State of California

DEPARTMENT OF FISH AND GAME

Region 2

THE DE SABLA-CENTERVILLE PROJECT

(FPC No. 803)

AND ITS IMPACT ON FISH AND WILDLIFE

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INTRODUCTION

The De Sabla-Centerville Project of the Pacific Gas and Electric Company (PG&E) will be considered for relicensing by the Federal Power Commission (FPC) before expiration of its present license (FPC No. 803) in 1979. This report has been prepared to provide information and data required for formulation of the Department of Fish and Game (Department) position on relicensing of the project. The Department, in this report, summarizes results of special investigations devoted to the effects of the project on fish, wildlife and recreation resources of the state and presents preliminary recommendations designed to protect and maintain these resources.

The special studies were, for the most part, cooperative efforts of the Department, the applicant (PG&E), the U.S. Forest Service (Lassen National Forest) and the U.S. Fish and Wildlife Service. Investigations included evaluations of trout and anadromous fish habitat of project-influenced streams, fish populations, minimum pool requirements, recreation and angler use, deer and other wildlife drowned in project canals, and the impact on wildlife by other project facilities.

Although the applicant and other interested parties participated in most of the investigations, the conclusions and recommendations presented in this report represent the views of the Department and may or may not be in agreement with those of the applicant or cooperating agencies.

SUMMARY AND PRELIMINARY RECOMMENDATIONS

In 1979 the Federal Power Commission will consider an application for relicensing of the De Sabla-Centerville Project (FPC 803) of the Pacific Gas and Electric Company. Accordingly, the Department of Fish and Game has investigated the various impacts of the project on fish and wildlife resources and, in this report, presents its findings and preliminary recommendations relative to relicensing.

Operations of the project affect three reservoirs having a total storage capacity of about 6,400 acre-feet of water. About 31 miles of stream in mountains and foothills of the west slope of the Sierra lie within project limits from elevation 5650 to about elevation 500.

The project produces about 170 million kilowatt-hours of electric energy annually and supplies some irrigation and domestic water.

The results of Department studies indicate the project has caused an annual loss of about 55,000 catchable-size trout, 2,700 anadromous fish, 50 deer (plus other wildlife) entrapped in canals, and wildlife carrying capacity on 375 acres of habitat.

To compensate for fish and wildlife losses attributable to the project, the Department recommends that:

1. A minimum pool of 250 acre-feet should be maintained in Philbrook Lake.
2. A minimum flow of 2 cubic feet per second (cfs) or the natural flow if less (but not less than 0.1 cfs), should be maintained in Philbrook Creek below Philbrook Dam.
3. A minimum flow of 16 cfs should be maintained in the West Branch Feather River below Hendricks Head Dam.
4. A minimum flow of 20 cfs should be maintained in Butte Creek from Butte Head Dam to Centerville powerhouse.

5. A fish ladder should be installed at Centerville Head Dam.
6. PG&E should reimburse the Department for a proposed five-year program to reestablish a run of steelhead trout in Butte Creek.
7. All project canals should remain accessible to the public for fishing, and natural canal bottoms should be retained.
8. A minimum flow of 5 cfs should be maintained in all project canals, except Upper Centerville Canal where the existing 2 cfs minimum flow is recommended.
9. Measures should be taken to improve waterfowl production at Snag Lake.
10. One hundred acres of new or improved wet-meadow habitat should be created.
11. Sixteen new deer crossings, improvements to all existing deer crossings, 2,200 feet of fencing, and 8 escape ramps and warning flashers should be provided to reduce the loss of deer and other wildlife in project canals.

PROJECT DESCRIPTION

Purpose of Project

Facilities of the De Sabla-Centerville Project (Plate 1) are located in Butte County on the West Branch of the North Fork of the Feather River and on Butte Creek. The primary purpose of the project is production of about 170 million kilowatt-hours of electricity annually, but a small number of local residents are served with irrigation water through project canals. The project impacts fish and wildlife habitat in the mountains and foothills of the west slope of the Sierra from about elevation 5650 (1695 m) at Snag Lake to about elevation 500 (150 m) at the Centerville Powerhouse (Plate 2).

Project Facilities

Water for the project is diverted from Butte Creek and the West Branch Feather River and is conveyed by canals to De Sabla Forebay and thence through a penstock to De Sabla Powerhouse in Butte Creek Canyon. Water from De Sabla Forebay is also supplied to residents in the Nimshew area through the Upper Centerville Canal. Water releases into Butte Creek and the natural flow are quickly diverted into the Centerville Canal and finally return to Butte Creek through the Centerville Powerhouse.

Butte Creek

Butte Creek originates as a network of small streams at about elevation 6200 (1860 m) in northeastern Butte County. The Department plants trout in this upper stream section near the village of Butte Meadows. Three miles (4.8 km) below the village, Butte Creek begins a plunge through an extremely rugged canyon from elevation 4400 (1320 m) to the edge of the Sacramento Valley at elevation 560 (168 m) in just 20 miles (32 km) or 192 feet/mile (40 m/km). The creek assumes a more gentle course in the 45 miles (72 km) before it enters the Sacramento River at elevation 20 (6 m).

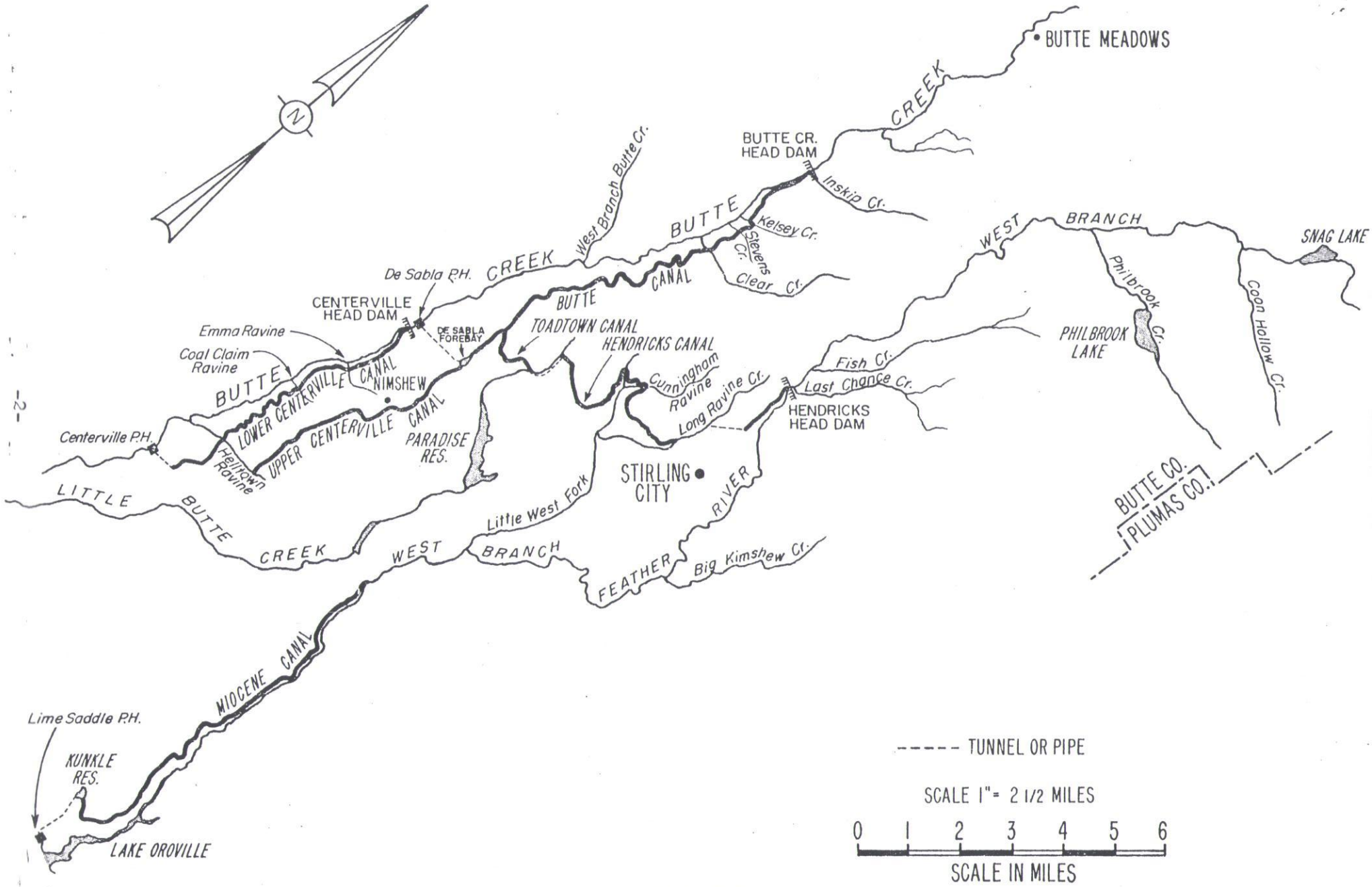
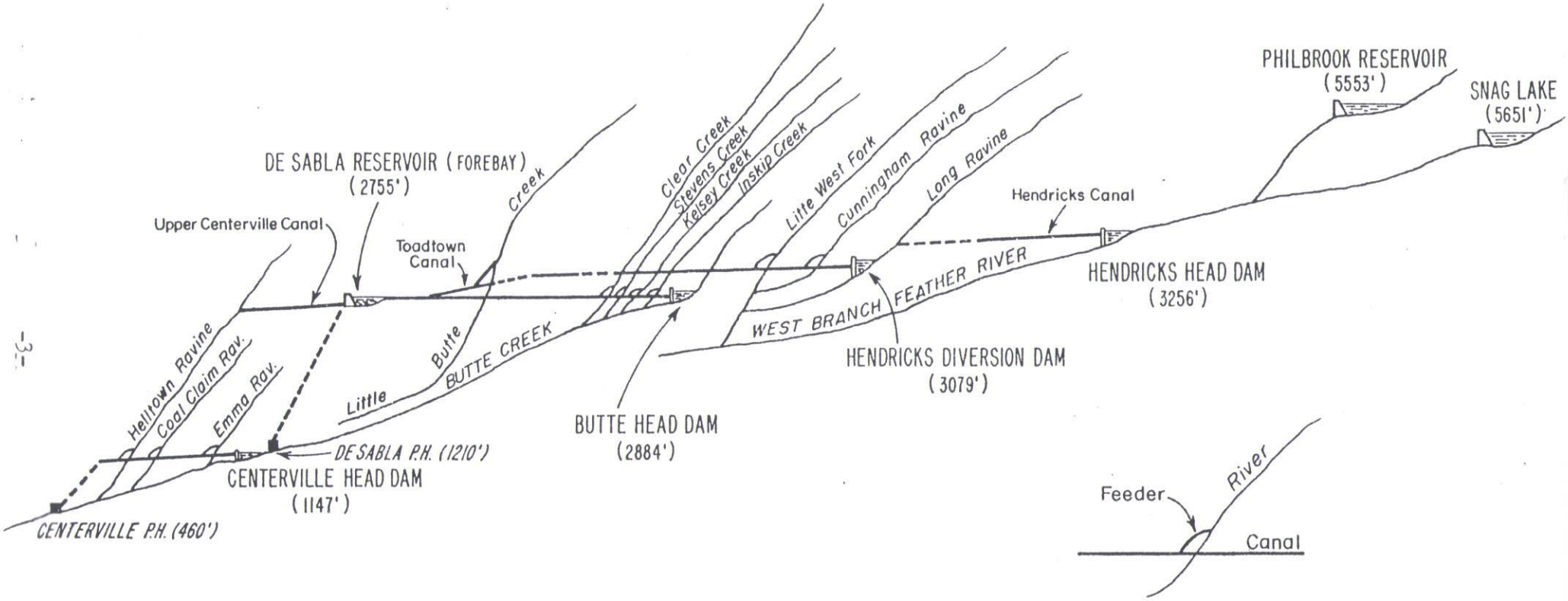

N
BUTTE MEADOWS
BUTTE CR. HEAD DAM
BUTTE CREEK
West Branch Butte Cr.
Inskip Cr.
Kelsey Cr.
Stevens Cr.
Clear Cr.
BUTTE CANAL
De Sabla P.H.
CENTERVILLE HEAD DAM
DE SABLA FOREBAY
Emma Ravine
Coal Claim Ravine
BUTTE LOWER CENTERVILLE CANAL
NIMSHEW
TOADTOWN CANAL
HENDRICKS CANAL
Cunningham Ravine
Long Ravine Cr.
Fish Cr.
Last Chance Cr.
HENDRICKS HEAD DAM
WEST BRANCH
SNAG LAKE
Philbrook Cr.
PHILBROOK LAKE
Coon Hollow Cr.
Centerville P.H.
Hellhawn Ravine
UPPER CENTERVILLE CANAL
PARADISE RES.
STIRLING CITY
BUTTE CO.
PLUMAS CO.
LITTLE BUTTE CREEK
WEST BRANCH
Little West Fork
FEATHER RIVER
Big Kimshew Cr.
MIOCENE CANAL
Lime Saddle P.H.
KUNKLE RES.
LAKE OROVILLE
----- TUNNEL OR PIPE
SCALE 1"= 2 1/2 MILES
0 1 2 3 4 5 6
SCALE IN MILES

PLATE 1



SCHEMATIC PROFILE

PLATE 2

Butte Head Dam and Canal

Butte Creek is first diverted by Butte Head Dam about 8 miles (12.4 km) below Butte Meadows, and the diverted water is carried by Butte Canal to De Sabla Forebay. Butte Head Dam is a 95-foot (30 m) long concrete arch structure built in 1917. Its crest elevation of 2884 (864 m) is 42 feet (13 m) above the streambed. The Butte Canal intake is at the east end of the dam and the canal runs 11.53 miles (18.4 km) to De Sabla Forebay. Canal capacity is 91 cubic feet per second (cfs) or 2.7 cubic meters per second (m^3s). Butte Canal also picks up water from Inskip, Kelsey, Stevens, and Clear creeks along its route.

De Sabla Forebay

De Sabla Forebay is a small lake created by an earthfill dam originally built in 1903 and modified in 1962. The lake covers 14.9 acres (6 hectares) and stores 188 acre-feet (225,600 cubic meters) of water at elevation 2755 (826 m). The reservoir level does not normally fluctuate. Water from De Sabla Forebay is routed to De Sabla Powerhouse by penstock or into Upper Centerville Canal by an outlet on the southwest side of the Forebay.

Upper Centerville Canal

Upper Centerville Canal is 5.1 miles (8.2 km) long with a capacity of 35 cfs (1.1 m^3s). The canal serves homeowners along its length and sometimes conveys water that is surplus to the capacity of the De Sabla Powerhouse. The surplus is used to augment flows in the Lower Centerville Canal by spillage into Helltown Ravine. Low flow in this canal is presently about 2 cfs (0.06 m^3s).

De Sabla Powerhouse

De Sabla Powerhouse is a horizontal Pelton-wheel generating unit in the bottom of Butte Creek Canyon. The existing powerhouse was built in 1962 and generates at a normal operating head of 1530 feet (460 m). Dependable capacity is 18,000 KW. Water flows from the powerhouse into Butte Creek and is again diverted about 500 feet (150 m) downstream by the Centerville Head Dam.

Centerville Head Dam and Lower Centerville Canal

Centerville Head Dam diverts Butte Creek into the Lower Centerville Canal. The dam is a 14-foot (4.2 m) high concrete structure with a spill crest at elevation 1147 (345 m). The canal intake is at the east end of the dam and the canal runs 7.97 miles (12.8 km) to the Centerville power drop. Rated canal capacity is 180 cfs (5.4 m^3s) above and 192 cfs (5.76 m^3s) below Helltown Ravine where flow from the Upper Centerville Canal is added. Emma Ravine and Coal Claim Ravine are two small springs that are diverted into the canal along its route, as are one or two other small feeders.

Centerville Powerhouse

Centerville Powerhouse, built in 1900, is a reaction-turbine generating Unit and an impulse turbine generating unit with normal operating heads of 590 feet (180 m) and 577 feet (176 m) respectively, and a dependable capacity of 3,100 KW.

West Branch Feather River

The West Branch Feather River originates in northeastern Butte County at an elevation of 6300 feet (1890 m) and flows generally southwest at a progressively increasing gradient to Lake Oroville. It is impounded near its source by the small earthen dam that forms Snag Lake.

One mile (1.6 km) below Snag Lake, the West Branch is augmented by Coon Hollow Creek, the first major tributary. The flow is again augmented three miles (4.8 km) downstream by Philbrook Creek and then by Fish and Last Chance

creeks. These combined flows are diverted by Hendricks Head Dam into the Hendricks Canal which then conveys the water to De Sabla Forebay via the Toadtown and Butte canals.

Below Henricks Head Dam, the West Branch plunges into a deep rugged canyon. From elevation 3120 (936 m) located about 1½ miles (2.4 km) below Hendricks Head Dam, the river meanders through sheer rock walls and tumbles over boulders and waterfalls for 18 miles (28.8 km) to the 900-foot (270 m) elevation of Oroville Lake - - a gradient of 123 feet per mile (23 m/km). Big Kimshew and Cold creeks are the only major tributaries in this entire reach. About 7½ miles (12 km) above Oroville Lake, the Miocene Head Dam diverts a maximum of 65 cfs (2.2 m^3s) into the Miocene Canal. The Miocene Canal is not a part of this project but is owned and operated by PG&E.

Snag Lake (Round Valley Reservoir)

Snag Lake is formed by an earth-fill dam across the lower end of Round Valley. The dam was built in 1877, stores 1196 acre-feet (1,435,200 m^3) and covers 98 acres (39.2 ha) when full at elevation 5651 (1695 m). Annual drawdown usually begins in early summer and the lake is dry by mid-August.

Philbrook Lake

Philbrook Lake is formed by an earth-fill dam (completed in 1926) across Philbrook Creek about two miles (3.2 km) above its mouth. The Lake covers 173 acres (69.2 ha) and has a capacity of 5009 acre-feet (6,010, 800 m^3) when full at elevation 5553 (1666 m). The maximum depth is approximately 80 feet (24 m) and dead storage is about 10 acre-feet (12,000 m^3). Philbrook Lake is used solely for power supply storage and recreation. Drawdown normally begins in mid-July and continues to the end of September or mid-October. The U.S. Forest Service maintains two campgrounds at the lake and there are summer homes on land leased from PG&E.

Hendricks Head Dam and Canal

Hendricks Head Dam is a ten-foot high structure at elevation 3256 (976 m) that diverts West Branch Feather River water into the Hendricks-Toadtown Canal. The canal intake is at the west end of the dam and the canal runs 11.09 miles (17.6 km) to join the Butte Canal above De Sabla Forebay. Rated canal capacity is 125 cfs (3.75 m^3s). In addition to 1-2 cfs (0.03-0.06 m^3s) leakage from the dam, all intake in excess of canal capacity is spilled back into the West Branch immediately below the dam. The canal picks up water from Long Ravine, Cunningham Ravine, Little West Fork and Little Butte creeks along its route.

The future plans (year 2020) of the Paradise Irrigation District include enlargement of the Hendricks Canal from the intake to Little Butte Creek. Water from the West Branch would thereby supplement the District's existing storage from Little Butte Creek in Magalia and Paradise reservoirs. The District has neither secured water rights nor made financial arrangements with PG&E for the project.

STREAMFLOW STUDIES

In a series of cooperative studies during 1974 and 1975, personnel of the Department, PG&E and the U.S. Fish and Wildlife Service investigated the trout habitat provided by different flows in the West Branch below Hendricks Head Dam, Upper Butte Creek below Butte Head Dam and Lower Butte Creek below the Centerville Head Dam. The methodology followed that described in Gervais, 1973. A range of flows was studied to observe habitat changes with alterations in flow. The results are presented in Figures 1, 2 and 3. The habitat parameters studied were spawning, food production and resting micro-habitat and the flows examined were about 4, 8, 16 and 32 cfs (0.12, 0.24, 0.48 and 0.96 m^3s) PG&E, 1976.

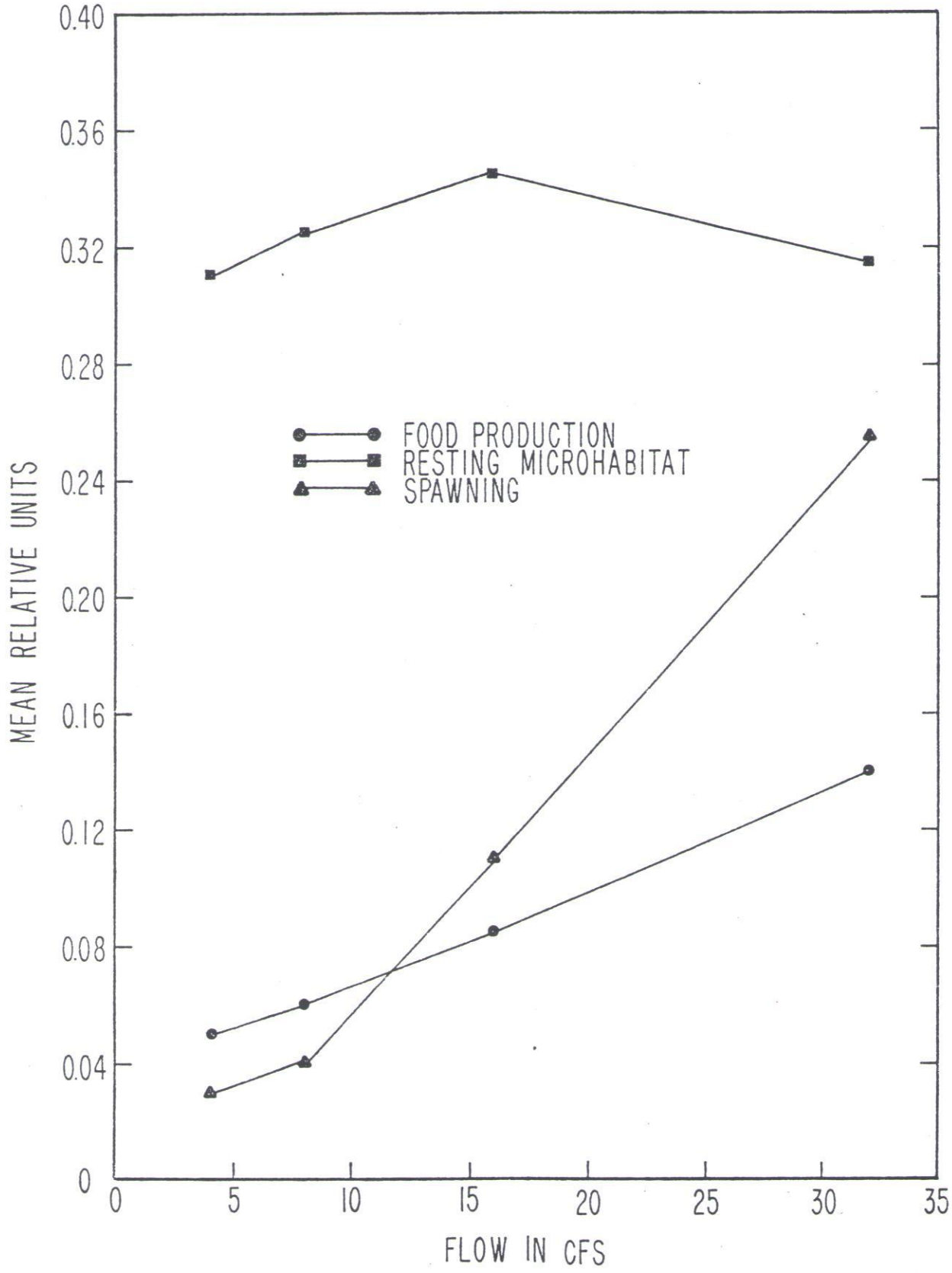


FIGURE 1. Trout habitat studies, Upper Butte Creek.

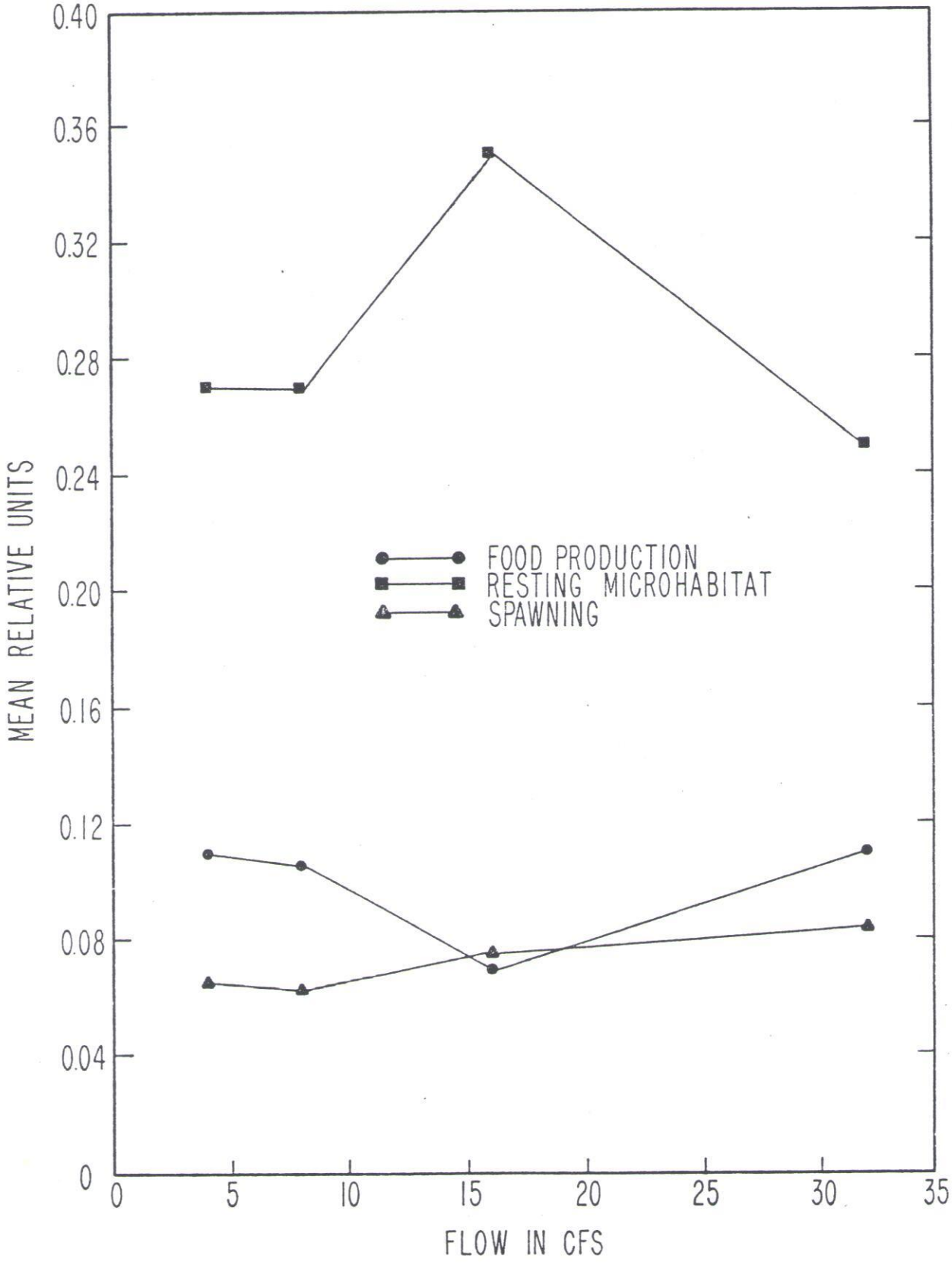


FIGURE 2. Trout habitat studies, Lower Butte Creek.

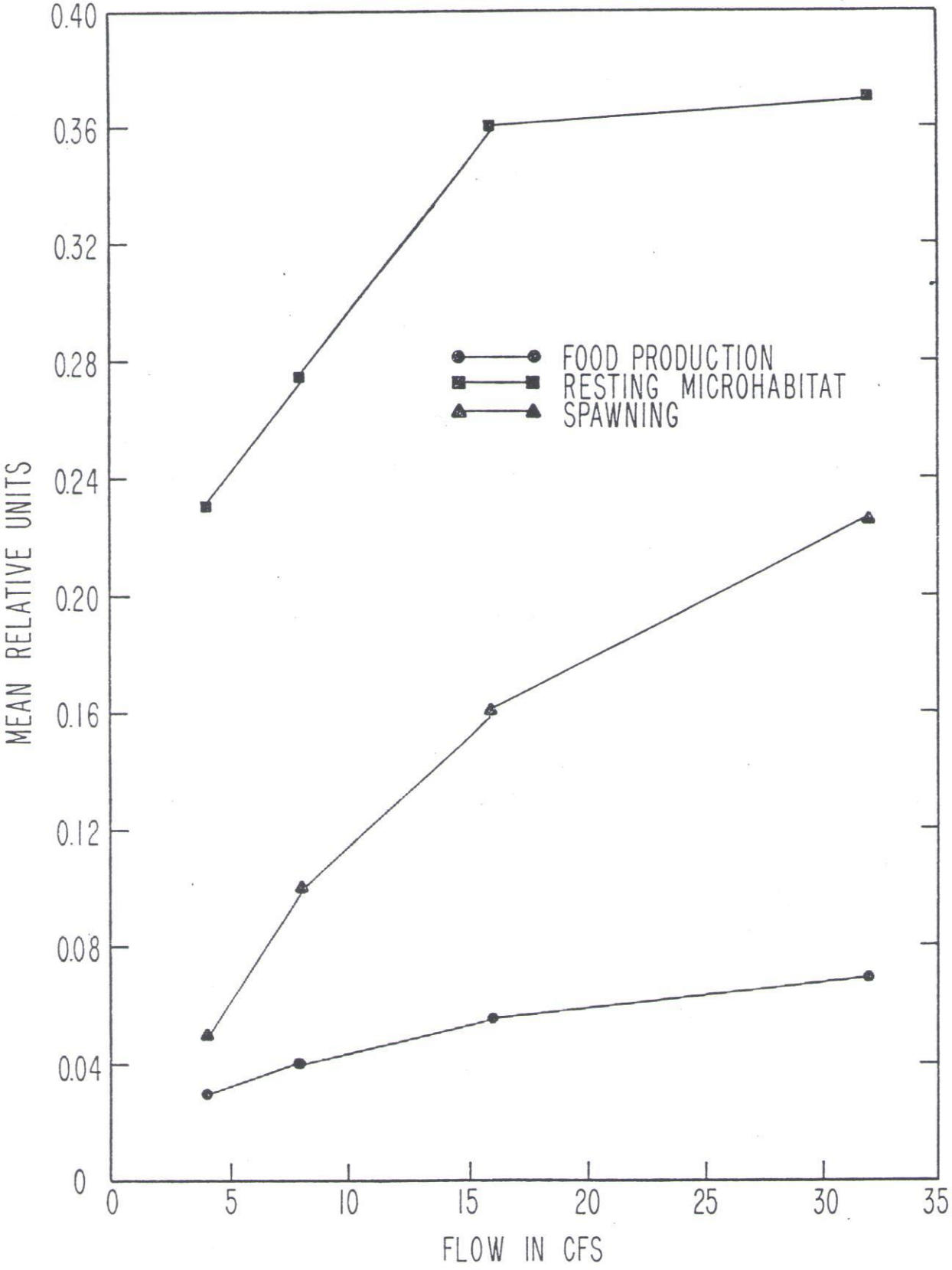


FIGURE 3. Trout habitat studies, West Branch Feather River.

These studies resulted in flow recommendations which were the rates at which trout habitat was greatest for the amount of water released. These flow recommendations should not be construed to be the optimum flow for fish life.

FISH RESOURCES

Butte Creek

Resident Trout

Trout, as used in this report, refers to catchable-size fish 6 inches (15 cm) or longer. Production estimates are for the fall population only.

Butte Creek is a trout stream from its headwaters to the lower end of Butte Creek Canyon at the Centerville Powerhouse. The high-meadow area near Butte Meadows attracts many anglers because of substantial populations of brown and rainbow trout (Salmo trutta and S. gairdnerii). The stream is very accessible and easy to fish. Each summer, the Department augments the abundant population of wild trout with 6,000 rainbow trout planted near Butte Meadows at three week intervals.

Each year the canyon area, despite its extremely rugged nature and very limited access, lures a substantial number of anglers. It provides an air of remoteness and an opportunity to catch large - - 15-inch (38 cm) or larger - - trout within a relatively short distance from the cities of Chico and Oroville.

In the unimpaired reach above Butte Head Dam, Butte Creek produces about 2,500 trout per mile (1563 per km). This estimate is based on electrofishing and visual survey data gathered in 1976 and on file in Region 2, Department of Fish and Game.

The trout population is drastically less in the six miles (9.6 km) from Butte Head Dam downstream to Forks of Butte where West Branch Butte Creek

joins the stream. After the spring runoff, major portions of this reach either dry up completely or are reduced to a series of warm, barely-connected pools. Trout production falls to about 50 fish per mile (33 fish per km). Production increases, however, to about 200 trout per mile (125 per km) for the $3\frac{1}{2}$ miles (5.4 km) between Forks of Butte and De Sabla Powerhouse. Production estimates were made by visual observations in 1975 and 1976.

Seasonally, Butte Creek below the Centerville Head Dam is again almost totally dewatered. For about two miles (3.2 km) downstream, large deep pools maintain small populations of trout. In the lower reaches of this $6\frac{1}{4}$-mile (10 km) section, however, the water is too warm for good trout production and the stream has become the province of suckers and a few large squawfish. Visual observations (1972 and 1975) by the senior author revealed a low level of trout production in Butte Creek below Centerville Head Dam. The estimated population was about 20 trout per mile (13 per km).

Inskip Creek within 100 yards (90 m) of its mouth, is diverted into the Butte Canal. Kelsey, Stevens and Clear creeks are diverted within 300 yards (270 m) from their mouths and therefore these stream sections are not considered to support a significant fishery, even if an adequate minimum flow release could be secured. Trout from Butte Creek cannot ascend these streams because of impassable falls near the mouths of the streams.

If it can be assumed that the production observed above Butte Head Dam would obtain in the rest of the canyon at unimpaired flows, then the project diversions result in an annual loss in production capability of approximately 38,000 trout in 15-3/4 miles (25.2 km) of Butte Creek.

Below Centerville Powerhouse, Butte Creek supports a varied fish population dominated by suckers and squawfish.

Salmon and Steelhead Trout

Butte Creek has historically produced runs of king salmon (Oncorhynchus tshawytscha), and steelhead rainbow trout. Both species originally spawned in the canyon, but the project dams and diversions have limited them to the reach of stream below Centerville Powerhouse. Three races of king salmon - - fall, winter, and spring runs - - presently spawn in Butte Creek.

The fall run has only recently been studied. The fish migrate upstream in October-December and spawn as soon as they reach their spawning grounds below Highway 99. The young probably move downstream on the relatively high flows of spring and early summer. The fall run has been extensively studied in the adjacent Feather and Sacramento rivers, and there is no reason to believe their behavior varies in Butte Creek. In 1971, carcass surveys were initiated and separation of fall and spring run estimates were made (formerly combined estimates). Enumeration of the fall run is based on carcass and live fish counts in salmon spawning areas downstream from Centerville. Estimated fall runs have been as follows:

1971 - 600

1972 - 450

1973 - no estimate

1974 - 200

1975 - 1,000

1976 - 640

The spring-run salmon is a declining race in California primarily because of water development projects. This fish migrates upstream in April and May,

summers in deep holes in cold water and then spawns in late September through early October. In the few drainages having spring runs, downstream movements of young probably vary. It was originally believed that young salmon in Butte Creek migrated immediately upon emergence from the gravel in December-January, but recent evidence suggests that some migrate downstream in May as 3-4 inch (7-10 cm) smolts. The spring-run salmon is a prized sport fish when newly arrived from the sea and has historically provided a good fishery in Butte Creek. The estimated run size has ranged from under 100 to nearly 22,000 fish over the past 20 years (Table 1). With only two exceptions, the estimated run has been under 350 salmon since 1965.

The winter-run (also known as late-fall run in the Sacramento River) salmon migrates up Butte Creek in January-February and spawns immediately after arriving at the spawning beds. Because this fish migrates upstream during high and muddy water periods, it is rarely seen, and little is known about its life history. The winter run fish contribute to the ocean sport and commercial catch but are seldom caught in Butte Creek.

Project dams and diversions in Butte Creek have had an adverse impact on spring-run salmon and steelhead. Both species originally migrated far into the canyon - - some steelhead probably going as far as Butte Meadows (R. Hallock, Citizens Advisory Committee, 1971, personal communication).

The project has decreased flows in about 15 miles (24 km) of spawning and nursery areas for salmon and steelhead in the reach from Butte Head Dam to Centerville. The unimpaired flow through the canyon once provided cool water in many large holes that could accommodate thousands of adult salmon. The steepness and remoteness of the canyon protected the fish from men, bears, and other predators. When autumn came, the salmon, unstressed by either warm water or human activity, moved to adjacent spawning gravels in good condition.

TABLE 1

Butte Creek Spring Run Salmon

Estimated Spawning Escapement, 1954-1976[1/]

Year	Number	Year	Number
1954	2,000	1966	124
1955	300	1967	211
1956[2/]	3,000	1968	80
1957	1,400	1969	670
1958	436	1970	240
1959	170	1971	227
1960	21,900	1972	62
1961	5,400	1973	314
1962	1,750	1974	148
1963	5,333	1975	650
1964	422	1976	46
1965[2/]	1,000		

1/ Except as noted, estimates are expanded from annual carcass, redd, and live salmon counts. A minimum run size was established from fish actually seen. The total run was then extrapolated by adding a number of fish calculated from observed redds and adjusting that total to account for variations in weather and methodology.

2/ From Menchen, 1966

Now, the salmon are forced to hold below Centerville Powerhouse and, almost daily are harassed by "tubers", swimmers, poachers, and curious people. They are usually in poor condition when they spawn and this adversely affects reproduction and survival of young.

Flows in Butte Creek below Centerville Powerhouse are augmented by water diverted from the West Branch Feather. Although the augmented flow makes available about 20 percent more gravel for spawning, this increase is less than half of the spawning gravel lost in the stream above the powerhouse - - a loss attributable to project construction and operation.

Most salmon that do swim past the powerhouse in spring fail to survive. High water temperatures in the summer kill many, and the quiet and transparent water invites poaching. The fish that do survive cannot find suitable flows for spawning in the reach above Centerville. Although cold water exists above De Sabla Powerhouse, few salmon negotiate the leap over Centerville Head Dam. In 1975, however, two PG&E employees reported seeing two salmon leap the falls adjacent to De Sabla Powerhouse.

Steelhead are now a rarity in the Butte Creek system. The barrier to upstream migration posed by Centerville Head Dam and the inability of the downstream pools to support substantial numbers of adults and smolts has resulted in near extinction of the Butte Creek steelhead. Restoration of the steelhead resource would require installation of a fish passage facility on Centerville Head Dam, the release of sufficient water to restore nursery and adult holding conditions below Centerville Head Dam and Butte Head Dam, and the planting of sufficient yearling steelhead to initiate a run.

Attainment of pre-project flows, alone, would not result in pre-project conditions for salmon and steelhead. In the 50 years since the first project diversions, massive changes detrimental to anadromous fish have occurred downstream from Centerville. Heavy diversions through unscreened structures, lowland drainage, and "bare bank" maintenance policies have taken heavy tolls but in

recent years, 11 diversions and barriers downstream from Centerville have been laddered or altered to assist salmon migration. One of the most recent projects involved expenditure of $60,000 by the U.S. Fish and Wildlife Service for construction of a fish ladder and weir on the west channel of Sutter Bypass. In addition, the Department of Water Resources is planning an equivalent or greater expenditure for fish passage facilities at Gilsizer, Willow and Nelson sloughs (east channel of Sutter Bypass). However, even in the face of present-day debilities, a natural Butte Creek would probably produce an average run of at least 2,000 spring salmon and 1,000 steelhead (estimate based on runs in similar streams). Considering that the average annual run is 300 fish, the project has resulted in an annual loss of 2,700 anadromous fish spawners. In terms of the sport and commercial fishery impact, the loss to the ocean/Sacramento River/lower Butte Creek fisheries would be about 1,000 steelhead and 5,100 salmon; because the steelhead catches generally equal the number of fish reaching spawning grounds, and salmon catches are about three times the spawning population.

7 who says?

West Branch Feather River: Trout

The West Branch Feather River is a fine trout stream from Coon Hollow Creek downstream to Hendricks Head Dam (about 13 miles or 21 km). This stream section is readily accessible, and annually yields brown and rainbow trout over 15 inches (38 cm) in length. Throughout the section, the stream has an average population of 1,800 trout per mile or 1100 per km (extrapolation from electro-fishing and visual observation data on file, Region 2, Department of Fish and Game). The natural population is annually augmented by the Department with 5,000 rainbow trout planted three weeks apart during the summer.

Following spring runoff, the six miles (10 km) of the West Branch between Hendricks Dam and Big Kimshew Creek are essentially dewatered. Large holes in this reach sustain trout through most summers, and they yield fine catches of brown and rainbow trout in the spring. Trout production in this reach is approximately 100 fish per mile (60 per km).

The flow is partially restored to 10-15 cfs (0.3 - 0.45 m^3s) by Big Kimshew Creek and this flow is maintained through six miles (10 km) of canyon above the Miocene Head Dam. This section of stream is confined within extremely rugged canyon walls that allow little access. Angler penetration into this reach is minimal, and overall fishing use is very light.

Below Miocene Head Dam, the West Branch is again seasonally dewatered and reduced to a series of pools for the remaining 7½ miles (12 km) to Lake Oroville. Annual losses of trout in this section are high because of high water temperatures and stagnation of pools during the summer. Spring trout fishing results in a fair yield, but late summer survival is very low. The Miocene project is operated by PG&E but is not under jurisdiction of the FPC.

In the 13½ miles (21.6 km) of seasonally dewatered stream from Hendricks Head Dam to Big Kimshew Creek and from Miocene Head Dam to Oroville Reservoir, the De Sabla project diversions effect an annual loss in production potential of at least 23,000 trout. In addition, an unquantified but substantial loss of trout production occurs in the reach between Big Kimshew Creek and Miocene Head Dam.

Snag and Philbrook Lakes

Snag Lake is drained completely each year and therefore does not support a fishery.

Philbrook Lake inundated 1½ miles (2.4 km) of Philbrook Creek. Because it is annually drawn down to less than ten acre-feet, it has been of limited value as a fishery. It was formerly planted with 6,000 rainbow trout each summer, but this program was terminated after a 1974 reward tag study showed that only 28 percent of the fish were caught, and that few survived the winter. There are two U.S. Forest Service campgrounds and numerous summer cabins at Philbrook. PG&E has, in exhibit R (PG&E, 1976), proposed to improve angling access and recreational facilities at Philbrook Lake.

Philbrook Creek

The two miles (3.2 km) of Philbrook Creek from Philbrook dam to the West Branch are of limited importance as a fishery because of low autumn flows, steep gradient, and frequent dewatering by the project. In its pre-project state, the creek was an important source of small trout (less than 6 inches or 15 cm) which grew to catchable size in the West Branch. The estimated productivity of the creek is 100 trout per mile (60 per km) and therefore, in terms of production potential, the project results in a loss of 200 trout annually.

De Sabla Forebay

De Sabla Forebay sustains a population of brown trout with many fish in the trophy class (over one pound or 0.45 kg). The estimated size of the population based on limited creel checks is about 200 trout per acre (500 per ha) or 3,000 trout.

De Sabla Forebay is also a very popular roadside catchable trout pond. Each year the Department plants about 10,000 trout with plants spaced at three-week intervals during the summer. A 1974 reward tag study showed approximately 90 percent of these trout are caught. The pond affords easy, safe access to shore anglers, and the PG&E Camp De Sabla provides small boats for its residents (PG&E employees).

Project Canals

Where project canals possess natural gravel, rock, or sand bottoms, aquatic insects are found and trout production occurs (Photos 5 and 6). Where canals are bottom-lined with concrete or other impervious material, living space for aquatic organisms, including trout, is eliminated.

The 35.7 miles (57 km) of canals provide early season angling for both brown and rainbow trout. Easy access is afforded by the maintenance trails that parallel the canals. The canals are fast flowing, have few eddies, and do not provide the best type of trout habitat. They are also drained periodically each year for inspections or during maintenance and repair of canals or powerhouses.

Despite these conditions, Butte Canal produces about 20 trout per mile (13 per km) or 230 trout in the 11.5 miles (18.5 km) of canal, Hendricks-Toadtown Canal supports about 200 trout per mile (130 per km) or about 2,200 trout in 11 miles (17.6 km), the Upper Centerville Canal about 100 trout per mile (65 per km) or about 500 in 5 miles (8 km), and the Lower Centerville Canal about 20 trout per mile (13 per km) or about 160 trout in 8 miles (13 km) of canal. Estimates result from visual counts during maintenance drawdowns in September-October, 1976.

WILDLIFE RESOURCES

Project Impact on Wildlife

Studies of the impact of the De Sabla-Centerville project on wildlife have included examination of reservoir basins, inspection of canal-side habitat and crossings for wildlife, and observations of wildlife entrapped in the canals. Some of the studies were cooperative efforts by the Department, U.S. Fish and Wildlife Service and PG&E.

Snag, De Sabla, and Philbrook lakes inundated about 285 acres (114 ha) of wildlife habitat, including about 115 acres (46 ha) of meadow and 170 acres (68 ha) of upland (primarily coniferous and deciduous forest). Meadow habitat is a critical habitat type in the project area because of its scarcity and high value to deer, grouse, and many nongame species.

Privately owned meadows in the area have been degraded by erosion of streambanks and deepening of the stream channel. These processes cause meadows to dry up and thereby decrease their forage value in late spring and early summer for deer, particularly does and fawns.

The meadow and upland habitat within the area of influence of the project support a major part of the Bucks Mountain Deer Herd. This herd, which is found in northeast Butte County and western Plumas County, has declined in recent years. The legal buck kill (forked-horns or better) is shown in the following table (No antlerless hunts have been held in this period).

Year	Butte County	Plumas County	Total
1971	689	344	1033
1972	530	259	789
1973	437	178	615
1974	265	141	406
1975	251	169	420

Some waterfowl nesting occurs on the lakes - - primarily Canada geese and mallards at Snag Lake. Waterfowl reproduction is limited by nest predation. Other predation losses occur on the occasional years when Snag Lake is drained before the young geese and ducks are able to fly and while adults are rendered flightless during the annual molting period.

The only endangered species known to frequent the project area is the southern bald eagle. No known nest sites of bald eagles are within the project area but eagles do use the project reservoirs and streams as feeding sites. Measures which increase fish populations would incidentally benefit the eagles.

Project canals changed about 40 acres (16 ha) of upland habitat into artificial streams with some benefits to riparian vegetation, another critical habitat type.

About 50 deer and an unknown number of smaller animals annually drown in project canals because of their steep sides, cold water, high velocity, and location (They traverse water-scarce areas and commonly-used migration routes). Losses of deer in project canals seem to be in direct proportion to their abundance in the area.

Project roads, powerhouses, employees' housing and related facilities have removed about 50 acres (20 ha) of habitat - - primarily upland type - - from wildlife use. Project transmission lines and their maintenance in second-growth, have, however, benefited wildlife by opening up dense forest and creating a diversity of habitat.

The De Sabla-Centerville Project has, in total, removed about 375 acres (150 ha) from wildlife use, including 115 acres (46 ha) of critical meadow and 260 acres (104 ha) of upland types.

Conclusions

The diversions of the De Sabla-Centerville project have resulted in annual loss of at least 61,000 resident trout and 2,700 anadromous fish from Butte Creek and the West Branch Feather River. As a result of cooperative studies of the project's influence on fish life, the Department has formulated recommendations to mitigate the detrimental impacts (Table 2).

Recommendations

A. Fisheries Mitigation Measures

1. Philbrook Lake and Philbrook Creek

a. A minimum pool of approximately 30 acres (12 ha) or 250 acre-feet (300,000 m^3) corresponding to elevation 5505 (1652 m) should be

TABLE 2

IMPACT OF PROJECT ON RESIDENT TROUT

Water	Existing		Potential 3/	
	Gain	Loss	Gain	Loss
De Sabla Forebay	3,000	--	3,000	--
Hendricks-Toadtown Canal	2,200	--	3,300	--
Butte Canal	230	--	1,380	--
Upper Centerville Canal	500	--	500	--
Lower Centerville Canal	160	--	960	--
Philbrook Reservoir	--	--	3,000	--
Snag Lake	--	--	--	--
Philbrook Creek	--	200	--	--
Butte Creek	--	38,000	--	12,670
West Branch Feather River	--	23,000	--	7,670
Totals	6,090	61,200	12,140	20,340
Net	--	55,100	--	8,200

3/ Provided Department recommendations are followed.

maintained. This would maintain sufficient depth to prevent winter-kill and thereby allow over-winter survival of trout. It would then be possible for the Department to provide a trout fishery based on small fish surviving over the winter. Based on productivity of comparable waters, the estimated carrying capacity of the minimum pool would be 100 trout per acre (250 per ha) or a total of 3,000 trout.

b. A minimum flow of 2 cfs (0.06 m^3s) should be maintained in Philbrook Creek below Philbrook Lake for the entire period of storage. When storage has reached the minimum pool, all inflow of 2 cfs (0.06 m^3s) or less but not less than 0.1 cfs (0.003 m^3s) should be allowed to flow through the lake and down Philbrook Creek. This would reestablish the two miles (3.2 km) of creek as an important recruitment source for the West Branch Feather and would provide a fishery for small trout.

2. West Branch Feather River

A minimum flow of 16 cfs (0.48 m^3s) should be maintained below Hendricks Head Dam and allowed to pass unimpaired to Oroville Lake. This flow could result in restoration of the fishery in 18 miles (28.8 km) of seasonally dewatered or partly dewatered stream to approximately two-thirds the level expected from the unimpaired stream.

3. Butte Creek

a. A minimum flow of 20 cfs (0.6 m^3s) should be maintained in Butte Creek below Butte Head Dam and allowed to pass unimpaired through the canyon to Centerville powerhouse. This flow would provide rearing area not only for resident trout but also for young salmon and steelhead. It would restore spring-run salmon holding areas.

b. The Centerville Head Dam should be laddered to afford passage to salmon and steelhead trout.

c. The Department should be reimbursed, in amounts not to exceed $4,000 per year, for the costs of a five-year attempt to reestablish a steelhead run in Butte Creek. Funds would be used to rear and plant yearling steelhead and to estimate steelhead runs resulting from the planted fish.

These efforts can be expected to result in the restoration of Butte Creek spring salmon runs to approximately 1,000 fish, steelhead runs to 500 fish, and trout populations to 1,600 trout per mile (1040 per km).

4. Canal Operations

a. The canals should remain open to the public for hiking and fishing.

b. Drawdowns for normal maintenance of all canals should be staged down to 5 cfs (0.15 m^3s) over a 24-hour period and 5 cfs (0.15 m^3s) maintained at all times, except for the Upper Centerville Canal where the existing 2 cfs (0.06 m^3s) minimum flow appears adequate.

c. Flow bypasses should be used while working on powerhouse equipment and a minimum flow of 5 cfs (0.15 m^3s) maintained in the canals during this period.

d. To afford better surveillance to protect the fisheries, the Department should be notified at least ten days in advance of all canal drawdowns. Notification of scheduled drawdowns should be by letter, and notification of emergency drawdowns should be accomplished by telephone with a follow-up letter.

e. Chemicals or pesticides in concentrations that are toxic to fish are not now and should not in the future be used in the canals or flushed from the powerhouses.

f. Those sections of project canals which now have natural bottoms should not be bottom-lined.

The above-recommended provisions would allow greater angler harvest and sustain an additional 100 trout per mile (60 per km) or 3,050 trout in the enhanced reaches of the canals.

The total effect of the above fisheries mitigation recommendations is summarized in Table 2.

B. Wildlife Mitigation Measures

To mitigate project-caused wildlife habitat losses and minimize drowning of wildlife in project canals, the following measures should be instituted by PG&E and maintained for the life of the project:

1. Snag Lake should be kept full until July 15 of each year to allow young waterfowl to reach flying stage before the lake is emptied. An alternative could be the creation of 5 acres (2 ha) of permanent shallow ponds in the upper reaches of Snag Lake by excavation and diking.

2. Five goose nesting sites should be installed in the upper end of Snag Lake to improve nesting success.

3. One hundred acres (40 ha) of new or improved wet-meadow habitat should be created in the vicinity of the project through measures such as:

   a. Conversion of tree or brush covered areas to meadow by clearing and irrigation.

   b. Restoration of existing meadow area or creation of new wet-meadows in cooperation with the U.S. Forest Service or private landowners, for example on the meadow area above Snag Lake.

   c. Irrigation of areas adjacent to existing project canals or through rejuvenation of the old Dewey or Miner's canals.

4. Drowning of deer and other wildlife in project canals should be minimized by adoption of the following measures:

   a. Deer crossings: New crossings (at least 3 feet wide with a non-skid surface) should be provided at various locations on project canals. Wing fencing should also be provided to direct deer to the crossing structures. The locations are:

      (1) Butte Canal: Seven new crossings are needed, and all existing crossings should be modified to allow deer to use them safely. The new crossings are required between flumes 1/9 and 2/1, between mile post 3¼ and flume 3/3, between flumes 4/2 and 4/3, between flumes 5/3 and 5/4, between mile posts 9 and 9¼ (two crossings) and at Station 541-20.

Short reaches of fencing are needed in about 15 locations to block access to the canal and direct deer to a more desirable crossing. The total length of needed fencing would be about 1,000 feet (330 m).

(2) Lower Centerville Canal: Five new crossings should be installed on this canal. The locations are: Above flume 2/8, above mile post 5¼, above flume 5/6 (two crossings required), and below mile post 7. In addition, short lengths of fencing are needed in 15 locations to block access to the canal and direct deer to a more desirable crossing. The total length of fencing would be about 1,000 feet (330 m)

(3) Hendricks-Toadtown Canal: New deer crossings (four) are needed at the following locations: At flume 2/3, between mile posts 3½ and 3-3/4, above the sand trap at mile post 5, and at mile post 5-3/4. In addition, short reaches of fencing are needed in 10 locations to block animal access to the canal and move deer to a more desirable crossing. The total length of required fencing would be about 200 feet (67 m).

b. The above crossings and fencing would reduce but not completely prevent large animal entries into the canals. To assist deer in escaping from the canals, adequate flashers, deer escape ramps, ane one-way gates, should be installed at the following sites:

(1) Butte Canal: Fifty feet (15 m) above mile post 10 and at the entrance to Cape Horn Tunnel.

(2) Lower Centerville Canal: Three hundred and thirty feet (100 m) above penstock, below end of road from Camp No. 4, and above tunnel at mile post 3-3/4.

(3) Hendricks-Toadtown Canal: One quarter mile (400 m) below Station 184-80, at tunnel opening at Station 391-09, and between mile post 8¼ and tunnel.

Evaluation of Mitigation Measures

The Federal Power Commission should retain jurisdiction over the project's fish and wildlife mitigation measures and, at ten-year intervals after issuance of the new license, require evaluation of the effectiveness of mitigation. In this way, mitigation measures which may not be completely effective may be modified or improved and new techniques or more cost-effective measures applied.