

THE FRESHWATER FISH AND FISHERIES OF THE SAN FRANCISCO BAY AREA

HISTORICAL REVIEW

The freshwater fish fauna of the San Francisco Bay Area is quite varied and supports a large angling population. This was not always so, however; the area originally was deficient in natural lakes and warmwater streams and the many varieties of so-called warmwater or spiny-rayed gamefish. The only native warmwater gamefish found here was the Sacramento perch (*Archoplites interruptus*).

Salmonids on the other hand inhabited virtually every stream. Native populations of rainbow trout (*Salmo gairdneri*) were found in most streams with a year-around supply of cool water. Silver salmon and steelhead also favored the cooler waters and utilized many of the intermittent streams for spawning.

Salmonids as a group have always been particularly favored both for food and sport and even in the early days of San Francisco were heavily exploited by anglers. Besides angling they were taken by spears, traps, weirs, explosives and any other available means.

As the population of the Bay Area increased between 1850 and 1890, the local redwood forests were timbered off and public water supplies were developed. Coastal streams suffered from pollution by sawdust, grist, and siltation. The streams were obstructed by log jams and were dammed to form water supply reservoirs and to harness their energy for the operation of sawmills and flour mills. Records of the Fish and Game Commission relating to this early period indicate the local salmonid fisheries suffered a severe setback.

It is of passing interest to note that the first hatchery and fish cultural station in California was established on the grounds of the University of California at Berkeley in 1869. The station, operated by "The California Acclimatization Society", and operated under the supervision of Mr. J. G. Woodbury, sold the fish to the State Fish Commission.

Immediately after the legislature established the State Board of Fish Commissioners (1870) this body set about to import prominent gamefish species of the East and Midwest. The black basses, panfishes (green sunfish, bluegills, etc.) catfishes, perches, and eastern brook and brown trout were among the freshwater varieties introduced. Most of them did extremely well in their new environment. As a matter of fact, the introduced species now sustain virtually all warm-

water angling in the Bay Area. The more common freshwater fish species are listed in Appendix F-1. Initial introductions of selected species now occurring in the Bay Area are given in Appendix F-2.

About 1884 the State Board of Fish Commissioners was concerned about the vanishing Sacramento perch. The species was disappearing at an alarming rate, presumably because of overfishing and reclamation. More recently, the introduction of alien species also has been blamed for the perch scarcity.

Sacramento perch and several non-game varieties found their way into the San Francisco commercial trade to some extent before 1870. They were obtained by seining in the Delta, in the lower reaches of the rivers tributary to the Delta, and in Clear Lake, Lake County.

The largemouth and smallmouth basses (*Micropterus salmoides* and *Micropterus dolomieu*) respectively, both highly esteemed as food and gamefish in the East and Midwest, were among the first varieties brought to California. They were brought out by Livingston Stone in 1874 and stocked in Alameda Creek and the Napa River. By 1890, most of the suitable lakes and streams in the Bay Area were well stocked with them.

The white catfish (*Ictalurus catus*) and brown bullhead (*Ictalurus nebulosus*) were introduced by Stone in 1874. Panfish and crappies were first introduced between 1890 and 1891 into Southern California and made their way to Bay Area waters through later transplantations.

White catfish and brown bullheads increased at such a prolific rate that they supported a substantial commercial fishery from the turn of the century until 1953 when the fishery was abolished by the legislature. Most of the catch, though landed at Pittsburg, was made in the Delta. Special fyke nets were employed.

Other freshwater species entering the commercial catch included carp (*Cyprinus carpio*), which were first introduced from Europe in 1872, and the native hardhead (*Mylopharodon conocephalus*), squawfish (*Ptchocheilus grandis*), splittail (*Pogonichthys macrolepidotus*), and Sacramento blackfish, (*Orthodon microlepidotus*). For the most part the latter species were taken incidental to shad and salmon by the Pittsburg fleet and landed at either Pittsburg or San Francisco. The Department of Fish and Game issues special permits to commercial operators to fish for some of these

species in certain inland waters infested with them. The quantity taken each year through 1958 is shown in Appendix B-2 under the heading "Commercial Freshwater Fisheries". Catfish landings are shown under the same heading. The fishery was discussed briefly in the commercial fisheries section of this report.

Lack of data makes it impossible to evaluate the freshwater sport fisheries of the past. Sport fishery surveys and censuses are of recent origin, and even these encompass but a small proportion of the fisheries.

ANGLING PRESSURE

General information concerning angling in the region, as compared to the state as a whole, is available from postal card surveys: Calhoun (1953), Skinner (1955) and Ryan (1959). It was estimated on the basis of these surveys that approximately 30 percent of the State's angling population resided in the Department of Fish and Game's Administrative Region 3, a considerably larger area than that encompassed by this report. (See Figure 3 and Figure 5.)

The catch of trout, river salmon and steelhead in this Region is on the order of ten, nine and seventeen percent, respectively, of the state-wide totals for these species. Black bass, catfish and panfish each represent 20 to 25 percent of the state-wide totals as judged from the postal surveys. The catch by species and percentage contributed to the state-wide catch of each is shown for Region 3 in Table 38, for five different years between 1951 and 1957. The percentage of anglers catching the above species in Region 3 is shown in Table 39. Table 38 gives an indication of the species contribution to the state-wide totals, while

the latter indicates angler preference and the relative proportion of anglers fishing for selected species in Region 3 as compared with the rest of the State. The number of anglers residing in the region was estimated at 307,000 and 323,000 in 1951 and 1953, respectively. This represented 29.7 and 27.0 percent of all licensed anglers in those years.

CLASSIFICATION OF FISHERIES

In general, the warmwater fisheries have been expanded through construction of water storage reservoirs, while stream habitat, supporting salmon, steelhead, and resident trout has decreased because of water development.

The continued growth of the Bay Area has resulted in a steady increase in storage reservoirs for municipal and industrial water supply and irrigation purposes until there are now more than 50 of them distributed throughout the nine Bay Area counties. As a consequence, there has been a steady increase in lacustrine habitat and fisheries. Most reservoirs are best suited to warmwater species, but a few, those too cool or fluctuating to support a good warmwater population, are often managed as trout lakes. Regardless of the type of fishery, all are potentially valuable recreational areas. Unfortunately many of the reservoirs used for domestic water supply are not open to the public for fishing or recreation.

Warmwater species, once stocked in a suitable environment, are usually able to maintain themselves, thus rarely necessitating restocking. Frequently, the fish become too abundant for the available food supply causing stunted fish. Such fish, though only a few

TABLE 38

ESTIMATED CATCH OF SELECTED GAMEFISH SPECIES BY ANGLING IN SAN FRANCISCO ADMINISTRATIVE REGION ¹

	Trout	Black Bass	Catfish	Panfish	River Salmon	Steelhead	Striped Bass
1951	1,767,000 (9.9) ²	170,000 (13.5)	709,000 (16.5)				770,000 (52.0)
1953	1,840,000 (8.8)	540,000 (24.6)	920,000 (14.9)		15,000 (7.4)	34,000 (12.9)	730,000 (54.5)
1954	993,000 (3.7)	486,000 (20.8)	1,713,000 (25.9)	1,648,000 (15.0)	14,000 (7.0)	75,000 (18.3)	747,000 (65.9)
1956	1,983,000 (7.4)	326,000 (12.7)	1,511,000 (22.8)	2,319,000 (22.2)	18,000 (8.7)	64,000 (17.8)	406,000 (46.5)
1957	4,562,000 (14.6)	681,000 (28.5)	3,020,000 (36.3)	2,768,000 (34.4)	25,000 (12.8)	110,000 (20.5)	1,087,000 (60.1)

¹ Data from postal survey estimates, Calhoun (1953), Skinner (1955) and Ryan (1959).

² The figures in parentheses are percentages of statewide totals of each species for the year cited.

TABLE 39

PERCENTAGE OF ALL CALIFORNIA ANGLING LICENSEES REPORTED HAVING CAUGHT SELECTED SPECIES IN THE SAN FRANCISCO ADMINISTRATIVE REGION 3

	1951	1953
Trout	10.8	9.3
Blackbasses	19.7	21.6
Catfish	22.9	16.2
Panfish	16.3	22.3
Striped Bass	47.6	48.7
River Salmon	--	17.3
Steelhead	--	32.6

inches in length, are capable of reproducing, thus further aggravating the situation. Lakes in which this condition occurs are sometimes chemically treated to eradicate the stunted population and are then restocked with a new or different broodstock combination.

Lakes which become infested with carp and other undesirable species which compete with game species are similarly treated and restocked.

The Department of Fish and Game maintains an active program of stocking catchable-size, (7-inch), or, in some cases, subcatchable-size or fingerling trout,

in streams and reservoirs suited to this type of management. In 1957, for instance, the scheduled allotment for the Bay Area included 381,000 catchable-size rainbow trout, 1,400,000 subcatchables, and 50,000 eastern brook trout fingerlings.

Usually trout streams near population centers are subjected to heavy angling pressure and are stocked regularly, provided the habitat is satisfactory and the return to the creel is reasonable. Numerous streams, too remote to be fished heavily, are stocked infrequently or not at all. Although such streams individually support relatively minor trout or steelhead populations, it is possible that they collectively shoulder much of the trout and steelhead angling pressure in the region. Their individual and minor character, however, makes them difficult or impractical to census and evaluate.

In a previous section of the report, it was shown that juvenile silver salmon and steelhead contribute substantially to angling in the Bay Area. Anglers frequently confuse these species with resident trout.

Many streams and lakes are not conducive to natural reproduction of game species, but nevertheless are valuable to the angling public. Thus, cool or fluctuating water-supply reservoirs which will not provide a satisfactory warmwater fishery can be stocked with trout and provide excellent angling, even though such habitat is not suitable for natural trout propagation because most trout require the cool running water of streams for spawning. Trout populations in heavily fished streams often cannot maintain sufficient levels of abundance through natural propagation and require supplemental stocks of fish.

Many of the freshwater lakes and streams of the Bay Area are located on, or flow through tracts of private land. Since most of them have not been open to the angling public, there has been little occasion to survey or stock them. Many of these streams support populations of resident trout and are spawning tributaries for steelhead.

As a means of outlining the freshwater fisheries of the San Francisco Bay Area, a county-by-county tabulation of the more important waters in each is provided.

In general, the freshwater fisheries fall into the five arbitrary categories listed in Table 40, and described below.

Trout Lakes: *These are in most cases water-storage reservoirs or other suitable impoundments under Department of Fish and Game management for trout stocking. A policy of the Fish and Game Commission provides that catchable-size trout be stocked only in those waters where a reasonably high (about 50 percent) percentage return of stocked fish may be expected. Normally, the suggested return can only be met under very intense angling pressures. Natural trout propagation in these lakes is generally lacking. There are a number of water supply reservoirs in the Bay Area with excellent potential as trout lakes and*

recreational areas, which are not now open to the public.

Trout Streams: *This category includes most of the cooler freshwater streams capable of sustaining wild or catchable trout. Many are heavily stocked with catchable rainbow trout and thus provide an easily accessible source of angling near the metropolitan areas. Many of these streams support resident populations of rainbow trout, steelhead, silver salmon, and frequently brown trout. Most streams in this category are utilized in some capacity by silver salmon, steelhead, or trout for natural propagation. Smaller tributaries of an intermittent character may require fish salvage operations by Fish and Game crews when they dry up.*

Warmwater Lakes: *Reservoirs which seasonally become too warm for trout may support excellent populations of black bass, crappie, panfish or catfish, if a minimum pool is provided. There are a number of these in the Bay counties, especially in Santa Clara, Napa and Solano counties. These lakes may support heavy annual fishing pressure. After an initial stocking, they are normally maintained through natural propagation. Many impoundments suitable for warmwater fishing are public water supplies not open to angling at this time.*

Warmwater Streams: *Streams under this heading usually get too warm in the summer and fail to sustain most trout, although brown trout may occur in some of them. The fish population may consist of any combination of small-mouth black bass, crappie, catfish, panfish, and roughfish. Angling pressure on these waters is usually light to moderate.*

Miscellaneous Waters: *The waters in this category are highly variable and generally without a specific management program. They may contain either salmonid, warmwater or brackish water species. In some cases, there may be a minor seasonal fishery for trout or steelhead, in others, perhaps, a sparsely utilized population of warmwater fishes. Angling pressure may vary greatly.*

Three distinct habitat zones are usually evident in the larger tributaries of the Bay. These zones are ostensibly the result of variable salinity and temperature conditions.

Headwaters of the streams are usually pure and cold since they are fed primarily by winter runoff or springs. Such waters are especially suitable for trout and other salmonids. At medium and low elevations, air temperatures are usually much higher and stream flows modified to the extent that the water becomes progressively warmer as it flows downstream.

At some point the stream usually becomes more suitable for warmwater fishes than salmonids. Near the mouth, which is very near sea level, the water becomes brackish to saline and the species which inhabit it are either marine or unique to brackish conditions. Brack-

TABLE 40
TABULATION OF FISHING WATERS IN THE SAN FRANCISCO BAY AREA

County	Trout Lakes	Trout Streams	Warmwater Lakes	Warmwater Streams	Miscellaneous
Alameda.....	None	San Lorenzo Creek Alameda Creek Arroyo Mocho Creek Arroyo las Positas San Leandro Creek Arroyo del Valle Arroyo de la Laguna	Temescal Lake Calaveras Reservoir Lake Chabot San Leandro Reservoir	San Lorenzo Creek Alameda Creek Calaveras Creek	Calaveras Creek Lake Merritt
Contra Costa...	None	Inadequate data to specifically isolate trout streams	San Pablo Reservoir ¹ Martinez Reservoir ¹ LaFayette Reservoir ¹ Mallard Reservoir ¹	Castro Creek San Pablo Creek Walnut Creek	Castro Creek Pinole Creek San Pablo Creek San Ramon Creek Tassajara Creek LaFayette Creek Pacheco Creek Walnut Creek Alamo Creek Pine Creek Sycamore Creek Bear Creek
Marin.....	Alpine Lake Phoenix Lake Lagunitas Lake Bon Tempe Lake Rodeo Lagoon Kent Lake	Olema Creek Pine Gulch Creek Papermill (Lagunitas) Creek Arroyo Nicasio San Antonio	Novato Reservoir	Novato Creek	Novato Creek Rush Creek Gallinas Creek Crystal Lake Bass Lake Pelican Lake Abbott's Lagoon
Napa.....	None	Dry Creek Redwood Creek Conn Creek	Conn Valley Lake (Lake Hennessy) Rector Reservoir ¹ Curry Lake ¹ Milliken Reservoir ¹	Napa River Conn Creek	Leoma Lakes Soda Creek Moore Creek Mill Creek Napa River Napa Slough
San Francisco..	Lake Merced	None	Stowe Lake	None	None
San Mateo.....	Pilarcitos Lake Higgins Creek Reservoir Upper Bean Hollow Lake	San Pedro Creek Tunitas Creek Denniston Creek Purissima Creek Gazos Creek San Gregorio Creek Butano Creek Pescadero Creek San Francisquito Creek	San Andreas Lake ¹ Crystal Springs Reservoir Searsville Lake Lake Lucerne ¹ Lower Bean Hollow Lake	San Francisquito Creek	Alpine Creek ElCorte de Madera Creek Deer Creek Frenchman's Creek LaHondo Creek Lobitas Creek Mindego Creek Pomponio Creek
Santa Clara....	Stevens Creek Reservoir Austrian Reservoir ¹ Lexington Reservoir Almaden Reservoir Guadalupe Reservoir	Arroyo Hondo Creek San Francisquito Creek	Felt Lake (Private) Calaveras Reservoir Calero Reservoir LeRoy Anderson Reservoir Coyote Reservoir	San Francisquito Creek Guadalupe River Coyote Creek Stevens Creek Los Gatos Creek	Guadalupe River Coyote Creek Stevens Creek Arroyo Bayo Packwood Creek Los Gatos Creek Williams Reservoir
Solano.....	None	Suisun Creek	Pine Lake (Private) Lake Herman ¹ Lake Chabot Lake Madigan Lake Frey	Suisun Creek Ledgewood Creek Montezuma Slough	Ledgewood Creek Green Valley Creek Sulphur Springs Creek Montezuma Slough
Sonoma.....	None	None	Petaluma Reservoir ¹	Petaluma Creek Sonoma Creek	Petaluma Creek Sonoma Creek Tolay Creek Napa Slough Calabazas Creek Carriger Creek Adobe Creek

¹ Currently closed to public fishing.

ish portions of creeks and sloughs are frequented by striped bass, are permanent habitat for cottids, gobies, smelt and other forage species, and some are highways for anadromous species.

All listed waters contain forage and non-gamefish of one sort or another, some of which provide limited angling. It should be realized, of course, that some waters do not fit any of the above classifications while others might possibly fit into two or more.

SUMMARY BY COUNTY

Alameda County

Trout Lakes.

There are no trout lakes in the portion of Alameda County discussed in this report.

Trout Streams.

San Lorenzo Creek: This is a steelhead stream which is tributary to San Francisco Bay. It has the usual estuarine fauna near its mouth and trout in the headwaters. The creek has been modified greatly by man and is scheduled for further development. There is some question as to the effect of a recent channelization project on the steelhead runs. Angling pressure has not been investigated recently.

Alameda Creek: During the 1930's, this creek accommodated a steelhead run of fair quality. At the present time, it is managed as a catchable trout stream about 35,000 being planted there in 1957. Angling pressure is generally moderate.

Arroyo Mocho Creek: Like many other streams in the Region, Arroyo Mocho Creek has a small annual run of steelhead and a fairly good resident population of rainbow and brown trout. According to survey records of the 1940's, it received moderate angling pressure and produced nice catches of trout.

Arroyo las Positas, San Leandro Creek, Arroyo del Valle, Arroyo de la Laguna: These creeks contain resident trout populations and may accommodate steelhead. They have not been surveyed as to their present or potential fisheries value and are not under any specific management program.

Warmwater Lakes.

Temescal Lake: This small lake contains the usual warmwater assemblage of largemouth black bass, panfish, catfish and forage fishes. It was chemically treated in 1951 to remove roughfish. The lake receives heavy local use particularly by juveniles.

Calaveras Reservoir: Formerly this lake was characterized by a good annual run of rainbow trout from Arroyo Hondo Creek. Beginning about 1940, they began to disappear. The reason for the disappearance was thought to be the methods employed to control algae. The lake now contains a typical warmwater assemblage of fish, about which little is known. Since it is a water supply reservoir, it is currently closed to public fishing.

Lake Chabot, San Leandro Reservoir: These are water supply reservoirs of the East Bay Municipal Utility District, which is currently studying the possibility of opening some of its reservoirs to public fishing. They contain warmwater species of fish but are closed to public fishing at the present time.

Warmwater Streams.

There are no streams in the portion of Alameda County discussed in this report which could be referred to as typical warmwater streams. Warmwater species of fish, nevertheless, inhabit portions of the following: *San Lorenzo, Alameda, San Leandro, and Calaveras creeks.*

Miscellaneous Waters.

Calaveras Creek: Below Calaveras Reservoir there are mixed populations of trout and warmwater species. Angler use has not been investigated.

Lake Merritt: Situated within the city of Oakland, this tidal basin was designated a waterfowl sanctuary in 1869, reportedly the first in the United States. The fish population is limited to brackish water forms; namely, flounder, smelt, gobies, striped bass and sticklebacks. Children account for light to moderate fishing use of the lake. The lake would appear to be a recreational asset which has not been developed to its fullest potential.

Contra Costa County

Trout Lakes.

There are no trout lakes in the portion of Contra Costa County discussed in this report.

Trout Streams.

The streams in Contra Costa County have not been adequately investigated to permit the separate listing of trout streams. Most of the streams in the county are intermittent but nevertheless contain local trout populations. However, since data are not available to specifically isolate trout streams, they are included in the miscellaneous classification.

Warmwater Lakes.

San Pablo Reservoir: This water supply reservoir supports a population of warmwater fishes, and, in addition, is reported to contain striped bass. Its fisheries value is potential, since it is presently closed to the public.

Martinez, La Fayette, Mallard reservoirs: None of these reservoirs have been investigated to the writer's knowledge, but it is safe to say they contain warmwater fish populations. They are presently closed to the public and, therefore, must be considered as potential fisheries.

Warmwater Streams.

Castro, Pinole, San Pablo, Pacheco, and Walnut Creeks: The part of Contra Costa County encom-

passed by this report does not contain any typical warmwater streams. However, the lower drainages of these waters accommodate a variety of warmwater species.

Miscellaneous Waters.

Castro, Pinole, San Pablo, San Ramon, Tassajara, La Fayette, Pacheco, Walnut, Alamo, Pine, Sycamore, and Bear creeks: These are for the most part small intermittent creeks about which little information is available. Most contain natural trout populations and several have small runs of steelhead. Several have mixed populations of warmwater, game and forage fishes. Lack of data does not permit more detailed description.

Marin County

Trout Lakes.

Alpine Lake: This lake is managed by the Department of Fish and Game as a catchable trout water. Pre-season plants of about 10,000 fish are made each year. It is a large lake with inadequate angling pressure to warrant heavier stocking. However, in 1957, it also received 100,000 sub-catchable trout for experimental purposes. After heavy initial pressure at the beginning of the trout season, use becomes moderate to light. It is a potentially valuable reservoir, capable of heavier angling pressure.

Phoenix Lake: This is another catchable trout lake managed by the Department of Fish and Game. About 25,000 rainbow trout were stocked here in 1957. Plants are made throughout the season. Angling pressure is heavy even though there is a lack of facilities. Warmwater, gamefish, forage and roughfish inhabit and maintain themselves in the reservoir, but conditions are marginal for the gamefish.

Lagunitas Lake: This also is a catchable trout lake under State management. It receives about 30,000 fish each year of which an estimated 70 percent are caught by anglers. As the results indicate, it receives intense angling pressure. Like Phoenix Lake, it is marginal for warmwater species of which several kinds are present.

Bon Tempe Lake: Like the preceding three, this is a catchable trout lake managed by the State. In 1957, it received 15,000 catchable trout and an experimental plant of 50,000 sub-catchables. Angling is heavy initially but fades as the season progresses.

Rodeo Lagoon: This lagoon only recently was put under State management for catchable trout. About 5,000 fish were stocked in 1957. Recreational use is somewhat restricted since the lake is on a military reservation.

Kent Lake: This is a water supply reservoir under State management. It was allotted 100,000 sub-catchable trout in 1957. Like a number of the others, it receives heavy angling pressure at the beginning of

trout season but progressively less thereafter. The lake has the normal assemblage of warmwater species but it is marginal for them.

Trout Streams.

Olema Creek: Natural populations of steelhead, silver salmon and resident rainbow trout are present in this stream. Its overall contribution to the Bay Area must be considered minor, but it is important to local anglers. In the past, dairy pollution was of sufficient severity to warrant an investigation by the Department of Fish and Game which resulted in action by the Regional Water Pollution Control Board. Fish passage structures are present in the creek.

Pine Gulch Creek: A small annual run of steelhead and a resident population of rainbow trout, about which little are known, occur in this stream. These populations maintain themselves without the aid of stocking. Angling pressure has not been measured.

Papermill (Lagunitas) Creek: This is one of the best steelhead and silver salmon streams in the Bay Area. Rainbow trout are also present. The natural spawning areas have been greatly reduced by numerous diversion dams. Angling is heavy during the winter when the steelhead run is on but overall use is moderate. Dairy pollution was severe at one time and still poses a threat to fishlife. Action was taken to clean up this problem at the same time as on Olema Creek.

Arroyo Nicasio: Self-sustaining populations of steelhead and resident rainbow trout occur in this stream. Angling pressure is moderate to low. Water development has been a problem on this stream. However, the developing agencies have been required to provide facilities for mitigation of damages to the resources.

San Antonio Creek: A natural population of rainbow trout and some steelhead are present in San Antonio Creek. Water development is also a problem on this stream. Angling pressure has not been measured but is presumably low.

Warmwater Lakes.

Novato Reservoir: This is a new reservoir being managed for largemouth black bass, bluegill and other warmwater species. The potential appears to be good, but it has not been fully evaluated yet as to its capability of sustaining a good natural population of warmwater fishes. Angling pressure is moderate.

Warmwater Streams.

Well defined warmwater streams do not exist in Marin County, although warmwater species occur in portions of Novato and Gallinas creeks.

Miscellaneous Waters.

Novato Creek: Near the mouth this is a typical brackish water slough which supports a striped bass fishery of fair quality and good waterfowl hunting. Above tidal influence, the fish population is negligible.

Hunting and fishing account for moderate use of the lower part of the creek. Domestic sewage is a constant threat to fish and wildlife. In 1953, a rather large kill of striped bass and carp occurred here.

Rush, Gallinas creeks: These are typical miscellaneous streams lacking survey data and without definite management programs.

Crystal, Bass, Pelican lakes: These are private lakes which have not been surveyed by the Department of Fish and Game.

Abbott's Lagoon: This is a private lagoon about which little is known except that striped bass have been reported from it.

Napa County

Trout Lakes.

There are no specifically managed trout lakes in the portion of Napa County covered by this report.

Trout Streams.

Dry Creek: A steelhead run and a resident population of rainbow trout occur in this creek. It is one of the best spawning tributaries for steelhead in the whole Napa River system. Angling use is minor and largely dependent upon the steelhead run. There are two low irrigation and domestic water diversion dams on the stream, each with a fish ladder.

Redwood (Napa) Creek: This is another tributary of the Napa River similar to Dry Creek. Although resident trout are present, the principal value of the stream is its use as a steelhead spawning tributary. The stream is intermittent in the lower reaches, but pools near the headwaters are maintained by springs where juvenile steelhead exist during the summer.

Conn Creek: Conn Creek is managed by the Department of Fish and Game primarily as a catchable trout stream, but a small self-propagating run of steelhead enters each year. During 1957, 11,000 trout were stocked here. Angling is generally moderate. A loose-rock dam which was put across the creek to form a small reservoir is stocked and reserved for the use of children.

Warmwater Lakes.

Conn Valley Lake, (Lake Hennessey): A water supply reservoir formerly managed for catchable trout, this lake now supports an assemblage of warmwater fishes including largemouth black bass, bluegills, green sunfish and crappie. It receives heavy angling pressure, is well policed, and is provided with a boat launching ramp and sanitary facilities. The fish population is self-sustaining. The lake is provided with rough-fish control structures at the inlets. Some trout are still taken; apparently they reproduce near the mouths of the tributaries.

Rector Reservoir: This is a water supply reservoir now closed to the public. The fishery was formerly managed by the State for catchable trout and rescued steelhead. It still contains a residual population of trout and roughfish.

Curry Lake, Milliken Reservoir: Like Rector Reservoir, these waters are closed to the public. They contain populations of warmwater fishes.

Warmwater Streams.

Conn Creek, Napa River, Napa Slough, Soda Creek: There are no well defined warmwater streams in the portion of Napa County discussed in this report. However, warmwater species do occur in the above named streams.

Miscellaneous Waters.

Leoma Lakes: These are a series of privately owned lakes which are used for domestic fish breeding purposes.

Soda Creek: Minor steelhead and resident rainbow trout populations maintain themselves in this creek but little is known about them. Angling pressure occurs during a short period each spring. Its value as a steelhead spawning tributary has not been investigated. There are water diversions on the stream but no fish facilities.

Moore, Mill Creeks: Both of these are small creeks which have not been surveyed and which do not have specific management programs.

Napa River: Although this river is classified miscellaneous, it is important to fishlife as well as the anglers who use it. The estuarine portion of the river to some distance above the city of Napa has furnished excellent striped bass angling. Above Napa, catfish, other warmwater species and resident trout are present. Steelhead pass up the river to spawning tributaries.

Below the city of Napa, the river was at one time one of the most favored striped bass fishing areas and a number of resorts were built to accommodate the fishery. It still receives moderate to heavy angling pressure. When the steelhead fishery was censused during the 1954-55 season, it was estimated that 1,508 angler days were spent here during January and February. Catch success was estimated at 0.28 fish per angler day.

Investigations have failed to reveal whether or not striped bass spawn in the river. However, plankton collections revealed tremendous numbers of eggs of other species, chiefly cottids and gobies.

The lower part of the river is used heavily by naval vessels, and freight barges which ply the river between its mouth and the city of Napa. A number of sources of pollution exist from Napa downstream. Domestic sewage has been the most aggravating. Above Napa, winery and dairy wastes are the principal pollution threats. Fish kills in the Napa River have not been uncommon in the past.

Napa Slough: The typical brackish water fauna occurs in this slough. Quantitative data on angler use are not available, but it may be assumed moderate. In addition, the slough runs through excellent waterfowl habitat and is used by many hunters each year. The State leases 5,000 acres adjoining it from the Leslie Salt Company for use as a waterfowl management area.

San Francisco County

Trout Lakes.

Lake Merced: This is a good trout lake managed by the Department of Fish and Game. Each year from 50,000 to 65,000 catchable-size trout are stocked in it. In 1957, the scheduled allotment included 50,000 catchables in the Lake Merced Impoundment, 260,000 fingerling rainbows and 50,000 eastern brook trout fingerlings in North Lake Merced, and 540,000 fingerlings in South Lake Merced.

The lake receives very heavy fishing pressure. Johnson (1957a) has analyzed the records from the boat fishery. His data are given in Table 41 for the years 1954, 1955 and 1956.

TABLE 41
STATISTICS OF THE LAKE MERCED BOAT FISHERY

Year	Angler Days	Total Catch	Mean Catch per Angler Day
1954	27,031	37,960	1.58
1955	26,740	65,526	2.40
1956	25,412	33,585	1.32

In a later report (1957b), Johnson used postal questionnaires to get an estimate of the amount of shore angling as compared to boat angling. It was determined that shore angling accounts for two to three times as much effort as the boat fishery. A total of 132,305 angler days were reported for both types of angling in 1956.

The lake is a standby water supply consisting of three artificial impoundments totaling 279 surface acres.

Trout Streams.

There are no trout streams as defined in San Francisco County.

Warmwater Lakes.

Stowe Lake: This and other small lakes in Golden Gate Park contain a variety of warmwater fishes and roughfish. Up to now a satisfactory combination of fish species to sustain a sport fishery has not been found. As a result, they are not presently of much value as recreational areas.

Warmwater Streams.

There are no warmwater streams in the county.

Miscellaneous Waters.

The only remaining waters in the county which might be included in this category are the sloughs along the shoreline.

San Mateo County

Trout Lakes.

Pilarcitos Lake: This lake is part of the San Francisco public water supply system and is closed to the public. It has 109 surface acres, and when surveyed in 1931, contained a good population of trout. Tributary streams are available for trout reproduction.

Higgins Creek Reservoir: The fishery at this private reservoir is managed by the State. In 1957, it received 6,000 catchable rainbow trout. Although too small to contribute appreciably to angling in the Bay Area, it is important to the local citizenry.

Upper Bean Hollow Lake: This is an irrigation water supply reservoir of about 50 surface acres. In 1957, it was stocked with 28,000 catchable rainbow trout. Angling pressure is moderate. Although angling is free, a fee is charged for parking.

Trout Streams.

Purissima, San Pedro, Tunitas creeks: These are small coastal streams utilized principally by natural steelhead populations. Angling is light.

Denniston Creek: Formerly managed for catchable-size trout, this creek was dropped from the program when a dam was constructed about a mile upstream from the mouth. Angler use is limited by the fact that the creek is bordered by private lands. It is of minor value for steelhead spawning since the dam is situated below the usable gravels. Angling pressure is negligible except at the beginning of the steelhead season.

Gazos Creek: This minor steelhead stream is also being managed under State's catchable trout program. Gazos Creek was stocked with 9,000 rainbow trout in 1957. During the 1930's, this creek was reported to have received heavy local use by anglers over a long season. It is now of minor value to anglers except for a short period during the winter when steelhead appear. Logging pollution has been a problem on Gazos Creek.

San Gregorio Creek: This is a moderately good steelhead stream for this area. The run is maintained through natural propagation. Resident trout are also present in the stream and support some angling. Angling pressure is heaviest during the winter steelhead season. During a January 1955 census, 188 angler days produced 51 steelhead.

Butano Creek: This is another small coastal stream with self-sustaining populations of steelhead, silver salmon and rainbow trout. Angler use is now limited by private lands which border the creek, but it was

formerly reported to receive heavy trout fishing pressure. Falls about five to six miles upstream presently limit its value for steelhead spawning.

Pescadero Creek: This is one of the best steelhead streams in the Bay Area. The headwaters in Portola State Park are stocked heavily with catchable trout, some 39,000 in 1957. Silver salmon also spawn in the creek. It receives heavy steelhead use and intense angling for catchable trout. The 1954-55 census indicated 2,281 angler days were spent to catch 249 steelhead.

San Francisquito Creek: Formerly a good steelhead stream, this creek has been greatly modified through man's activities. There still is a small run each year which must contend with adverse runoff conditions, pollution, and obstructions. Angling pressure depends to some extent on water conditions but must be considered light. Except during extreme high water, fish are unable to negotiate a dam which they must do to reach the spawning areas.

Warmwater Lakes.

San Andreas Lake, Crystal Springs Reservoir: Both of these are water supply reservoirs for the City of San Francisco and are presently closed to the public. Both contain good warmwater fish populations. Crystal Springs Reservoir has been a designated fish and game refuge for many years.

Searsville Lake: This small water supply reservoir contains a mixed population of largemouth black bass, panfish, and catfish. A boat rental concession has been established on the lake and angling pressure is heavy.

Lake Lucerne: Not much is known about this irrigation storage reservoir except that it contains the usual assemblage of warmwater species. Being a private lake, trespass problems are involved. It is another potential fishery, however.

Lower Bean Hollow Lake: After chemical treatment by the State, this irrigation storage reservoir was stocked with largemouth bass and panfish. Since it has only recently come under any form of management, its angling potential is not known. It appears to be marginal for warmwater species. Though privately owned, it is open to the public.

Warmwater Streams.

There are no well defined warmwater streams in San Mateo County. San Francisquito Creek, however, contains a limited population of forage, gamefish and roughfish species.

Miscellaneous Waters.

Alpine, El Corte Madera, Deer, Frenchman's, La Honda, Lobitas, Mindogo, Pomponio Creeks: Each of these creeks contain resident trout populations and some are used by steelhead. However, they have not been specifically surveyed as to their present or potential fisheries value.

Santa Clara County

Trout Lakes.

Stevens Creek Reservoir: This is a water supply reservoir managed as a catchable trout fishery. It was chemically treated first to remove the roughfish before being stocked with trout of which about 27,000 were planted in 1957. The lake is very heavily fished.

Austrian Reservoir: Formerly managed as a catchable trout lake, this water supply reservoir is now closed to public use. Since its closure, the fish population has not been investigated.

Lexington Reservoir: This reservoir was stocked with 30,000 catchable size trout and 100,000 sub-catchables in 1957. Because the reservoir is drawn down severely each year, fishing is limited to the early part of the season, when it is possible at all. Angling pressure is heavy when the reservoir can be fished.

Guadalupe, Almaden Reservoirs: These are small reservoirs subject to severe annual drawdown. They are stocked with catchable-sized trout when water is available. Some warmwater fishes are present.

Trout Streams.

Arroyo Hondo Creek: Until the late 1940's, excellent rainbow and brown trout populations existed in this creek. The present status of the resource and the fishery is not known. Since it is almost completely bordered by private lands, public access is difficult.

San Francisquito Creek: (See San Mateo County).

Warmwater Lakes.

Felt Lake: This is a standby water supply and private reservoir under the management of Stanford University. It contains largemouth black bass, bluegills, and forage species and is used as an experimental pond by University fisheries personnel. It is closed to the public.

Calaveras Reservoir: (See Alameda County).

Calero Reservoir: This water supply reservoir undergoes too great a drawdown each year to support a stable year-around warmwater fishery but it sometimes furnishes angling early in the season.

Le Roy Anderson Reservoir: This reservoir supports one of the best warmwater fisheries in the Bay Area. It has a good population of largemouth bass, bluegills, black crappie and catfish. It is a water supply and as the lake lowers, angling pressure drops from intense early in the spring to light in the fall.

Coyote Reservoir: This is a major reservoir with a good warmwater fish population most years. It is subject to severe draw-down in dry years.

Warmwater Streams.

While there are no typical warmwater streams in Santa Clara County, the tributaries of the Bay in Santa Clara County provide angling for warmwater species.

Among these may be cited the Guadalupe River and Coyote and Los Gatos creeks.

Miscellaneous Waters.

Guadalupe River: The lower part of this river formerly was favored by striped bass, but they are rarely seen there now. Steelhead ascend the river and its tributaries to spawn during the runoff period, but there has also been a progressive decline in the size of the runs. Above Guadalupe Reservoir, the river and its tributaries support small, but locally important, trout populations. Steelhead reproduction occurs in the small tributaries below Guadalupe Dam and good populations of black bass, bluegill and catfish exist in ponds between tidewater and Guadalupe Dam.

Generally speaking, angling quality has been impaired by the degradation of the river. A serious pollution problem has existed in the lower section for many years and although much has been done to alleviate the situation, recent investigations indicate it is still unsatisfactory to fishlife. Pollution is most acute in the late summer during the peak of the canning season.

Coyote Creek: The description of the Guadalupe River is appropriate to Coyote Creek. Except for a considerably larger estuary, the two streams are similar. The same fish species inhabit the estuary and upstream areas. Pollution is also serious in the estuary of this creek.

Stevens Creek: Stevens Creek is similar to the above two except that the estuary is much smaller. The fishery is also less intense. The headwaters of the creek support a local trout fishery.

San Felipe, Penitencia, Packwood, Los Gatos creeks: These are small, mostly intermittent streams supporting local trout fisheries. They do not have a specific management program and have not been surveyed in detail.

Williams Reservoir: This is a small reservoir which usually dries up each year. It provides sporadic fishing.

Solano County

Trout Lakes.

There are no trout lakes in the portion of Solano County discussed in this report.

Trout Streams.

Suisun Creek: A small annual run of steelhead occurs in this creek as well as a limited number of resident trout.

Warmwater Lakes.

Lakes Madigan and Frey: These lakes are part of the City of Vallejo's water system. They were stocked with catchable trout from 1940 (except during World War II) until 1960. Angler use (and stocking) varied depending on the water level of the reservoirs and the period of time the City of Vallejo allowed fishing. The lakes were recently surveyed, (Kelley 1959) and were found to be unsuitable for trout management. Kelley

recommended development of a warmwater fishery in both.

Pine Lake: This is a 15-acre lake on the property of the Benicia Arsenal. When last checked by the Department of Fish and Game, there were largemouth black bass, bluegill and small forage fishes present. Angling is restricted to military personnel.

Lake Herman: Lake Herman is a water supply reservoir for the City of Benicia. It contains the usual assemblage of warmwater species. The lake is now closed to public fishing, but was open in the past.

Lake Chabot: This is another water supply for the City of Vallejo. It supplies some angling for warmwater fishes but frequently goes dry and requires restocking.

Warmwater Streams.

Suisun, Green Valley, Ledgewood creeks: There are no typical warmwater streams in the portion of Solano County encompassed by this report, although warmwater game species are found in those listed above.

Miscellaneous Waters.

Ledgewood, Green Valley, Sulphur Springs creeks: These creeks are not under a specific management program and have not been surveyed. However, it is assumed they contain both warmwater and salmonid fishes. Angler use has not been investigated but all indications are that it is light.

Sonoma County

Trout Lakes.

There are no trout lakes of public significance in the portion of Sonoma County encompassed by this report.

Trout Streams.

There are no surveyed streams in this category, although unsurveyed tributaries of the larger creeks may possibly fit into this class.

Warmwater Lakes.

Petaluma Reservoir: This reservoir has the potential for development of a warmwater fishery, but it is not presently open to the public. It is a public water supply.

Warmwater Streams.

There are no specific warmwater streams within the portion of Sonoma County encompassed by this report. However, sections of the larger creeks and sloughs above tidal influence contain good populations of catfish, carp, largemouth bass and panfish. Such waters include: Petaluma, Sonoma, and Tolay creeks, Napa Slough, Second and Third Napa Sloughs.

Miscellaneous Waters.

Petaluma Creek: Near the mouth, this creek supports the typical brackish water fauna with striped bass be-

ing the principal game species. Catfish and other warm-water species are present above tidal influence. Some steelhead ascend the creek to upstream tributaries to spawn. Angling and recreational use has not been measured but it is probably minor. Waterfowl and waterfowl hunters also use the creek to some extent. Petaluma Creek is navigable water and receives wastes from both river traffic and shore installations.

Sonoma Creek: The fish fauna of Sonoma Creek near the Bay and into freshwater is similar to Petaluma Creek and seasonally provides excellent striped bass fishing. Above the City of Sonoma, there are steelhead and catchable trout fisheries. Some 5,000 trout are stocked annually. The creek receives moderate local use in the upper section where it is bordered by private lands. The fishery in this area is generally during the summer, although there is a minor winter steelhead fishery also. The Valley of the Moon Recreation District, located on Sonoma Creek, operates a small recreational angling impoundment. The riffles in the upper part of the creek are utilized by steelhead during the spawning period. As at Petaluma Creek, water-

fowl utilize the lower part during the winter and some hunting takes place. Dairy and winery wastes are potential pollution threats

Tolay Creek: This creek may be assumed to be similar to the preceding two in the lower section, but on a smaller scale and without the steelhead or trout fisheries

Napa Slough: (See Napa County).

Calabazas Creek: Not much is known about the general fish population of this creek. However, it does have a small annual run of steelhead and is used by them for spawning. Recreational use is limited to summer fishing for juvenile steelhead.

Carriger Creek: This creek supports a minor but locally important steelhead fishery. A fish ladder is present and the stream is included in the State's fish rescue program.

Adobe Creek: The fish population and angling use made of this creek are not well known, although it accommodates a small run of steelhead each year.

FRESHWATER FISHERIES REFERENCES

- Allen, K. Radway
1949. The Objects of Freshwater Fisheries Research. Proceedings, Seventh Pacific Science Congress, Vol. 4, pp. 556-562.
- Calhoun, A. J.
1950. California Angling Catch Records from Postal Card Surveys: 1936-1948: With an Evaluation of Postal Card Nonresponse. California Fish and Game, Vol. 36, No. 3, pp. 177-234.
1951. California State-Wide Angling Estimates for 1949. California Fish and Game, Vol. 37, No. 1, pp. 69-75.
1953. State-Wide California Angling Estimates for 1951. California Fish and Game, Vol. 39, No. 1, pp. 103-113.
- Cope, Oliver B. and Leo F. Erkkila
1952. Weekday Angling Pressure in the Sacramento-San Joaquin Delta, 1948 and 1949. California Fish and Game, Vol. 38, No. 1, pp. 73-84.
- Curtis, Brian
1939. Anglers' Catch Records in California. Trans. Am. Fish Soc., Vol. 69, pp. 125-131.
1941. Creel Counts in California. California Fish and Game, Vol. 27, No. 3, pp. 185-189.
1942. The General Situation and the Biological Effects of the Introduction of Alien Fishes into California Waters. California Fish and Game, Vol. 28, No. 1, pp. 2-8.
1949. The Warm Water Game Fishes of California. California Fish and Game; Vol. 35, No. 4, pp. 255-273. (Revised 1954)
- Davis, H. S.
1956. Culture and Diseases of Game Fishes. University of California Press, Berkeley and Los Angeles. 332 p. illustrated.
- Fisher, C. K.
1957. The 1954-55 Steelhead Fisheries in Region 3 Streams, Based on Angler Census Conducted by Wildlife Protection Officers. Administrative Report in preparation, California Department of Fish and Game.
- Hatton, S. Ross
1940. Progress Report on the Central Valley Fisheries Investigations, 1939. California Fish and Game, Vol. 26, No. 4, pp. 334-373.
- Hatton, S. Ross and G. H. Clark
1942. A Second Progress Report on the Central Valley Fisheries Investigations. California Fish and Game, Vol. 28, No. 2, pp. 116-123.
- Hubbs, Carl L. and Karl F. Lagler
1949. Fishes of the Great Lakes Region. Cranbrook Institute of Science, Bloomfield Hills, Michigan. 186 pp. illustrated.
- Job, S. V.
1955. The Oxygen Consumption of *Salvelinus fontinalis*. University of Toronto Biological Series #61. University of Toronto Press.
- Johnson, William C.
1957a. Sampling Fishing Success by Postal Card Questionnaires at Lake Merced, San Francisco County—1956. California Department of Fish and Game, Inland Fisheries Branch Administrative Report No. 57-12, 6 pp. mimeo.
1957b. Lake Merced Boat Catch Records in 1956 and Their Reflection on the Lake's Fisheries Management Program. California Department of Fish and Game, Inland Fisheries Branch Administrative Report No. 57-17, 9 pp. mimeo.
- Kelly, D. W.
1959. Investigation at Frey and Modigan Reservoirs, Solano County with Recommendations for Improvement of the Fishery. California Department of Fish and Game, Administrative Report No. 60-4.
- Kimsey, J. B.
1958. Possible Effects of Introducing Threadfin Shad (*Dorosoma petenensis*) into the Sacramento-San Joaquin Delta. California Department of Fish and Game, Inland Fisheries Branch, Administrative Report 58-16.

- Kimsey, J. B. and Leonard O. Fish
1960. Keys to the Freshwater and Anadromous Fishes of California. California Fish and Game, Vol. 46, No. 4, pp. 453-479.
- Lagler, Karl F.
1952. Freshwater Fishery Biology. Wm. C. Brown Company, Dubuque, Iowa, 360 pp. illustrated.
- Morgan, Ann Haven, Ph.D.
1930. Field Book of Ponds and Streams. G. P. Putnam's Sons, New York, London; 448 pp. illustrated.
- Murphy, Garth I.
1941. A Key to the Fishes of the Sacramento-San Joaquin Basin. California Fish and Game, Vol. 27, No. 3, pp. 165-171.
- Neale, George
1915. The Catfish in California. California Fish and Game, Vol. 1, No. 2, p. 62.
- Needham, Paul R., Ph.D.
1938. Trout Streams. Comstock Publishing Co., Ithaca, New York. 233 pp. illustrated.
- Rounsefell, George A. and W. Harry Everhart
1953. Fishery Science. Its Methods and Applications. John Wiley & Sons, Inc., New York. 444 pp. illustrated.
- Ryan, James H.
1959. California Inland Angling Estimates for 1954, 1956 and 1957. California Fish and Game, Vol. 45, No. 2, pp. 93-109.
- Shapovalov, Leo and William A. Dill
1950. A Checklist of the Freshwater and Anadromous Fishes of California. California Fish and Game, Vol. 36, No. 4, pp. 382-391.
- Shapovalov, Leo, William A. Dill and Almo J. Cordone
1959. A Revised Check List of the Freshwater and Anadromous Fishes of California. California Fish and Game Vol. 45 No. 3 pp. 159-180.
- Shebley, W. H.
1917. History of Introduction of Food and Game Fishes Into the Waters of California. California Fish and Game, Vol. 3, No. 1, pp. 1-12.
1922. A History of Fish Cultural Operations in California. California Fish and Game, Vol. 8, No. 2, pp. 61-99.
1927. History of Fish Planting in California. California Fish and Game, Vol. 13, No. 3, pp. 163-174.
- Skinner, John E.
1955. California State-Wide Angling Estimates for 1953. California Fish and Game, Vol. 41, No. 1, pp. 19-32.
- Snyder, John Otterbein
1905. Notes on the Fishes of the Streams Flowing into San Francisco Bay, California. U. S. Department of Commerce and Labor, Bureau of Fisheries, Appendix to Report of the Commissioner of Fisheries for 1904.
1916. The Fishes of the Streams Tributary to Tomales Bay, California. Bulletin of the U. S. Bureau of Fisheries. Vol. XXXIV, 1914, Document No. 825.
1933. California Trout. California Fish and Game, Vol. 19, No. 2 pp. 81-112.
1940. The Trouts of California. California Fish and Game Vol. 26, No. 2, pp. 95-114.
- Wales, J. H.
1957. Trout of California. California Department of Fish and Game, State Printing Office, Sacramento. 56 pp. illustrated.
- Welch Paul S.
1935. Limnology. McGraw-Hill Book Company, Inc. New York. 471 pp. illustrated.
1948. Limnological Methods. The Blakiston Company, Philadelphia-Toronto. 381 pp. illustrated.
- Wohlschlag, Donald E.
1952. Estimation of Fish Population in a Fluctuating Reservoir. California Fish and Game, Vol. 38, No. 1, pp. 63-72.