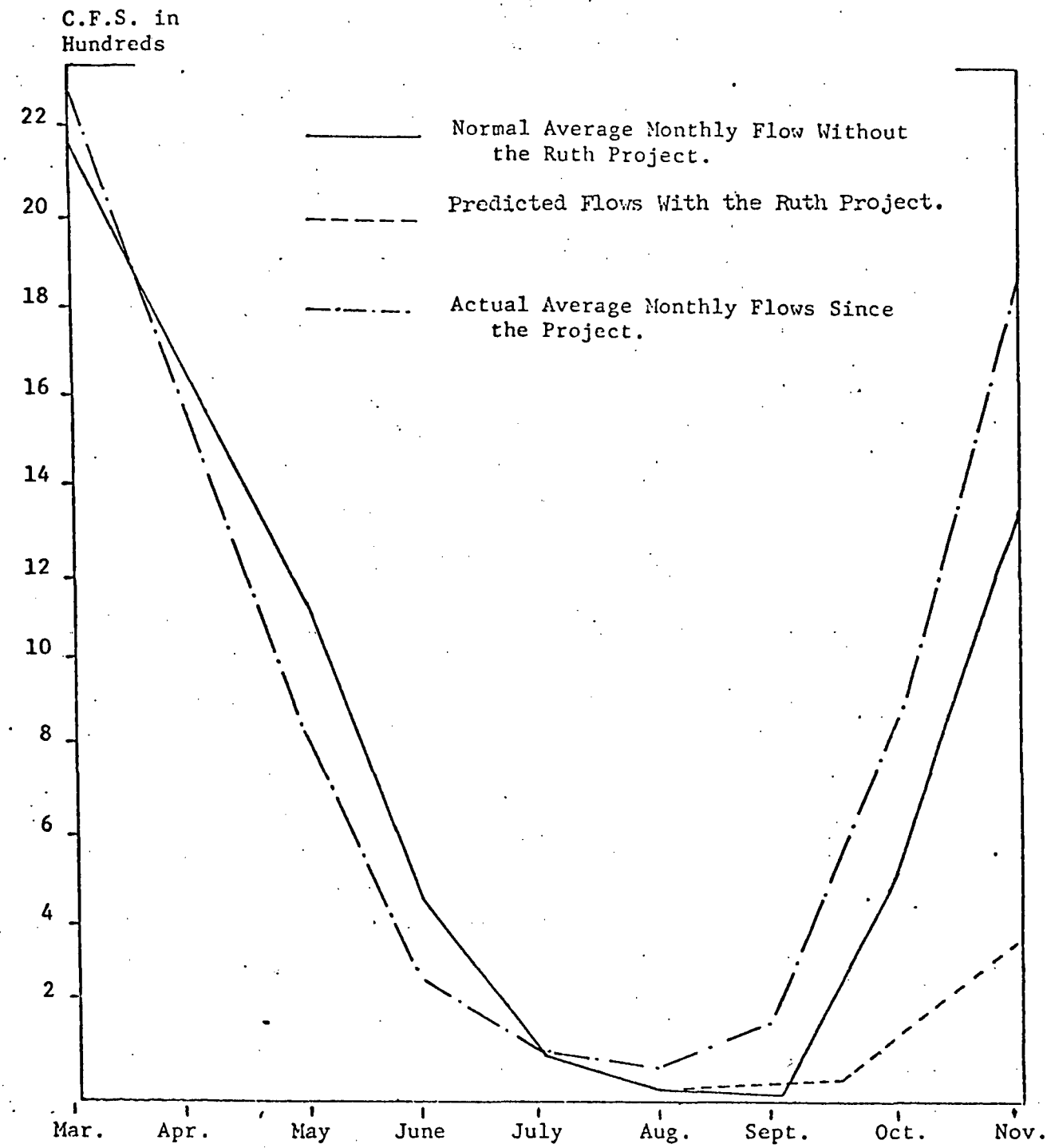
The highest mean concentration of suspended sediments recorded in the Mad River in 1964 was 5,010 ppm, measured on January 20 when the mean discharge was 32,600 cfs. Suspended sediment in the Mad River is made up of particles ranging from 0.002 mm to 0.125 mm in diameter. During peak flows a small percentage of larger suspended particles up to 1.0 mm may also be present. The river generally remains turbid during periods of increased runoff. As flows subside, water clarity increases. Concentrations of suspended sediments at the U.S.G.S. gage near Arcata have been measured as low as 2 ppm during the summer.

United States Geological Survey chemical analysis data for the 1963-64 water year indicates that the Mad River is slightly alkaline with pH ranging from 7.2 to 8.4. The water has a specific conductance of from 82 to 189 micromhos at 25 degrees C. and an average hardness, as $CaCO_3$, from 35 to 88 ppm. Total dissolved solids range from 83 to 110 ppm, and bicarbonates from 46 to 100 ppm.

The Mad River naturally exhibits a wide annual variation in flow. From 1950 to 1965 flows near the mouth have ranged from 77,800 cfs to 17 cfs. The lowest flows occur during the summer usually from July through September. Highest flows generally occur between December and March. The river above Ruth Reservoir normally becomes intermittent during the summer. When the Sweasey diversion was still active, summer flows to the ocean occasionally became seepages. Since the operation of the Ruth project in 1961 and the abandonment of Sweasey, a live stream has been maintained to the Pacific Ocean throughout each year.

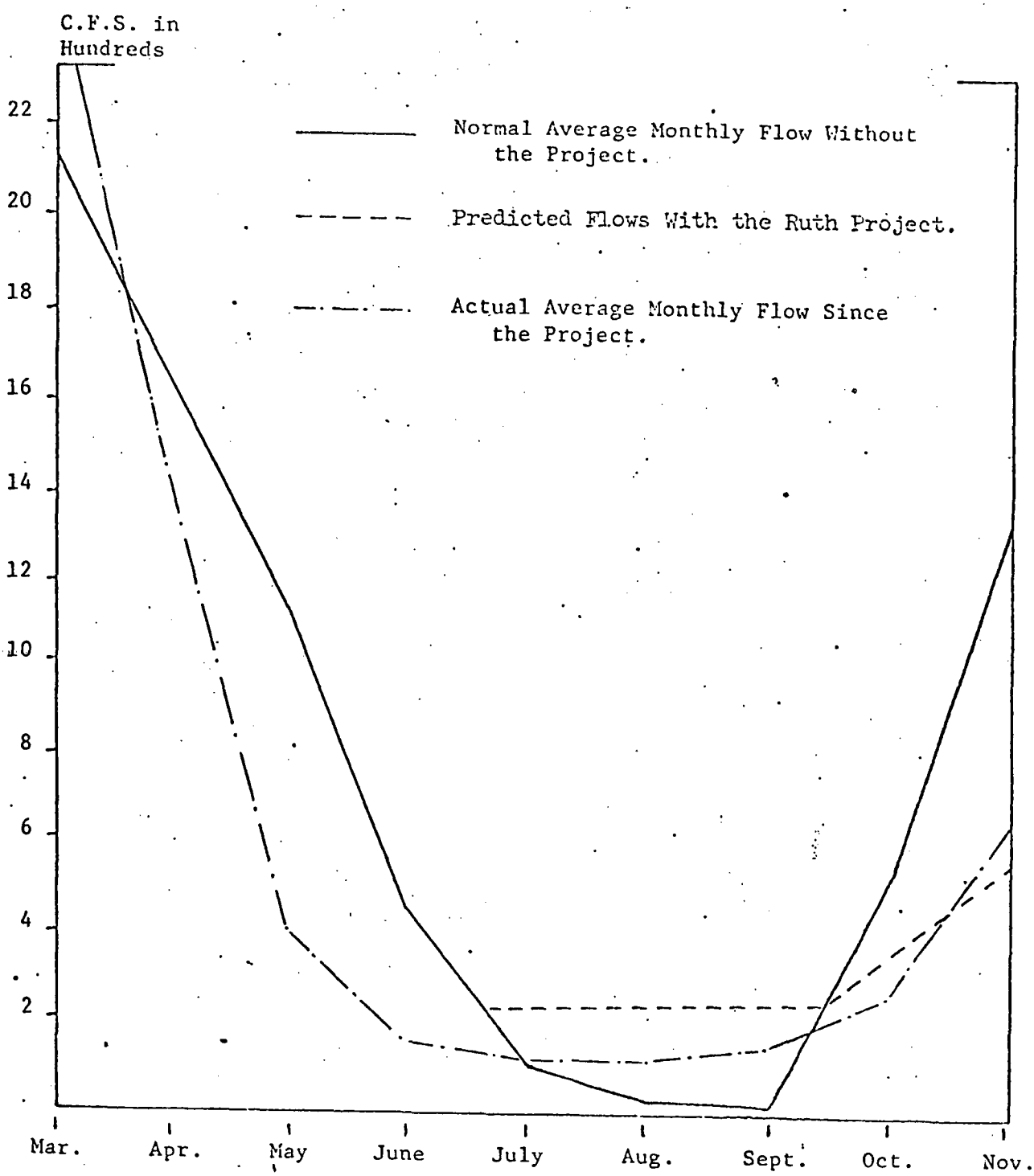
Flooding in the lower Mad River basin occurred even before the watershed had been affected by logging and road building. The high flows of 1903 and 1904 are examples referred to by Ridenhour, et al (1951), which resulted in considerable property damage in the Delta area near the mouth of the river.

Operation of the Ruth project has increased summer flows of the river to the Pacific Ocean. Winter flows have been relatively unaffected except immediately below the dam where they have been reduced and stabilized. Figure 1 shows the changes in the average monthly discharge of the Mad River during the summer below Essex resulting from the operation of the Ruth project. Differences in the summer flow pattern immediately upstream from Essex are approximated in Figure 2.



Average monthly discharge of Mad River near Arcata prior to construction of Ruth Project compared to actual and expected flows below Essex caused by operation of Ruth and the Ranney Pumps at Essex.

Figure 1



Average monthly discharge of Mad River near Arcata prior to construction of Ruth Project compared to actual and expected flows above Essex caused by the operation of Ruth Reservoir.

Figure 2

Operation of the Ruth project has changed the Mad River, benefiting both the anadromous and resident fishery resources. Increased flows in the river during the summer are believed to have reduced losses of young anadromous salmonids due to stranding. Increased habitat has been provided during the summer and early fall for all species of young salmonids, adult summer-run steelhead, and resident trout. The increase in food-producing areas resulting from these flows has probably had a beneficial effect on the stream survival of all species of young salmonids in the river.

Although increased flows have improved the Mad River during the summer below Ruth Dam, turbidity is noticeable for a considerable distance downstream. This condition is prevalent year-round below the dam. Turbidity is more pronounced with higher discharges. Seasonal climatic conditions affect run-off and increase the turbidity of the reservoir. According to Department of Water Resources unpublished data, the turbidity of the river below the dam normally ranges from 13 to 22 ppm from June through August. Concentrations of this order gradually filter out through the streambed and are not noticeable downstream.

Water temperatures of the Mad River are generally suitable for salmonids throughout most of the year. According to Department of Water Resources unpublished data the water discharged from Ruth Reservoir is about 44 degrees F. in May and gradually becomes warmer throughout the season. By October the temperature of the river below the dam may be as high as 65 degrees.

In 1966 fall overturn of the reservoir had occurred prior to October 18. The reservoir was homothermous at 65 degrees on that date. The increase in temperature of the river below Ruth Dam during the summer is due to depletion of the hypolimnion in the reservoir. Fall overturn would probably

occur later and at a lower temperature if the hypolimnion remained longer. Following overturn, the reservoir remains homothermous, and gradually cools to about 55 degrees by November, and may reach a low of close to 40 degrees by January or February.

Temperatures of the Mad River during the summer before and since the operation of Ruth Dam are summarized in Table 1. Present temperature conditions of the river are shown in the upper half of Table 1 for six different locations below the dam to show the rate of warming of the river as it travels downstream, and the cooling effect of the ocean on temperatures at the lowermost station (75 miles downstream). By comparing lines 4 and 5 with line 7 it can be seen that maximum summer temperatures were higher in 1967 than in 1956, suggesting that perhaps the Ruth project has slightly warmed this part of the river.

TABLE 1

MAD RIVER SUMMER WATER TEMPERATURES

BELOW RUTH DAM

Year	Stream Miles Below Ruth Dam	APRIL Max-Min		MAY Max-Min		JUNE Max-Min		JULY Max-Min		AUGUST Max-Min		SEPT Max-
1967*	1 mi. downstream	45	44	49	44	59	45	55	48			
1965**	7 mi. downstream	58	51	64	52	67	57	68	57	67	60	63
1967*	17 mi. downstream (Pilot Creek)			60		73	49	76	63	73	61	
1967+	48 mi. downstream (Butler Valley)							77				
1967+	66 mi. downstream (Mad R. Hatchery)					76		77				
1964**	75 mi. downstream	58	51	64	52	67	57	68	58	67	60	63
1956+	61 mi. downstream (Sweasey Dam)	54	44	58	46	69	54	74	64	72	64	70

* From California Department of Water Resources unpublished records.

** From U.S.G.S. records.

\+ Hand thermometer readings by Department of Fish and Game

FISH RESOURCES

The Mad River is primarily important as a spawning and rearing stream for three species of anadromous salmonids, king salmon (Oncorhynchus tshawytscha) silver salmon, (O. kisutch) and steelhead trout (Salmo gairdnerii). It also contains a good population of resident rainbow trout (Salmo gairdnerii). Anadromous coast cutthroat trout (Salmo clarkii) are present in the lower river and tributaries but are of minor importance. Other species naturally occurring in the drainage include shiner perch (Cymatogaster aggregata), three spined stickleback (Gasterosteus aculeatus), starry flounder (Platichthys stellatus), sculpins (Cottus gulosus), (Cottus aleuticus), (Leptocottus armatus), Humboldt sucker (Catostomus humboldtianus), eulachon (Thaleichthys pacificus), Pacific lamprey (Entosphenus tridentatus). Sturgeon (Acipenser sp.) and American shad (Alosa sapidissima) have been reported as infrequent visitors. Catfish (sp?) were introduced in 1881, but no records are available indicating survival (Wainright, 1965). Japanese ayu (Plecoglossus altivelis) were introduced into Ruth Reservoir in 1964.

Salmon and steelhead runs have been counted at Sweasey Dam almost every year from 1938 to 1964 by the Department. These records are shown in Table 2 and Figure 3 and indicate that salmon and steelhead runs passing the dam were very stable for the first 14 years of record. Since 1952 the natural runs have declined seriously. Silver salmon have shown a sharp rise beginning in 1959, resulting from a special stocking program undertaken by the Department.

Several complex factors are believed to be responsible for the general reduction of the native Mad River anadromous fish runs including gravel removal, logging, floods, and lack of fish screens at the Sweasey diversion

intake for over 25 years. Gravel removal has destroyed salmon spawning areas in the lower river. However, most of the major spawning areas in the river are located upstream from these operations. Extraction of gravel from upstream sites in the future is improbable under present conditions. Annual replenishment of gravel has been sufficient to prevent depletion at the existing excavation sites, making it unnecessary for the operators to seek new deposits.

Logging on the unstable slopes of the Coast Range can adversely affect fish habitat. Removal of the vegetative cover shading the smaller streams causes undesirable increases in summer temperatures. Erosion from cut-over land plugs up the spawning gravel with fine material thus reducing its usefulness for spawning. Siltation can smother eggs and young fish.

Population levels of anadromous fish are expected to increase from improved summer flow conditions in the river through the operation of the Ruth Dam project, providing temperature and turbidity problems do not outweigh increased flows.

TABLE 2

SALMON AND STEELHEAD COUNTS

MAD RIVER
(Sweasey Dam)

Year	King salmon	Silver salmon	Steel-head
1933 [1]	-	-	-
1934	-	-	-
1935	-	-	-
1936	-	-	-
1937	-	-	-
1938	1,273	498	3,110
1939	1,257	725	3,118
1940	1,293	73	5,706
1941	3,139	308	4,583
1942	1,676	378	6,650
1943	1,236	259	4,921
1944	-	-	-
1945	-	-	-
1946	1,181	415	5,106
1947	717 [2]	510	3,582
1948	672	515	3,139
1949	484	512	4,074
1950	1,505	147	4,430
1951	1,519	414	5,543
1952	401	72	5,613
1953	847	91	2,943
1954	409	59	2,390
1955	390	2	148
1956	129	21	2,717
1957	494	11	1,957
1958	478	3	1,780
1959	19	541	1,376
1960	55	244	1,343
1961	40	710	1,985
1962	238	3,580	1,708
1963	232	1,419	2,178
1964	492	332	373

[1] 1933 refers to counting year 1933-34, etc.
[2] Does not include an estimated 250 fish that passed the dam before counting started.

MAD RIVER
SALMON AND STEELHEAD COUNTS
AT SWEASEY DAM

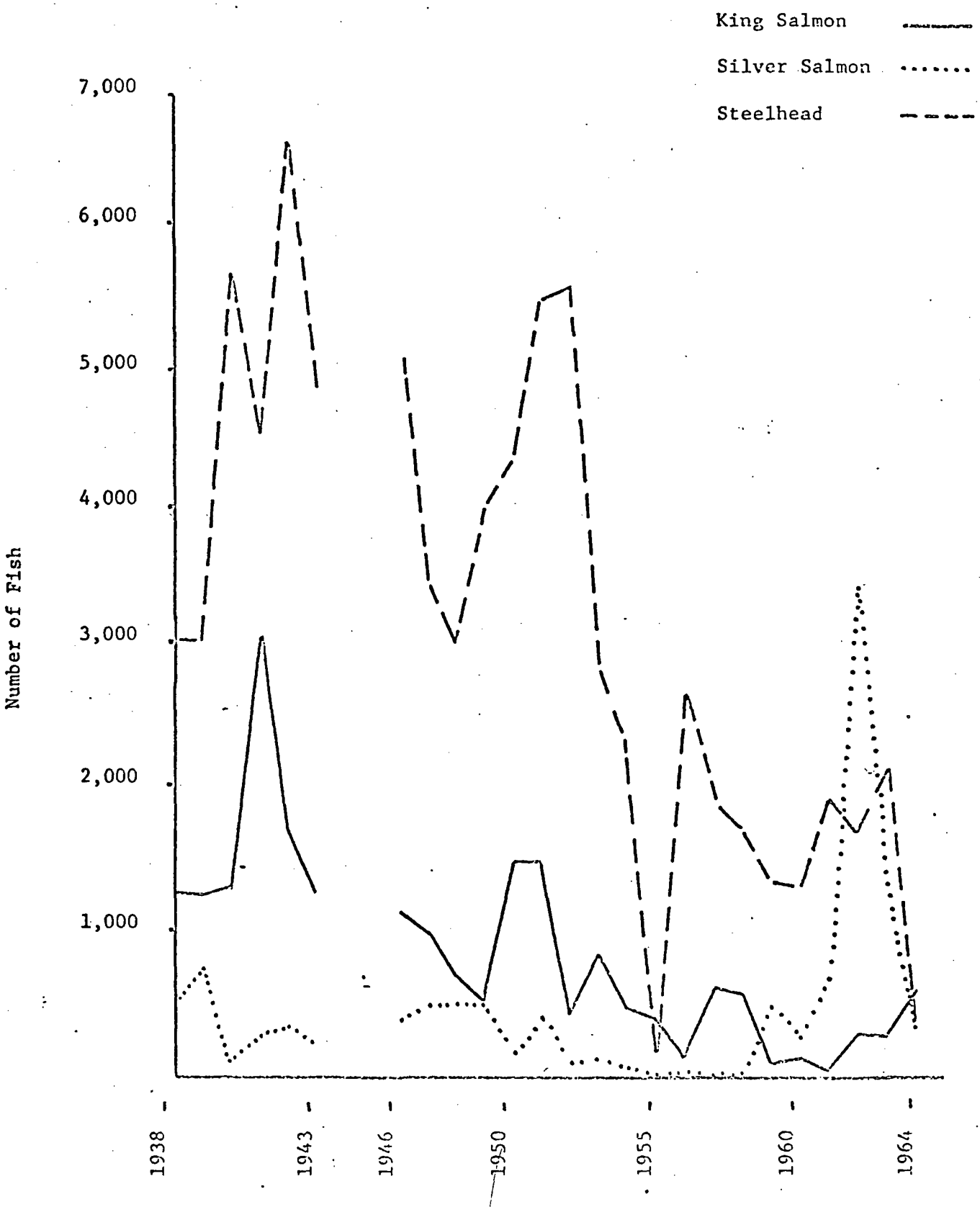


Figure 3

KING SALMON

Beginning about 1850 a commercial salmon fishery, primarily for king salmon, was active in the lower Mad River and estuary. Statistics are lacking, but newspaper accounts for the year 1905 suggest that the catch for that season may have amounted to about 200,000 pounds or 10,000 fish, exclusive of sport caught fish (Ridenhour et al, 1961). The last year of commercial fishing in the Mad River was 1918 (Anonymous, 1949). This was the first active river fishery in the State to be closed to commercial salmon fishing.

According to Ridenhour, who interviewed long-time residents and fishermen of the area, the runs declined noticeably from 1920 to 1930, and larger fish became scarce. A 73-pound king salmon, caught and weighed in 1895, was the largest reported. Kings over 50 pounds were taken frequently until about 1925.

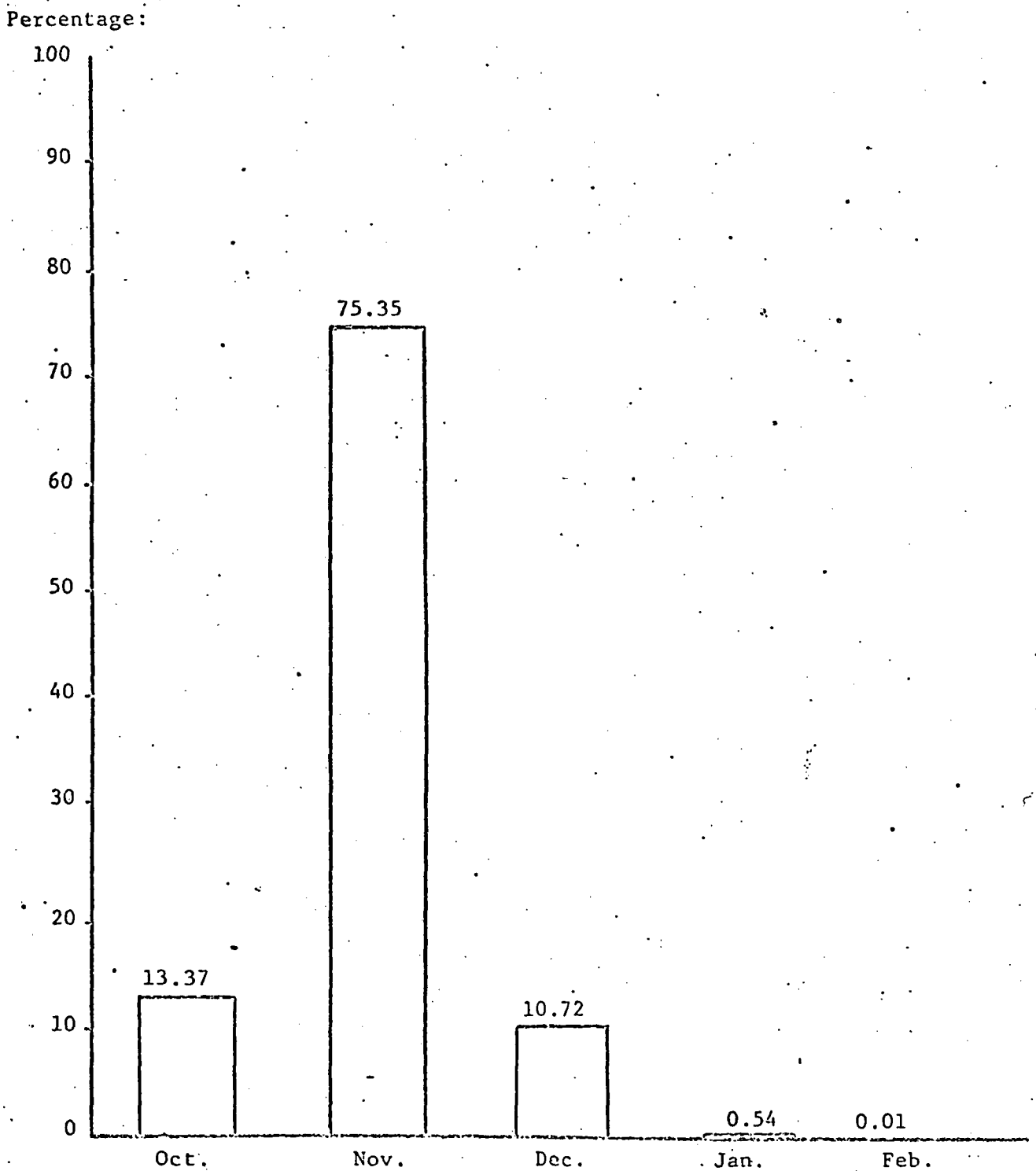
Reduced escapement of king salmon to the river during this period may have been due largely to the expansion of the early commercial offshore troll fishery which began in the Monterey Bay area in the early 1880's and spread to north coastal waters in 1916. In 1919 nearly three million pounds of salmon were troll caught in the Eureka region which, since this time, has produced the greatest salmon landings of any region in the State.

King salmon usually start their annual upstream migration in the Mad River with the first substantial fall rain in October or November. They have been known to enter the estuary and lower river as early as August. Although the mouth of the river remains open in most years, and has remained open all year during the past 10 years, including 1959 when the flow near the mouth reached a low of 1.7 cfs, a sand bar occasionally forms during periods of

low flow. Once formed the bar remains until flows increase sufficiently to remove it. Late opening of the bar has occasionally caused delays in upstream migration of king salmon.

The arrival of the first king salmon at Sweasey Dam each season has usually been preceded by a significant peak flow. Most frequently, peak flows prior to the start of the counting season have ranged from 100 to 400 cfs. In 1952 king salmon did not reach Sweasey Dam until the flow had increased to 170 cfs on November 15, though they had been in the lower river for some time prior to that date. These fish had entered the river while flows ranged from 21 to 24 cfs. The lowest peak flow preceding the first king salmon of the season at Sweasey was 64 cfs, which occurred on October 11, 1959. The first king salmon counted through the ladder was on October 18. The highest recorded flow before commencement of the king salmon counting period at Sweasey Dam occurred in October 29, 1950, and was 23,500 cfs. November is the peak month of upstream migration of Mad River king salmon (Figure 4).

Stream flows may fluctuate from less than 100 to several thousand cfs during the spawning period, November through December. Optimum spawning flows for Mad River king salmon in the main river are presently being determined by the U. S. Fish and Wildlife Service and the Department. The principal spawning areas for this species are located in the main river and tributaries downstream from Sweasey Dam. Canyon Creek, North Fork Mad River, and the main stem between Sweasey Dam and the North Fork are most heavily utilized spawning areas. About 65 stream miles of suitable spawning habitat exists in the drainage. Upstream from Sweasey Dam king salmon spawn in Maple and Boulder Creeks and in the main river in the vicinity of Butler Valley. (See Figure 5) A series of roughs and a fall, located about 40 miles upstream



Monthly Migration Pattern of King Salmon Through the Ladder at the Sweasey Dam Fish Counting Station 1949-50 Through 1962-63.

Figure 4

from the mouth of the Mad River, marks the upstream limit of migration for anadromous fish. Steelhead and a few silver salmon are known to reach the barrier but king salmon rarely do.

In 1952 the first spawning escapement estimate, using a tag and recovery method, was made for Mad River king salmon by the Department of Fish and Game. A similar study was conducted in 1954 by the U. S. Fish and Wildlife Service, and in 1956 field observations and carcass recovery data were used to estimate the total population (Table 3). The total average run is estimated to be 5,000 fish per year.

TABLE 3

TOTAL ESCAPEMENT FOR MAD RIVER KING SALMON FOR 1952, 1954 AND 1956 IN COMPARISON TO SWEASEY COUNTS

Year	Estimated Total Escapement	Sweasey Counts Actual	Sweasey Counts % of Total
1952	6,320 1/	401	6.3
1954	3,424 2/	409	11.9
1956	1,429 3/	129	9.0

The percentages in Table 3 seem to suggest that there may be a fairly constant relationship between total yearly escapement and the annual king salmon counts at Sweasey. It appears that roughly 10 percent of the annual spawning escapement is counted at Sweasey. Fall flow conditions are known to affect this relationship however.

1/ Unpublished data from California Department of Fish and Game Region 1 files September 17, 1953.

2/ Unpublished data from Region 1 files by U. S. Fish and Wildlife Service

3/ Unpublished data from Region 1 files by California Department of Fish and Game.

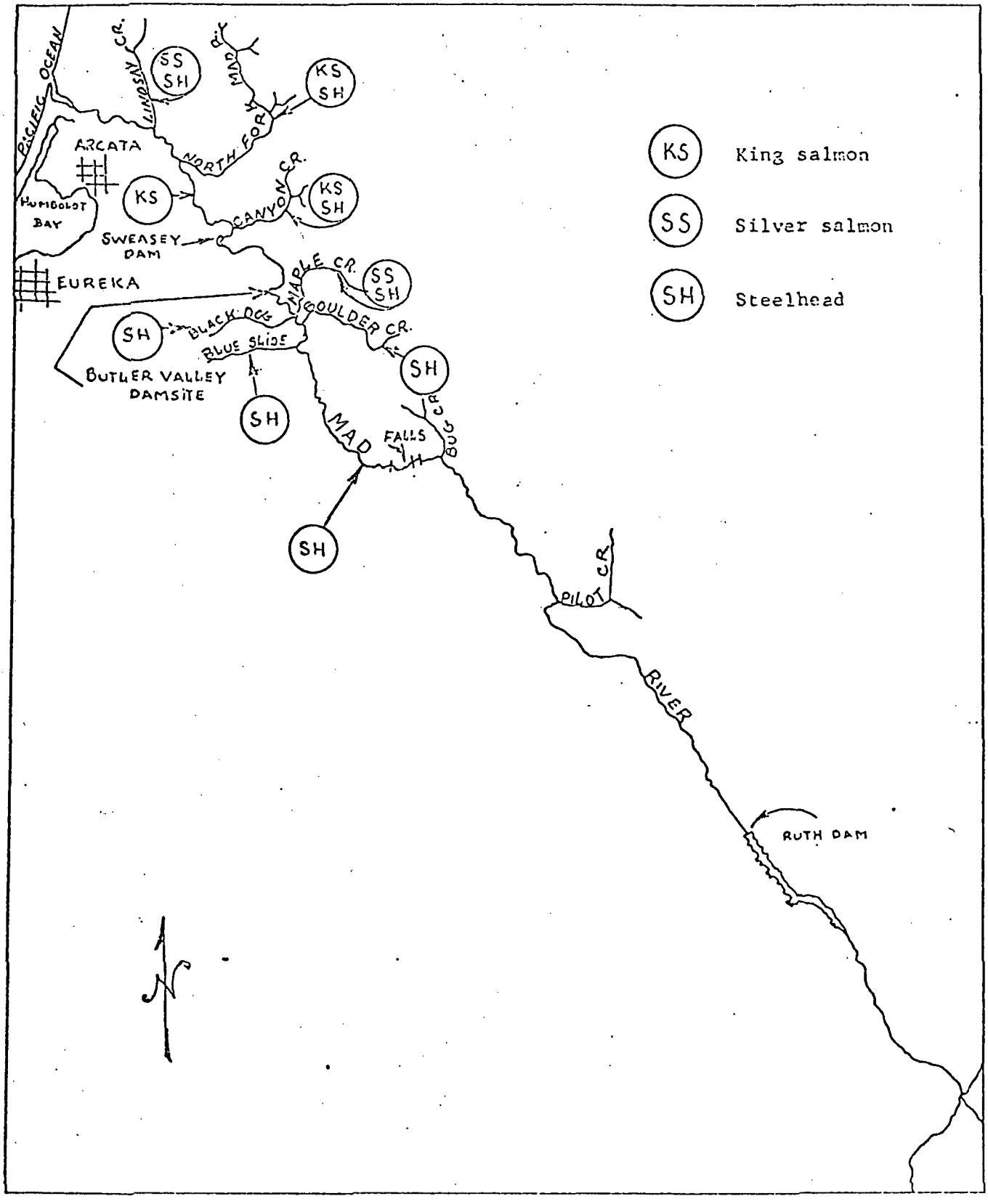


Figure 5 . Map showing distribution of principal anadromous salmonid spawning and rearing areas in the Mad River drainage.

Seaward migration of juvenile salmonids in the Mad River was studied in 1951 and 1952 to determine the optimum time for planting hatchery-raised fish. Wild seaward migrant king salmon passing Sweasey Dam in 1951 were most abundant in May and June (Figure 6).

During the sampling period from May 1 to August 1, downstream migrants ranged in size from 1.7 to 3.9 inches fork length. During the peak of migration, June 12 through 18, the average size was 2.82 inches.

Bailey and Gibbs, 1963, determined that the transition from fresh to salt water takes place from June through August when the young fish have attained an average size of about 3.1". The size of the fish, not the time of year, is apparently the most important factor controlling this transition in both wild and hatchery-raised fish. It was concluded that hatchery-raised king salmon should be planted in the Mad River at less than 5 per ounce (2.8" fork length) to reduce fresh water mortality.

Mad River king salmon averaged roughly 4,500 eggs per female as determined from samples of 42 and 37 collected in 1950 and 1951, respectively (Bailey, 1952).

SILVER SALMON

The population of silver salmon native to the Mad River drainage declined rapidly in the early 1950's. In 1957 a restoration program was initiated using silver salmon from the Quilcene and Klaskanine Rivers in Oregon. Annual plantings of yearling silver salmon, 40,000 to 75,000 fish each year since 1957, has resulted in higher returns of the introduced strain than the present run of native fish.

Native silver salmon may begin their spawning migration as early as October, but do not run in large numbers until the stream has risen substantially.

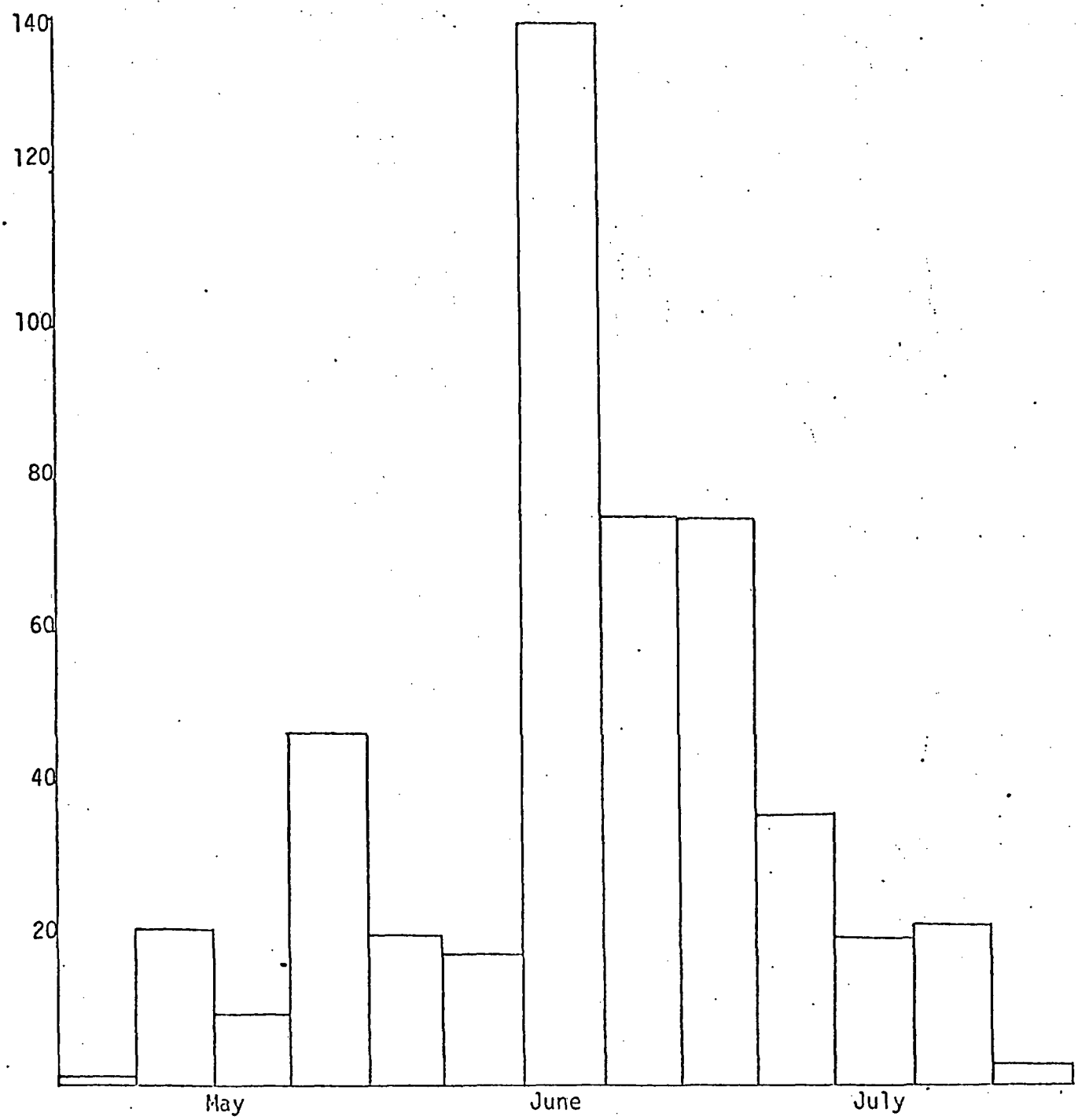


Figure 6
Juvenile King Salmon Samples from Downstream
Migrant Trap, Sweasey Dam, 1951

Figure 6

The normal migration and spawning period extends from November through January. The Quilcene and Klaskanine strains appear to have an earlier migration pattern, appearing in the river in large numbers during September and October. The differences in migration pattern between native and introduced strain is illustrated in Table 4.

TABLE 4 1/

A COMPARISON OF THE MONTHLY MIGRATION PATTERNS OF THREE STRAINS OF SILVER SALMON - MAD RIVER 2/

	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	TOTAL
1949-50/1958-59							
Mad River Strain	11	525	703	91	2	0	1,332
Percentage	0.83	39.41	52.78	6.83	0.15	0.00	100.00
1959-60/1962-63							
Klaskanine & Quilcene	1,906	962	927	44	0	0	3,839
Percentage	49.65	25.06	24.15	1.15	0.00	0.00	100.01

1/ Region 1 Correspondence March 19, 1964.
2/ Counts taken at Sweasey Dam.

Little is known about the distribution of spawning and rearing areas utilized by Mad River silver salmon. Lindsay Creek and its tributaries have been regarded as being the most important silver salmon producers in the system. Lindsay Creek enters the river about five miles upstream from the Pacific Ocean and receives about 250 spawners annually.

In order to learn more about the relative importance of silver salmon rearing areas in the Mad River system, the major tributaries, including North Fork Mad River, Boulder, Lindsay, Blue Slide, Black Dog Canyon and Maple Creeks were sampled on July 27 and 28 and on August 3, 1967, using seines

and electrofishing gear. Only Maple and Lindsay Creeks were found to contain young silvers. Other Department personnel have observed silver salmon also utilizing the smaller tributaries to the lower river, such as Warren and Mill Creeks. Figure 5, which is based on our limited observations, shows the distribution of spawning and rearing areas utilized by silver salmon within the Mad River system.

The average total run of silver salmon, including hatchery returns, is presently estimated to be about 2,000 fish.

A trapping study of juvenile silver salmon conducted by the Department at Sweasey Dam in 1951, has shown that the peak of seaward migration occurs from mid-May through June (Figure 7). Fork lengths of sampled fish ranged from 1.8 to 4.8 inches during the sampling period.

The feasibility of establishing a salmon hatchery on the Mad River is now being studied by the Department. The hatchery would be located on the Mad River near Blue Lake, about $2\frac{1}{2}$ miles upstream from the confluence with the North Fork. Experimental facilities have been constructed and are now in operation.

If all phases of a large hatchery operation can be successfully completed, a permanent hatchery will be constructed to provide for the production of 1,000,000 yearling silver salmon and 5,000,000 king salmon fingerlings. Fisheries benefits are estimated to be 340,000 pounds of commercially caught fish and 51,000 angler days of sport fishing annually. The hatchery facilities would cost about $3,000,000 and would be jointly financed by State and Federal funds, as authorized by the Anadromous Fish Act recently passed by Congress.

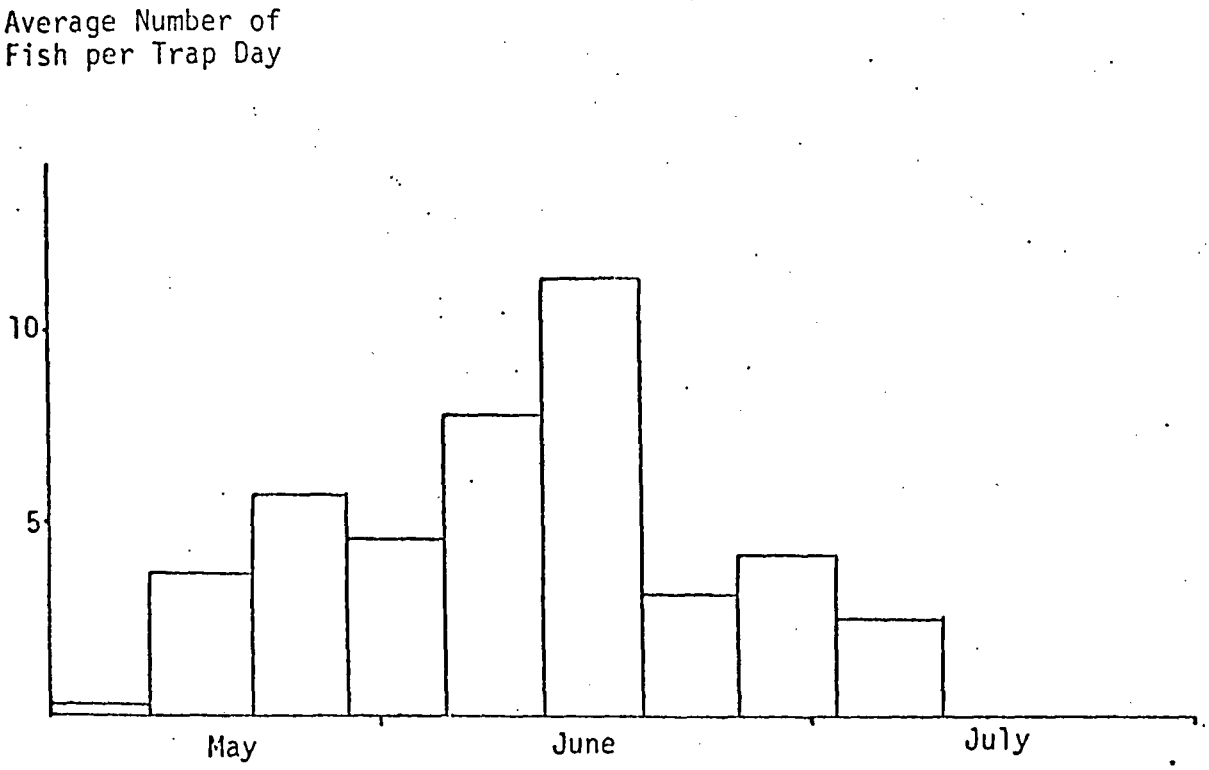


Figure 7

Juvenile Silver Salmon Samples from Downstream
Migrant Trap, Sweasey Dam, 1951

Figure 7

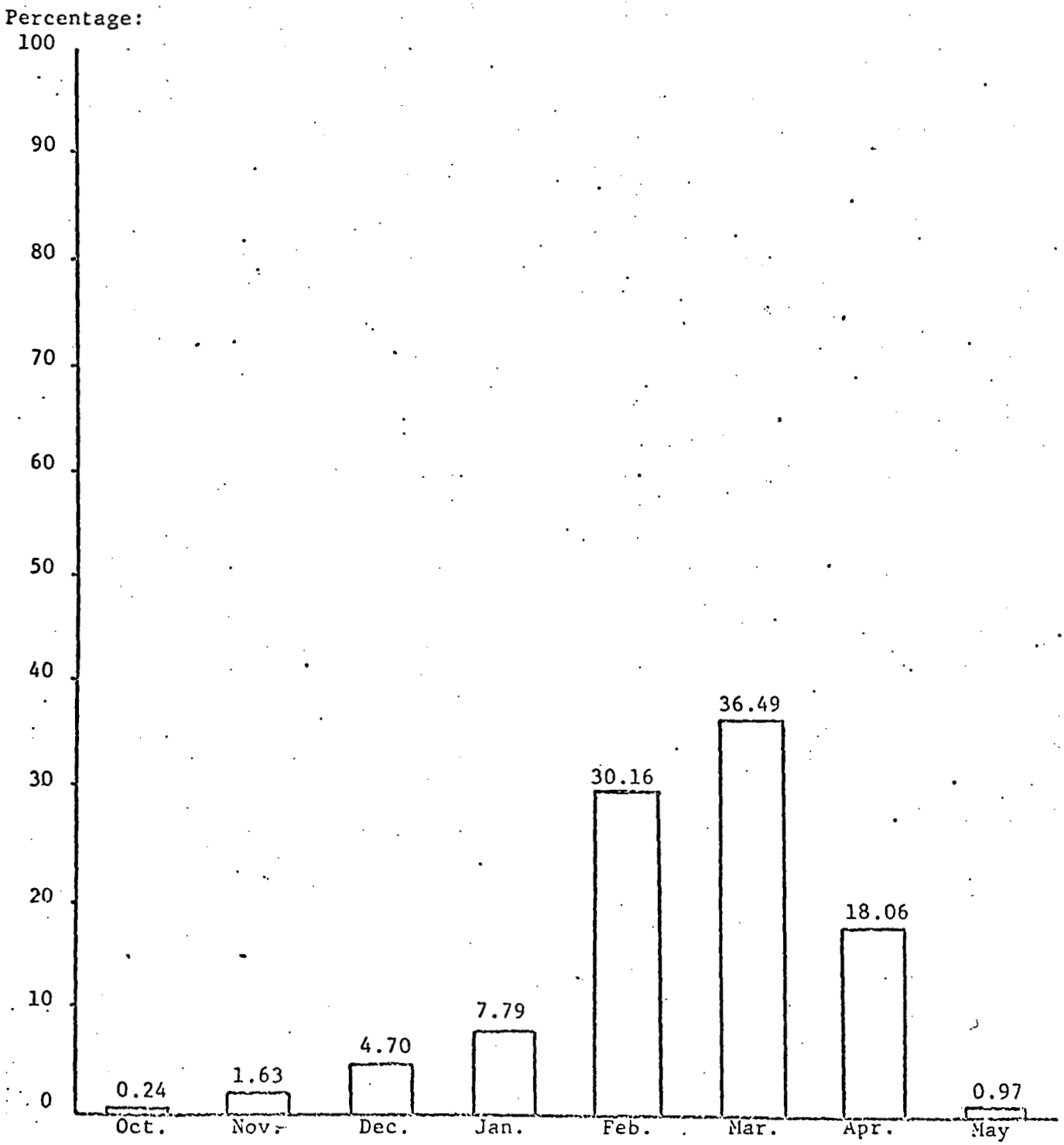
STEELHEAD

The most important steelhead producing waters in the Mad River system are located above Sweasey Dam. Boulder, Maple, Black Dog and Blue Slide Creeks are used principally by this species. Lindsay Creek and the North Fork are also good steelhead producers. There are presently about 89 stream miles of spawning habitat in the drainage utilized by steelhead. Figure 5 indicates the wide distribution of spawning and rearing areas in the drainage.

Adult steelhead migrate over an extended period in the Mad River from fall to early spring and spawn in late winter or early spring. From Figure 8 it can be seen that annual steelhead spawning migrations begin as early as October with the largest part of the migration past Sweasey Dam occuring from January through April.

A small number of steelhead that spend the summer and fall in deep pools above Butler Valley prior to spawning are believed to be a distinct "summer run." Although no information is available on the life history of this separate population, many of the steelhead counted at Sweasey Dam in May are thought to be summer run since they lack the physical characteristics of sexually mature fish. The total annual run is presently estimated at 6,000 fish.

A trapping study was conducted by the Department of Fish and Game in 1951 to determine the downstream migration period of Mad River steelhead. Steelhead were taken throughout the trapping period May 1 through August 1, and were most abundant during July. This is demonstrated in Figure 9. Various age classes of young steelhead were obtained, ranging from 1.4 to 6.6 inches fork length.



Monthly Migration Pattern of Steelhead Through the Sweasey Dam Ladder From 1949-50 Through 1962-63.

Figure 8

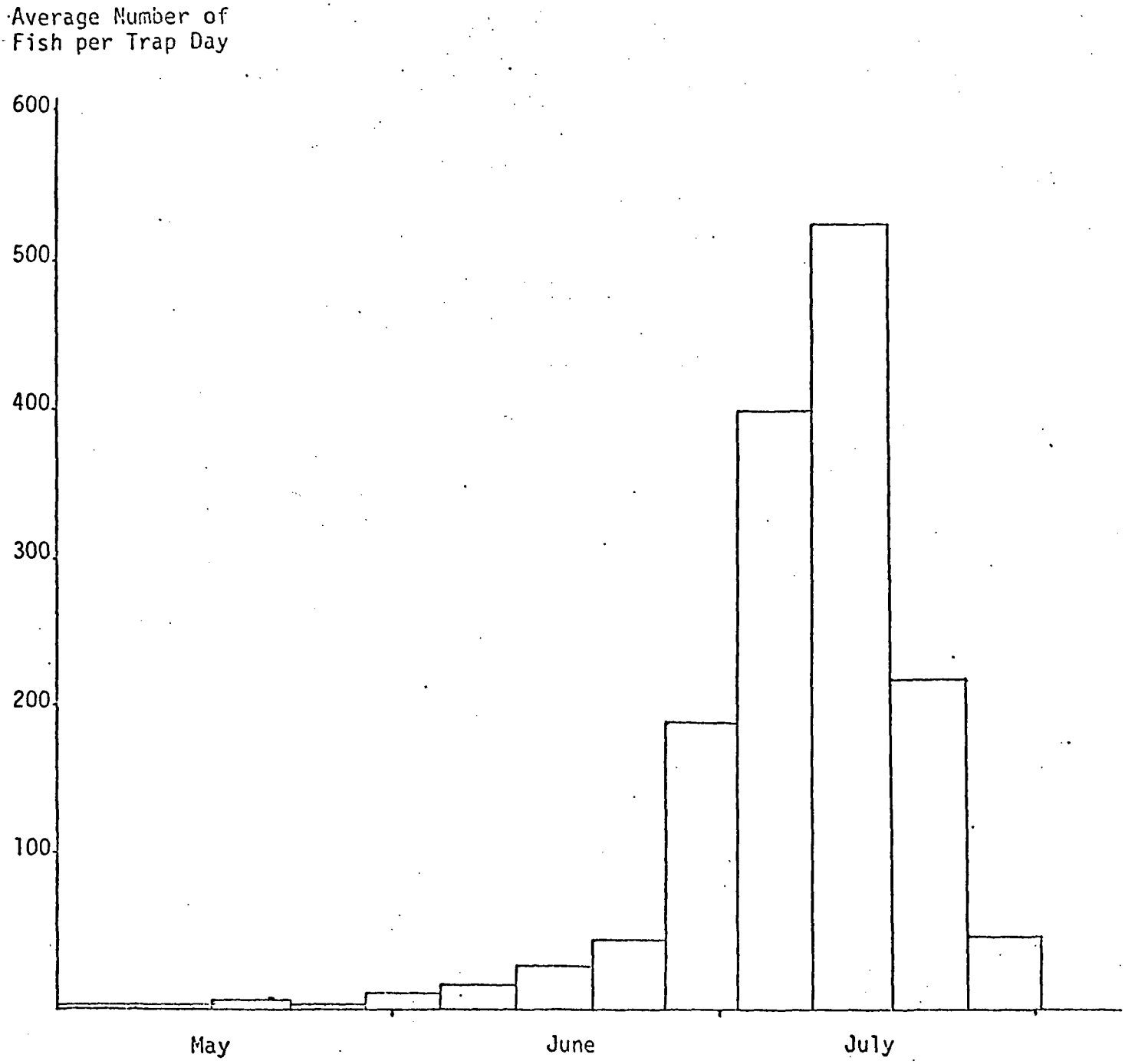


Figure 9

Juvenile Steelhead Sampled from Downstream
Migrant Trap, Sweasey Dam, 1951

Figure 9

FISHERIES

Without the Project

The Mad River supports anadromous fish resources of great economic and recreational value. Salmon and steelhead produced in this stream contribute to valuable offshore sport and commercial fisheries and provide sport fishing in the river.

The salmon and steelhead sport fishing area on the Mad River is limited by regulation to the main river from 3,000 feet below Sweasey Dam to 200 yards upstream from the mouth. Although the lower section of the river is in private ownership it is readily accessible to fishing except for the first eight miles below Sweasey Dam which is behind a locked gate. In spite of this, a considerable number of fishermen manage to get past the gate. Mad River fishermen are mainly local residents.

In 1952, according to counts and estimates by the U. S. Fish and Wildlife Service, 6,000 angler days were spent fishing for steelhead. Although no precise data are available, it has been estimated that Mad River steelhead anglers catch an average of about 1,500 fish each season.

Studies conducted by the Department and the U. S. Fish and Wildlife Service indicate that 750 king salmon were taken by anglers in 1962 and 240 were caught in 1954. It was also estimated that an average of 1,600 angler days were spent fishing for king salmon in the river each of these seasons.

Since 1959, due to the introduction of Oregon strains, the number of silver salmon returning to the Mad River has increased remarkably and has resulted

in a greatly improved river sport fishery. The contribution of these fish to the river sport fishery was evaluated by creel censuses conducted in 1959 and 1962. It was estimated in 1959 that about 2,000 hatchery-reared silvers were caught from September 17, when the first fish entered this fishery, to November 22. In 1962 a creel census was conducted from October 1 to October 7. This information is summarized in Table 5. A total of 118 silver salmon were examined; all were two-year olds except for one three-year old. About eight percent of the two-year olds were females ranging from 6.9 inches to 21.2 inches fork length, the remainder were males ranging from 11.8 to 21.7 inches fork length. A predominance of two-year old silver salmon is abnormal. Silver salmon usually return as three-year olds. It was estimated that about 400 of these fish were caught during the month of September. Very few were caught after October 7 due to high flows. The total catch during this period was estimated to be 700 hatchery-reared silver salmon. From September 11 to November 5, 1963, 475 silver salmon were caught from the Mad River, 177 of which were two-year olds.

Although a high percentage of the river silver salmon sport catch has been grilse (two-year olds) most of the runs counted at Sweasey Dam have included a good percentage of three-year old fish. This relationship is shown in Table 6, which summarizes the returns of planted marked hatchery silver salmon. The Table also indicates that returns of Klaskanine and Eel River strains of silver salmon, planted in the Mad River at yearling size, ranged from 0.24 to 4.13 percent and averaged 2.01 percent.

TABLE 5

1962 CREEL INFORMATION - MAD RIVER SILVER SALMON [1]

	Total Boat Angler Hours	Catch/ Hour	Total Shore Angler Hours	Catch/ Hour	Total Catch Silver Salmon
October 1	108	0.15	48	0.12	23
2	80	0.42	40	0.00	34
3	158	0.27	94	0.02	45
4	114	0.19	32	0.00	22
5	142	0.46	64	0.00	66
6	232	0.32	184	0.12	98
7	104	0.09	108	0.00	10
	938		570		298

1/ Region 1 Correspondence.

TABLE 6 [1]

RELEASES AND RETURNS OF MARKED SILVER SALMON PLANTED IN THE MAD RIVER

Brood Year	Strain	Release Date	Number Released	No. Per Lb.	Returns 2 Yr. Old	Returns 3 Yr. Old	Returns Total	Percent Escapement
1957	Klaskanine	3/10-17/59	40,212	9.3 to 10.9	487	144	631	1.57
1959	Eel River	2/23/61	58,036	9.8	707	528	1,235	2.13
1960	Klaskanine	1/25-2/1/62	40,265	8.5	1,272	393	1,665	4.13
1961	Klaskanine	2/4-2/6/63	60,989	12.1	109	36	145	0.24

1/ From: C. S. Kabel and E. R. German 1967, Some Aspects of Stocking Hatchery-Reared Steelhead and Silver Salmon. Marine Resources Administrative Report No. 67-3.

Turbidity has probably limited the Mad River salmon and steelhead sport fishery more than any other factor. Heavy silt loads of over 1,000 ppm prevail during winter floods. Experimental incubation of king salmon eggs at Sweasey Dam in 1960-61 resulted in heavy losses due to siltation. It is assumed that survival of naturally spawned eggs in the river and tributaries is probably affected similarly by this problem. During the summer and early fall the river is usually very clear and remains so until the season's first substantial rain.

Once the river rises and becomes turbid the stream may be unfishable for some time. The river was fishable for less than 40 percent of the 1957-58 winter season from November to February due to high and turbid water conditions which are typical for the stream during this period.* Because these conditions prevail during most of the native silver salmon and steelhead migration periods these fish are relatively less vulnerable to angling than king salmon which enter the stream when flows are low and clear. Early running hatchery-reared silvers, so far, have been highly vulnerable to angling for this same reason.

Although the Mad River sport salmon fishery is a valuable recreational asset to Humboldt County residents, the greatest benefits derived from the river's salmon resources are realized by offshore commercial and sport fisheries. Table 7 summarizes estimates of the sport and commercial ocean catches of salmon produced in the Mad River.

*Fishable water is defined according to visibility of secci disc immersed between 12 and 16 inches.

TABLE 7

ESTIMATED PRESENT CONTRIBUTION OF MAD RIVER SALMON TO OCEAN SPORT AND COMMERCIAL FISHERIES

	King Salmon	Silver Salmon
Commercial	12,700	1,100
Sport	2,800	700

Ocean sport fishermen spend an estimated average of 4,200 angler days fishing for Mad River king salmon and 1,700 angler days fishing for silver salmon.

Resident rainbow trout are present in most of the Mad River drainage, including Ruth Reservoir. A minimum flow of five cubic feet per second is released at all times from Ruth Dam to maintain the downstream trout fishery. The river is readily accessible by good roads for about 12 stream miles below Ruth Dam and 12 stream miles above the upper end of the lake. The lake at high level is about 11 miles long. Access on about 35 miles of stream between Mad River Ranger Station and Sweasey Dam is limited to a major road crossing near Maple Creek and a few points located near the middle of this section where unimproved roads terminate. Ruth Reservoir is easily accessible to both boat and shore anglers. Because of accessibility the reservoir and the river upstream from Mad River Ranger Station receive more angling pressure for resident trout than does the rest of the stream.

Angler success rates on the Mad River, prior to the construction of Ruth Reservoir, were determined along the more accessible sections in 1957 and 1958 by the U. S. Fish and Wildlife Service and the Department.

The average catch per hour was more than 1.4 fish during both summers. The rate of angler success in 1966 in the river below Ruth Dam averaged 1.0 fish per angler hour during May and June. Angler counts made by the Fish and Wildlife Service showed that 4,000 angler days were expended for trout in the Mad River in 1956.

Since its completion in 1962, Ruth Reservoir has been managed by stocking 100,000 to 200,000 fingerling rainbow trout annually and has provided satisfactory fishing although angling pressure is low.

On May 26 and 27, 1962, the opening weekend of trout season, a Department of Fish and Game creel census indicated that anglers caught .83 fish per hour. A total of 225 trout were examined which ranged from 5 to 14 inches fork length. Other studies indicate opening day success rates ranged from 2.42 fish per angler hour on May 25, 1963, to .63 fish per angler hour on June 2, 1964. On June 2, 1963, 527 anglers visited the reservoir.

An experimental introduction of 8,000 marked catchable rainbow was made on May 11, 1966, and evaluated by a creel census which was started on April 30, the opening day of the 1966 trout season, and terminated on July 4. The census also included the accessible sections of the river in the vicinity of the reservoir. The catchable trout program has been discontinued because the total estimated return of planted fish to the angler was only 23 percent (LaFaunce, 1966). Based upon this work it is estimated that Ruth Reservoir presently receives about 3,300 angler days of use per year.

With the Project

Butler Valley Dam would create an impassable barrier to anadromous fish. About 26 miles of important spawning and rearing streams presently utilized by salmon and steelhead would be cut off by the proposed dam. Counting records obtained at Sweasey Dam, located seven miles downstream from the dam site, provide the best means of determining the average annual runs of fish that would be affected by the project. Based upon these records average annual spawning escapements of 4,500 steelhead trout (including summer-run), 1,500 king salmon and 500 silver salmon would be blocked from their natural spawning and rearing areas by Butler Valley Dam.

If a low-level diversion dam is constructed near Essex, it would effectively block all of the runs of anadromous fish from the entire Mad River system, including returns of fish to the proposed Mad River Hatchery. Losses of young and adult salmonids associated with the diversion of water at such a dam would be high unless suitable facilities are provided to protect fish migrating both upstream and downstream.

Stream flow regulation below Butler Valley Dam could have significant adverse effects on the anadromous fishery resources of the Mad River. Anadromous fish runs would be jeopardized if flows in the river to the Pacific Ocean were insufficient to provide for?

1. Attraction of adult salmon and steelhead from the ocean to the mouth of the river.
2. Transportation of adults to spawning areas in the river and tributaries below Butler Valley Dam including the Mad River Hatchery.
3. Successful spawning of king salmon in the river below the dam.
4. Rearing and seaward migration of juvenile salmonids.

Degradation of water quality in the river could result from the operation of the project. Excessive turbidity or unfavorable temperatures of water released from the dam would be detrimental to the anadromous fishery resources of the river and would limit sport fishing in the river.

Low dissolved oxygen in the river immediately below Butler Valley Dam could interfere with the operation of the recommended fish trapping and egg taking facility needed at the dam to preserve anadromous fish runs.

Primarily because of the excessive water surface fluctuations which are expected to result from the operation of Butler Valley Reservoir, the reservoir will probably not support a good fishery either for trout or warmwater fishes. In addition to the fluctuation of the reservoir, turbid water, and possibly unfavorable temperatures may further reduce the productivity of the reservoir.

Butler Valley Dam would reduce transport and natural replenishment of sand and gravel in the lower river where large commercial operations are located. This might result in these operations moving elsewhere in the river and further destruction of spawning areas.

DISCUSSION

Artificial propagation, coupled with adequate protection of habitat which will still be available after the project is constructed, would be the most practical means of preserving the anadromous fishery resources threatened by the construction of Butler Valley Dam. Fish hatchery facilities and an egg taking station would be needed to perpetuate average annual runs of 1,500 king salmon, 500 silver salmon, and 4,500 steelhead trout that would be

blocked by the dam. The capacity of the proposed Mad River Hatchery could probably be increased to produce the additional number of fish required to maintain these runs. Assuming that the percent return of adults would be 1.0 percent for steelhead and 2.0 percent for silver salmon planted as yearlings in the Mad River it would be necessary to design additional hatchery facilities with a capacity for rearing 450,000 steelhead (8 per pound) and 25,000 silver salmon to yearling size.

To maintain an annual escapement of 1,500 Mad River king salmon, 2,000,000 fingerlings should be raised to an average size of 5 per ounce before being released. A fish barrier and trapping and loading facilities would have to be located below the Butler Valley Dam outlet to trap the salmon and steelhead that would be blocked by the dam.

The total cost of the hatchery, fish barrier dam, and the trapping and loading facilities would be about $2.5 million and total annual operating costs would be about $84,000.

Fish passage facilities, to permit unimpaired upstream movement of anadromous fish, would be required if a low-level diversion dam were constructed near Essex. Adequate screening devices would also be needed at this dam to prevent juvenile and adult salmonids from being diverted and lost into the water conveyance system. If a surface diversion without a dam is used, only screening devises would be required.

Cost estimates for the proposed facilities at Essex cannot be made until the location and nature of the diversion are known.

Based upon limnological information available regarding Ruth Reservoir, waters in the hypolimnion of Butler Valley Reservoir would undoubtedly be turbid and at times low in dissolved oxygen. Since this would be the primary source of cold water needed for attracting fish to the recommended trapping facility below the dam, features for providing well oxygenated water might have to be incorporated to assure efficient operation of the trap.

Stream flows necessary to preserve the fishery resources of the Mad River are recommended according to Table 8. These flows are over and above existing downstream water rights.

Table 8
Releases from Butler Valley Dam

Period	Flow
October 16 - April 30	300 cfs. (116,900 AF)
May 1 - June 30	200 cfs. (24,200 AF)
July 1 - October 15	100 cfs. (21,400 AF)

Flows to Pacific Ocean Downstream from Diversion Near Essex

Period	Flow
October 16 - April 30	300 cfs. (116,900 AF)
May 1 - June 30	150 cfs. (18,100 AF)
July 1 - October 15	45 cfs. (9,700 AF)

This schedule is preliminary. Studies are now being conducted by the U. S. Fish and Wildlife Service and the Department of Fish and Game to determine, more accurately, the flow requirements for fishery preservation below the dam.

Preservation of the fishery resources downstream from Butler Valley Dam would depend also upon maintenance of temperatures and dissolved oxygen concentrations suitable for salmonids. Suspended sediment concentrations in the

river would have to be controlled to permit full recreational utilization of these resources. Attraction water of suitable quality would be required for successful operation of the recommended fish trapping facility at or near the dam and for artificial propagation of anadromous fish at the proposed Mad River Hatchery, which will be designed to obtain water periodically from the river. Temperature, dissolved oxygen, and turbidity levels affecting fishing, salmon reproduction, and summer-run steelhead ripening could be more closely controlled if releases from the dam could be drawn from various depths in the reservoir. Multiple level outlets should, therefore, be included as a water quality control feature of the project for fisheries preservation purposes.

Large quantities of streambed materials are annually removed from the lower Mad River for aggregate production. Salmon spawning habitat in the lower river has been damaged by these operations. These damages have been minimized because of the continuous natural transportation and replenishment of gravel by the river. Butler Valley Dam could reduce this natural replenishment of gravel. The industry would then be forced to develop other gravel deposits which could result in further destruction of salmon spawning areas elsewhere in the Mad River.

All streambed gravel deposits in the river are on private lands. Means of protecting the remaining salmon spawning habitat would require acquisition

of the stream channel and adjacent lands. We recommend that the river channel and a strip of land at least 100 feet in width bordering both sides of the river from Butler Valley Dam downstream to the proposed Mad River Hatchery be purchased by the Corps of Engineers and managed by the Department of Fish and Game to protect existing gravel deposits in the river for salmon spawning use. The acquisition and management of these lands should be funded as a project cost.

Although Butler Valley Reservoir would be relatively close to population centers, fishing use is expected to be comparable to Ruth Reservoir which presently receives an estimated 2.79 angler days per acre annually. Ruth Reservoir is annually planted with about 150 fingerling rainbow trout per acre. Management of Ruth Reservoir with planted fingerling trout has produced quality fishing and is more feasible than a catchable trout program.

Butler Valley Reservoir could probably be managed most feasibly with fingerlings. We are unable to develop a reservoir fisheries management plan at this time due to uncertainties in the reservoir operation schedule. The Department of Fish and Game will be responsible for developing and implementing a fishery management program for Butler Valley Reservoir. Adequate public access to the reservoir should be included as part of the project for fishing and other recreational purposes.

WILDLIFE

Without the Project

The Butler Valley Basin contains excellent wildlife habitat. The land is in private ownership and held in large blocks which are posted against trespass. They are subjected to light human pressure. The area includes timber, brush,

natural meadows, and agricultural lands. The timbered lands have been logged at various intervals which has created different aged stands of trees and brush. The active farms contain irrigated and dry land pastures, and some cereal crops. On abandoned farm areas the fields are covered with grass and forbs which are slowly being invaded by brush and trees. Some natural meadows are found in the timbered areas. The combination of the above factors and an abundance of water provide a large amount of food and cover for wildlife.

Black-tailed deer and black bear are found in the project area of influence. Deer are numerous, averaging one deer per every 6.2 acres. Black bear, while not resident in the reservoir site, are frequent visitors to the area. Mountain lion and Roosevelt elk have been reported in the drainage, however, no sign of either were observed during the wildlife inventory.

Upland game observed in the reservoir site included large numbers of quail and a lesser number of band-tailed pigeons, mourning doves, grouse, and gray squirrels, as well as brush and jack rabbits.

Furbearers inhabiting the area include mink, river otter, and raccoon. Coyotes, bobcats, and skunks are also found within the reservoir area of influence.

Waterfowl use of the reservoir site is limited to a few wood ducks and mergansers. Most of the waterfowl use occurs in the lower river and especially the Mad River estuary where not only waterfowl but shorebirds and seabirds concentrate seasonally in large numbers.

Various non-game species are found in the project area. Although they have no recognized tangible economic value, their presence adds to the esthetic enjoyment of the outdoor enthusiast.

With the Project

The influence of the Butler Valley project upon the wildlife habitat can be summarized as follows: (1) 4,100 acres permanently or periodically inundated and consequently lost to wildlife use; (2) 6,000 acres of adjacent land set aside for recreational development and its capacity to support wildlife reduced; (3) elimination of a unknown amount of habitat within borrow areas and covered by project developments; (4) possible improvement of riparian habitat through controlled flow releases downstream and; (5) potentially improved water management in the Mad River estuary.

Wildlife dependent upon habitat destroyed by the project will be displaced or drown when the reservoir fills. Resident terrestrial species will be displaced to adjacent lands which are already supporting maximum populations. Here they may perish by a spectacular die-off, or as is most often the case, by a longer more subtle process involving reduced reproduction brought about by stress and malnutrition. For all species the end result is inevitable and always the same, that is, the displaced animals cannot be replaced and eventually will be lost unless carrying capacity equal to that destroyed is created and maintained.

In order to determine the amount of mitigation required it was necessary to determine the deer population within the reservoir site. Sight counting can be very misleading in timber and brush areas. However, the number of deer

in a resident herd can be determined by the standard deer pellet group counts. The investigation indicated one deer for each 6.2 acres of habitat.

Large numbers of quail will be lost and specific plans will have to be formulated to mitigate the loss.

DISCUSSION

Mitigation for the loss of wildlife habitat destroyed by the Butler Valley Project will require acquisition, development, and management of certain lands. These lands should be acquired in fee title or leased for the life of the Butler Valley project. The area proposed for mitigation of wildlife losses would extend from the Butler Valley Dam downstream to the Mad River Fish Hatchery and abut upon the Mad River channel. (See Plate 1)

Approximately 1,800 acres of land adjacent to the river channel (acquisition of which is also proposed as a fisheries mitigation resource) should be acquired and managed to mitigate wildlife losses attributable to project construction. Such lands should be improved to increase wildlife carrying capacity to offset losses.

Habitat improvement will fall into two major types of development: (1) creation of riparian habitat within the river channel, and (2) development of the upland area. Each area will require continuing maintenance.

Riparian Habitat. The most important wildlife habitat in most areas is the riparian association along water courses. A significant increase in wildlife carrying capacity, especially for deer and quail, can be achieved by allowing riparian habitat to develop in the river channel. The riparian growth will establish itself if not scoured out by excessive water releases.

A major portion of wildlife mitigation could be accomplished by this method at small incremental cost as it is also recommended that the river channel be purchased for protection of spawning areas for fish.

Upland Habitat. In order to provide ideal wildlife habitat in the upland an interspersion of open areas which create the maximum of edges is required. The areas adjacent to the river could most easily be improved as wildlife habitat. Development and management would be according to vegetative type, as follows: (1) timber land, (2) brush fields, and (3) open areas, glades, meadows, and grasslands. A brief description of the development and management of each vegetative type follows:

(1) Timbered Land - Most lands within the mitigation area have been logged at one time or another. Thus the re-growth of trees and brush are in various stages of development. This intermixture of revegetative stages is advantageous as it puts the wildlife habitat on a sustained yield basis.

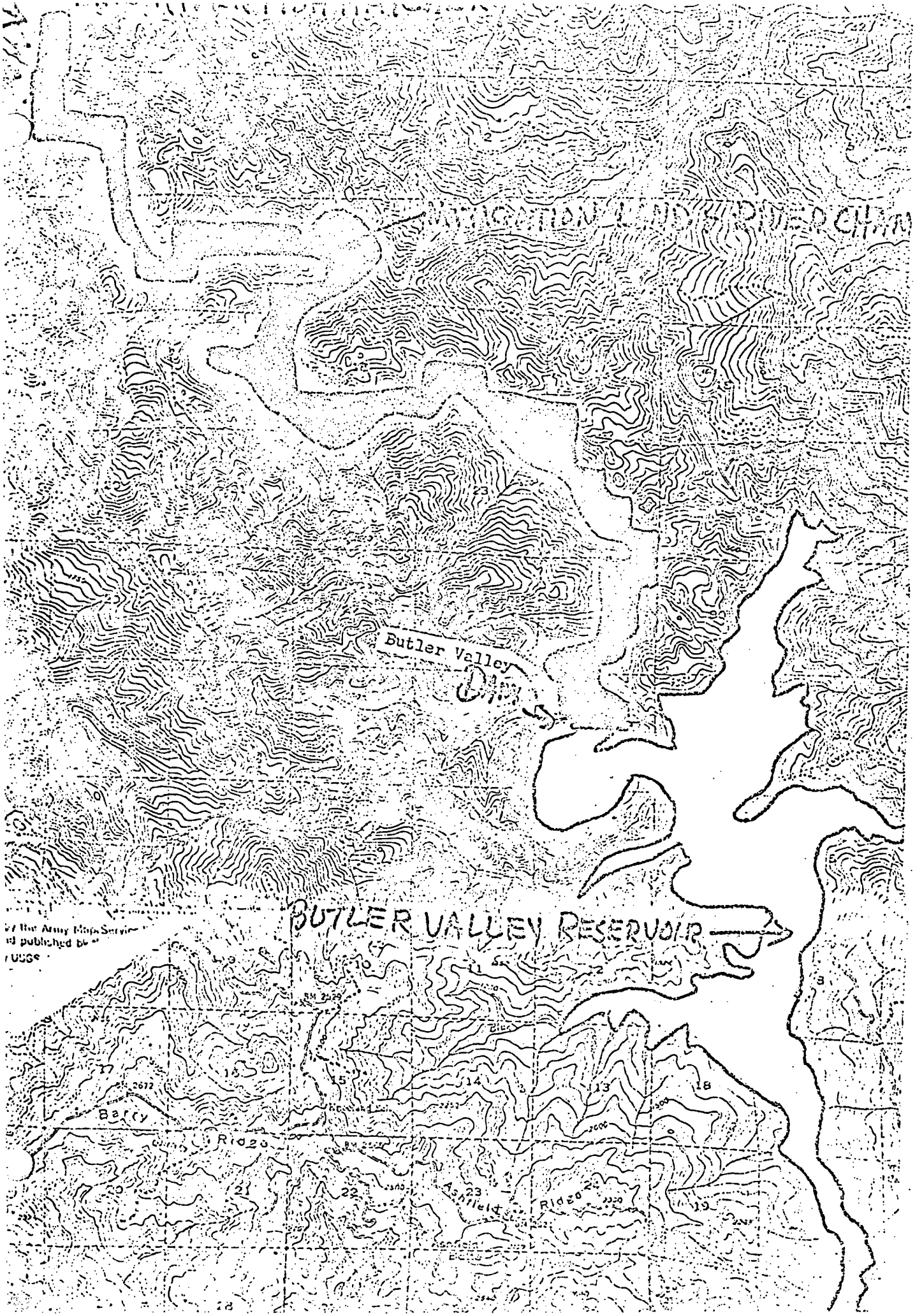
Some of the cut-over lands will produce at least one timber crop and some two during the life of the project. Some of the more dense stands should be thinned now. It would be advantageous to initiate a sustained yield system of timber cropping. This system would tend to stabilize the amount of forage produced annually. No attempt would be made to eradicate timber trees other than thinning stands to create the essential open areas. Extent of forest areas would be controlled by limiting reproduction. A part of the wildlife mitigation costs might be defrayed by income from the logging operations.

(2) Brush Fields - Decadent and dense stands of brush would be opened up or rejuvenated by burning, mechanical and chemical methods. Browse species now

out of reach of the deer would be reduced in height so that they could be utilized.

(3) Open Areas - Grass and forbs play an important part in the diet of coast range deer. For best results the open areas should be interspersed in brush and timber stands. Blackberry thickets should be developed near water in the larger open areas to provide habitat for upland game. Grazing of livestock on the area during certain periods of the year would be desirable to control herbaceous species not taken by deer. Grazing fees may also cover a portion of the annual wildlife mitigation costs.

A detailed development and operation plan for the wildlife mitigation area should be developed and adopted by the Corps of Engineers in cooperation and agreement with the California Department of Fish and Game and the Bureau of Sport Fisheries and Wildlife prior to initiation of construction. Such a plan should recognize the California Department of Fish and Game as the agency to manage the fish and wildlife resources developed on the mitigation lands.


MITIGATION LAND
RIVER CHANNEL
Butler Valley
Dike
BUTLER VALLEY RESERVOIR
Barry
Ridge
Ashfield
Ridge

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