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THE THICKTAIL CHUB, GILA *CRASSICAUDA*, AN EXTINCT CALIFORNIA FISH

by

Terry J. Mills

and

Kathy A. Mamika

Inland Fisheries, Sacramento

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THE THICKTAIL CHUB, GILA CRASSICAUDA, AN EXTINCT CALIFORNIA FISH[1]

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Terry J. Mills[2]

and

Kathy A. Mamika[3]

ABSTRACT

The thicktail chub, once one of the most abundant fishes of the Central Valley of California, has not been collected during the past 22 years. It is now considered extinct. The loss of this native minnow is believed to be a result of: (1) habitat alteration resulting from drainage of large, shallow lakes and the removal of vegetative cover, and (2) the introduction of exotic fishes which competed with and preyed on thicktail chub. This report presents information on the taxonomy, synonomy, and life history of the species, as well as a discussion of the factors most likely responsible for its extinction.

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[2] Fishery Biologist, Endangered Species Program, Inland Fisheries Branch, 1701 Nimbus Road, Rancho Cordova, California 95670.

[3] Current address: 1630 East Menlo, Fresno, California 93710.

INTRODUCTION

Currently three members of the California freshwater fish fauna are thought to be extinct[1]. Under authority of the California Endangered Species Act of 1970 an additional eleven fishes are listed as endangered while three others are listed as rare (Leach, Brode, and Nicola 1976). Included among the endangered fishes is a minnow native to the Sacramento-San Joaquin River drainage, the thicktail chub, *Gila crassicauda* (Figure 1). Miller (1961, 1963, 1972), Moyle (1976a), and Moyle and Nichols (1974) have reported that the thicktail chub is likely extinct. In this report we trace the sequence of events which we believe led to the extinction of the thicktail chub by describing: (1) historical distribution, (2) historical habitat, (3) habitat alterations, and (4) the effects of the introductions of exotic fish species. We also summarize thicktail chub taxonomy, life history, and incidence of hybridization with the hitch, *Lavinia exilicauda.*

Several sources of fishery data were examined to verify thicktail chub status. These sources included fish collections from the Sacramento-San Joaquin Delta compiled by the Department of Fish and Game's Bay-Delta Fishery Project, records of fishes salvaged from the Delta-Mendota Canal by the Water and Power Resources Service (Bureau of Reclamation), and similar records from the California Aqueduct compiled by the California Department of Water Resources. A recent Department survey of the fish habitat of Central Valley and foothill area streams did not yield thicktail chub (Aceituno, Caywood, and Nicola 1973), and resampling during the past 2 years at several locations believed to be likely chub habitat also produced negative results.

DESCRIPTION

The following description of the thicktail chub is from Miller (1963).

> Least depth of caudal peduncle into head length, 1.5 to 2.05 (ave. 1.9), and into standard length, 6.2 to 7.5 (ave. 6.9). Distance between caudal base and dorsal origin into predorsal length, 1.05 to 1.4 (ave. 1.2).
>
> Scales large and regular, 40 to 60 along the lateral line, bearing apical radii only, and weakly shield-shaped to broadly rounded at the base; predorsal scales 27 to 36, usually 31 to 32. Dorsal and anal fins almost always with 8, and pelvics usually with 9 rays. Pharyngeal teeth (2,5-4,2) usually hooked and without grinding surfaces, the pharyngeal arches strong. Origin of dorsal fin over or just behind the insertion of the pelvics. The intestine has a single S-shaped loop that bears a restriction at the second loop. Peritoneum

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[1] The three extinct fishes are the Tecopa pupfish, *Cyprinodon nevadensis calidae;* the Shoshone pupfish, *Cyprinodon nevadensis shoshone;* the Clear Lake splittail, *Pogonichthys ciscoides.*

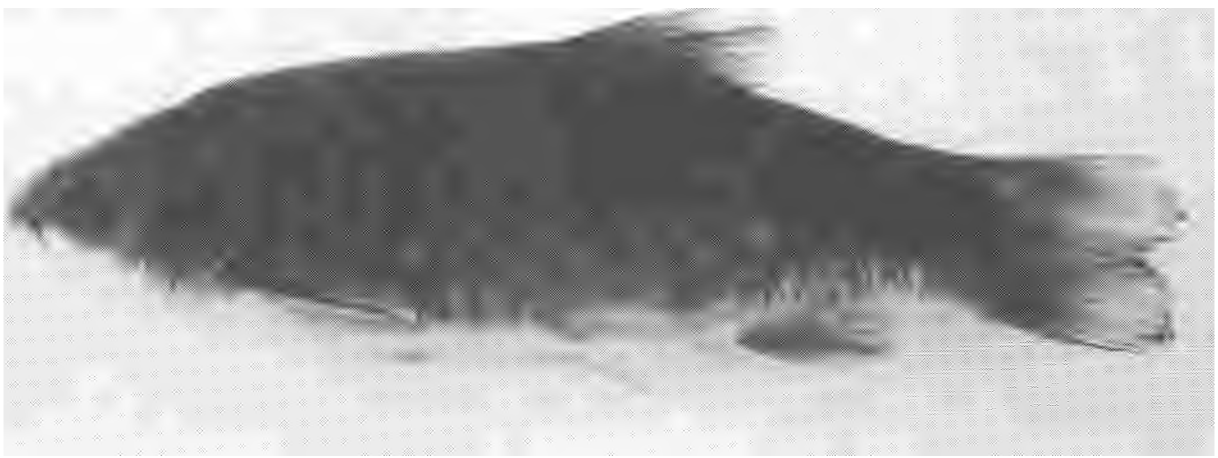

FIGURE 1. The thicktail chub, *Gila crassicauda.* (CAS 20456, 156 mm SL. Photo by Robert R. Miller.)

silvery in color, with few to numerous, small to large, brown punctulations. Dermosphenotic enlarged, width about two and one-half to three times the length, usually occupying more than half of the lateral temporal fossa.

This species of *Gila* is characterized by a short, very deep and thick caudal peduncle. The head is short, cone-shaped, the dorsal profile ascending steeply from snout to nape in adults. The back varies from greenish-brown through bluish and purplish-brown to purplish-black. The sides are lighter, with a yellowish ground color. The venter is usually silvery but has also been recorded as full yellowish. The opercular bones are tinged with purple, and the young have a black spot at the base of the caudal fin. In males the body is covered with numerous small melanophores appearing as puncticulations, that are especially prominent during the spawning season.

Besides differences in maximum size (females larger), in coloration during the breeding season, and development of nuptial tubercles, the only other noted difference between the sexes is the position of the dorsal fin. The fin is slightly more anterior in males than in females. The distance between the caudal base and the origin of the dorsal fin usually falls in advance of the orbit in males and over or behind that structure in females.

TAXONOMY

The common name "chub" was first given to a heavy-bodied European minnow, *Leuciscus cephalus,* and also now applies to a number of North American minnows (Moyle 1976*a*) members of this genus were first described by Baird and Girard (in Girard 1853) from the Gila and Zuni rivers in New Mexico, thus the generic name *Gila*. *Crassicauda* means thick tail and refers to the wide caudal peduncle (Moyle 1976a).

SYNONOMY

Thicktail Chub

Gila crassicauda (Baird and Girard)

Leuciscus gibbosus, Ayres, 1854a
Lavinia crassicauda, Baird and Girard in Girard, 1854
Lavinia conformis, Baird and Girard in Girard, 1854
Lavinia gibbosa, Ayres, 1854b
Tigoma crassa, Girard, 1856
Tigoma conformis, Girard, 1856
Siboma crassicauda, Girard, 1856
Tigoma conformis, Girard, 1858
Squalis gibbosus, Jordan and Jouy, 1881
Squalis crassus, Jordan and Gilbert, 1883

Leuciscus crassicauda, Jordan and Gilbert, 1894
Leuciscus crassicauda, Jordan and Evermann, 1896
Leuciscus crassicauda, Snyder, 1905
Leuciscus crassa, Rutter, 1908
Leuciscus crassicauda, Rutter, 1908
Leuciscus crassicauda, Snyder, 1908
Siboma crassicauda, Evermann and Clar, 1931
Gila crassicauda, (Baird and Girard), Miller, 1945

Common names for *Gila crassicauda* include thicktail chub, Sacramento chub, and thicktail (Moyle 1976a).

The holotype specimen of *Lavinia (Leuciscus) conformis* was examined by Miller (1945) and found to be a large-scaled variant of the thicktail chub.

HYBRIDIZATION

Hybrids of *G. crassicauda* x *L. exilicauda* were collected on three occasions during the period 1872-1926, but were incorrectly assigned to "*Lavinia conformis*". Only five hybrid specimens were available for study by Miller (1963). The hybrids were compared using several characters that readily distinguish the two species (Table 1).

1. Gill rakers. The average number of gill rakers for the hybrids is intermediate between that of *G. crassicauda* and those of populations of *L. exilicauda* from the Sacramento-San Joaquin drainage.

2. Fin rays. The numbers of dorsal, anal, pectoral, and pelvic fin rays of hybrids are almost exactly intermediate between those of *G. crassicauda* and *L. exilicauda*.

3. Pharyngeal teeth. Hybrids have 4 or 5 teeth in the main row and 1 or 2 in the lesser row. This number is not only intermediate but is an unexpected pattern since western minnows normally have either 0 or 2 teeth in the lesser row and 5-4, 4-4, or 5-5 in the main row.

It can only be surmised as to why the thicktail chub and the hitch interbred. Hitch occupy a wider variety of habitats than the chub apparently did, but they also frequent sluggish streams and sloughs, places that were probably also habitat for the thicktail chub. Kimsey (1960) showed that hitch are not obligatory stream spawners and will reproduce successfully in lakes over gravel or mud substrate. This overlap of spawning habitat may have led to hybridization.

Life History, Ecology, and Abundance

Little is known of the life history, ecology, and abundance of the thicktail chub, since there was little interest in this species until it became extremely rare. Judging from the evidence that exists, however, it can be inferred that thicktail chubs occupied lowland lakes, sloughs,

TABLE 1. Taxonomic comparison of *G. crassicauda*, *L. exilicauda*, and the hybrid (Miller 1963).

Item	*Gila*	Hybrid	*Lavinia*
Gill rakers	11.20	17.0	25.53
Dorsal rays	8.04	9.17	10.87
Anal rays	8.04	9.83	12.32
Pectoral rays	17.88	17.70	16.35
Pelvic rays	9.11	9.60	9.93
Pharyngeal teeth	2,5-4,2	No data	5-5
Total teeth	13.0	11.7	9.9
Lateral-line scales	54.47	56.55	60.25
Predorsal scales	31.29	34.60	38.05

slow-moving stretches of river and, during years of heavy runoff, the surface waters of San Francisco Bay. Based on Miller's (1963) study of 101 fish, the species was probably carnivorous. The stubby gill rakers, short intestine, and snout, hooked pharyngeal teeth indicate the thicktail probably fed on small fish and large aquatic invertebrates.

Coleman (1930) reported that anglers frequently caught thicktail chubs while fishing in Clear Lake. During the latter part of the 19th century the thicktail chub was abundant enough in the Sacramento-San Joaquin Delta to be sold in the San Francisco fish markets (Miller 1963). Lockington (1879), however, rated their occurrence in the markets as only "occasional". Collins (1892) reported thicktail chub abundant in the Sacramento River during 1888. Jordan and Gilbert (1895) listed the thicktail chub as common.

HISTORICAL DISTRIBUTION

Historical distribution of the thicktail chub is based both on ichthyological collection records compiled by Miller (1961) (Figure 2, Table 2), and from the location of Indian midden sites containing thicktail chub remains (Figure 2, Table 3). Collection sites for thicktail chub ranged from the Sacramento River near Fort Reading [Redding] to Poso Creek in the lower San Joaquin Valley.

Archaeological investigations of Indian middens in the southern portion of Sacramento County at Stone Lake indicate that, at one time, thicktail chub formed a major part of the local Indian diet (Schulz and Simons 1973).

The probable distribution of the thicktail chub based on these collections is represented in Figure 3.

HISTORICAL HABITAT

Our literature search of causes for the decline of the thicktail chub revealed two possible reasons for the loss of this species: alteration of pristine habitat and successful introductions of nonnative fishes. Assessing habitat alterations was made difficult by lack of a quantitative description of the historic habitat. The little information we did locate was in the form of daily journals kept by early explorers. These early descriptions have been included but we have refrained from judging the accuracy of these reports.

The Central Valley of California occupies approximately one-tenth of the area of the State (Oakeshott 1971) and is comprised of the Sacramento and San Joaquin valleys lying between the Sierra Nevada on the east, the Cascade Range on the north, and the Coast Range on the west (McGlashan and Henshaw 1912). The east side of the Valley has been bordered by the Sierra Nevada since the beginning of cretaceous time. On the west side, rock movements and displacements have gradually built up the barrier of the Coast Ranges, changing the depression between the Coast Range and the Sierra from a gulf of the ocean to a lake,

FIGURE 2. Archaeological and ichthyological collection sites of the thicktail chub.

TABLE 2. Historical Collection Sites (North to South) of *G. crassicauda* (R. R. Miller 1963; DFG records).

Location	Collection or identification
Sacramento River near Fort Reading [sic], Shasta County	J. S. Newberry, 1855
Clear Lake, Lake County	L. Stone, 1873
Clear Lake, Lake County	M. A. Kayser, 1938
Putah Creek near Davis, Yolo County	H. O. Jenkins, 1936
Putah Creek (no locale)	Stanford University
Sacramento River, at Sacramento, Sacramento County	F. Steindachner, 1872
Sacramento River near Rio Vista, Solano County	Fish and Game Records, 1957
Sacramento River (westside), 2 miles north Rio Vista, Solano County	E. Mitchell, 1950
Coyote Creek, Santa Clara County	J. O. Snyder, 1908
Soap Lake, San Benito County	I. L. Coppell, 1916
Fresno, Fresno County	Eisen, 1881
"Pose or O-co-ya" [sic] Creek, Valley ("Pose" Creek is assumed to be Poso Creek)	A. L. Heermann, 1853

TABLE 3. Archaeological Records of *G. crassicauda.*[1/]

Location	Identification[2/]
Junction Sacramento River and Feather River, Yolo County	P.D.S.
1/4 mile west of Sacramento River, 10 miles south of Grimes, southwest Colusa County	P.D.S.
American River at Carmichael, Sacramento County	P.D.S.
Deer Creek, Consumnes River, 3 miles southwest of Sloughhouse, Sacramento County	
Sacramento River, southern edge of Sacramento City, Sacramento County	R.W.C.
Former west shore South Stone Lake, 2 miles south of Hood, Sacramento County	P.D.S.
-former south shore South Stone Lake, 2 1/2 miles south of Hood, Sacramento County	P.D.S.
-southeast South Stone Lake, 3 miles southeast of Hood, Sacramento County	P.D.S.
1 mile south of Mokelumne River, 1 mile northwest of Thornton, San Joaquin County	W.I.F.
1 mile south of Mokelumne River, 1 1/2 miles northwest of Thornton, San Joaquin County	P.D.S.
Alamo Creek, 1/2 mile south of Vacaville, Solano County	R.W.C.
Napa River, north edge of Napa City, Napa County	P.D.S.
Sacramento River and Georgiana Slough, north end Andrus Island	P.D.S.
3 miles west of Old River channel, San Joaquin River, on Hotchkiss Tract, Contra Costa County	W.I.F.
Little Panoche Creek, 20 miles south of Los Banos, Fresno County	R.W.C.

1/ Compiled by Peter D. Schulz, State Park Archaeologist, Dep. Parks and Recreation, Sacramento.

2/ R.W.C. - Richard W. Casteel, University of Washington, Seattle; W.I.F.- W.I. Follett, Curator of Ichthyology, California Academy of Sciences, San Francisco; P.D.S. - Peter D. Schulz.

FIGURE 3. Proposed historical distribution of the thicktail chub.

and from a lake to a Valley. During this period large masses of alluvium were deposited in the Valley by erosion from the rising Sierra (Lindgren 1911). The terrain of the Central Valley is a gently sloping, nearly unbroken plain, approximately 400 miles long and a few miles to 80 miles wide. The northern portion of the Valley is drained by the Sacramento River, and the southern part by the San Joaquin River. These two rivers join at the head of Suisun Bay, from which they pass to the Pacific Ocean (McGlashan and Henshaw 1912; Anon. 1931).

Historically, the Central Valley consisted of a series of extensive lakes formed by flood season overflow into large areas of the Valley. On occasion, three of these lakes--Tulare, Buena Vista, and Kern---combined to form the largest freshwater lake in California (Oakeshott 1971).

The Sacramento Valley comprises the northern part of the Central Valley occupying the area from the mouth of the Sacramento River 150 miles northward to Red Bluff. Except for the Sutter Buttes, its slope is gentle and uniform. The Delta area south of Sacramento and the Basin lands situated between the rivers and the mountains were subje2t to annual or periodic overflow by the Sacramento River and tributaries. The flood plain varied in width from 2 to 30 miles and extended all the way to Red Bluff (Jones 1967).

The lowest depressions in the Valley floor were covered with swamp grass and tule, in which sloughs and areas of standing water widened during floods to form lakes. River banks of sand and clay, varying from a few ft to 20 ft high, were noted as prominent features (Lindgren 1911).

Captain Pedro Fages, who led an expedition into the upper San Joaquin Valley in 1772, described the entire plain of the Valley as being a network of lakes and marshes (Leach 1960). This flood plain existed from the confluence of Fresno Slough and the San Joaquin River to the Merced River, and, at times, flood waters from the Tulare Lake basin would join with those of the lower San Joaquin Valley covering the plain (Leach 1960).

Moraga (1808) led an expedition through the Central Valley and briefly described the terrain. South of the Mokelumne River he found large areas of "tulare" (swampy areas with thick tule beds), lagoons, green meadows, and abundant pine woodlands. North of the Mokelumne River he found wide plains indicating that periodic flooding occurred.

F. F. Latta (1937) in "Little Journeys in the San Joaquin" gave still another report of the San Joaquin Valley topography:

> In primeval days the San Joaquin was a valley of contrasts. Two hundred and fifty miles long and 75 miles wide, it was comprised for the most part of barren desert... .throughout the length and about the rim of the San Joaquin were a

> hundred or more oases, every one a veritable paradise, abundantly watered, shaded with beautiful trees, and filled to overflowing with game of all kinds.. .At all times these lakes and connecting sloughs, as well as the San Joaquin River, were bounded with an almost impassable barrier of tules, willows, and mud flats. During times of high water the basin was filled to a great depth with flowing water, presenting a barrier passable with stock at probably not more than three places between the upper end of Kern Lake and San Francisco Bay.

The Sacramento Valley, in 1894, included 2,510 $miles^2$ of high lands not subject to overflow; 450 $miles^2$ of land subject to occasional overflow; 1,250 $miles^2$ of low lands, flooded periodically and submerged for long periods; and 38 $miles^2$ of perennial stream surface (Anon. 1912).

HABITAT ALTERATIONS

Modifications of the aquatic habitat in the Central Valley that occurred since the mid-1800's were massive. The earliest and possibly the most damaging event was the unrestricted use of hydraulic mining in the river drainages along the eastern edge of the Central Valley. This belt of hydraulic mining transversed the Sierra Nevada drainage basins of streams tributary to the Sacramento and upper San Joaquin valleys. The most intensive hydraulic mining, however, occurred on the Feather, Yuba, and Bear rivers. It is estimated that the excavated materials from just the Yuba, Bear, American, and Feather rivers exceeded 1.3 billion yd^3 5/ (Lindgren 1911). This debris, composed of clay, sand, gravel, and cobbles, gradually washed downstream. As early as 1860, a sand bar had formed in the Sacramento River across the mouth of the American River. By 1866, the larger river steamers could no longer reach Sacramento, and by 1876, the channels of the Bear and Yuba rivers had been completely filled resulting in adjacent agricultural lands becoming covered by sand and gravel (Lindgren 1911).

The State Supreme Court, in 1884, upheld a suit against the hydraulic mining interests filed on behalf of agricultural interests. That decision was the beginning of the end for hydraulic mining. But the damage had already occurred and the rivers were slowly shifting these great masses of mining debris downstream. This accumulation of debris compounded the problems of navigation and reclamation by filling the river channels and causing inundation of lands not previously subject to flooding (Lindgren 1911).

Prior to the construction of levees for reclamation and flood control, the Sacramento River was confined, at normal flows, between its natural

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5/ As a comparison to show the magnitude of this volume, the Oroville Dam in California, was constructed using only .08 billion (78 million) yd^3 of fill (Cortwright 1962).

river banks. During periods of flood large areas of the Sacramento Valley were inundated. The Sacramento River system partitioned the Valley lowlands into six natural overflow basins that served as flood storage reservoirs (Figure 4). The six overflow areas are the Butte Basin extending from Chico south to the Sutter Buttes; the Sutter Basin, located between the Buttes and the Feather River; the American Basin between the Feather and the American River; the Sacramento Basin between the American and Mokelumne rivers; the Colusa Basin between Stony Creek south to Cache Creek; and the Yolo Basin between Cache Creek to Rio Vista (Jones 1967).

Flood control in the Sacramento Valley had its inception with low levees constructed on the rimlands along stream banks by farmers endeavoring to protect their crops. Until 1850, ownership of the tule, swamp, and overflow lands was vested in the United States government. With the passage of the "Arkansas Act" in 1850, these lands were transferred to the State of California and made available to private ownership in 1865. By 1868, nearly all the land had been sold with the provision that the owners reclaim the land through the formation of reclamation districts (Jones 1967).

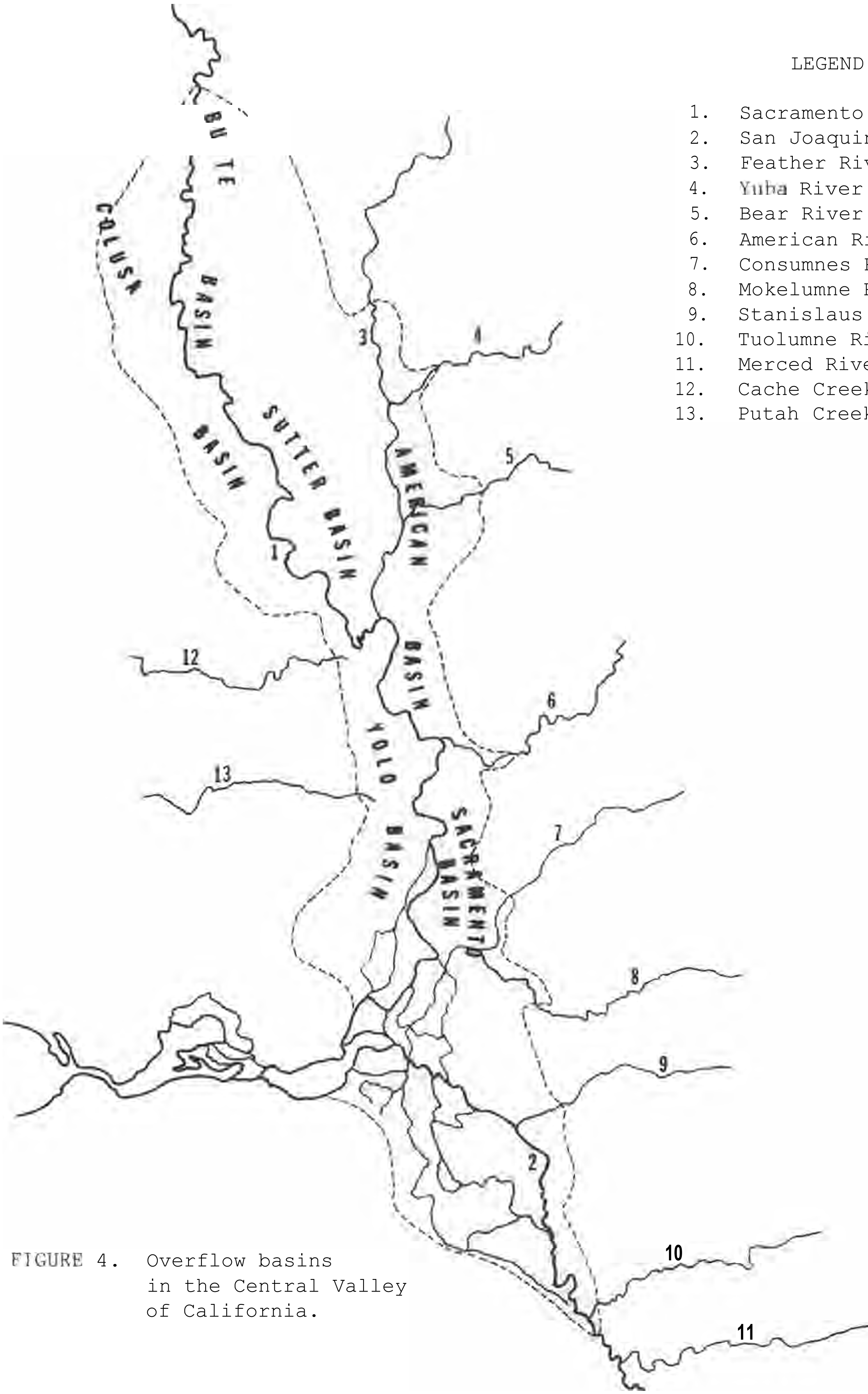
By 1894, many miles of levees had been constructed along the stream channels and some of the favorably located lands had been formed into districts with levees of sufficient height to afford some degree of flood protection. By the 1930's only 25% of the land of the Sacramento Valley floor was subject to periodic inundation (Jones 1967).

In 1893, the Congress established the California Debris Commission to deal with the loss of navigable river channels and to provide a plan to control flooding in the Valley. The flood control plan was adopted by the State Legislature in 1911 by the United States Congress in 1917. Adoption of the plan brought together a large number of reclamation districts and allowed reclamation of the greater part of the swamps. Flood control was accomplished using a system of levees to protect farmlands, by establishing areas to bypass flows of flood water, and by constructing dams on the rivers to capture flow. The flood control plan proposed by the Debris Commission is now essentially complete (Jones 1967).

The entire flood control project comprises about 440 miles of river, canal, and stream channels; 1,000 miles of levees; five major weirs; two sets of outfall gates; three major drainage pumping plants; 95 miles of bypasses; five low-water check dams; 50 miles of drainage canals and seepage ditches; and numerous minor weirs, control structures, bridges, and gauging stations (Jones 1967).

REASONS FOR DECLINE

Little is known of the life history of the thicktail chub other than it was probably carnivorous, or predaceous; and had, on occasion, hybridized with hitch. We attribute the decline of the thicktail chub to two causes: habitat modification and introduction of exotic fishes.



LEGEND

1. Sacramento River
2. San Joaquin River
3. Feather River
4. Yuba River
5. Bear River
6. American River
7. Consumnes River
8. Mokelumne River
9. Stanislaus River
10. Tuolumne River
11. Merced River
12. Cache Creek
13. Putah Creek

FIGURE 4. Overflow basins in the Central Valley of California.

Modification of Habitat

Minckley and Deacon (1968) found that modification of aquatic habitat by man in the American southwest was largely responsible for the decline and extirpation of many native fishes. Pister (1974) noted that man's activities, particularly water diversion, in California, Nevada, and Arizona during the past 35 years has caused the extinction of three species and six subspecies of desert fishes.

Cook, Moore, and Connors (1966) attribute the decline in fish abundance and the disappearance of some species, including the Clear Lake population of thicktail chub, to reduced inflow, introduction of exotic species, and habitat alteration. They reported Clear Lake had been subject to extensive reclamation efforts aimed at eliminating marsh and swamp lands.

Overall, the effect of hydraulic mining was more serious than just causing habitat degradation in the Central Valley. The increase in frequency and extent of periodic flooding caused by mining debris accelerated the need for flood control measures to protect adjacent agricultural lands. Levee construction to protect these lands eliminated fish access to shallow, overflow areas, and dredging operations to construct levees eliminated tule bed habitat along the river channels. Since the 1850's, 700,000 acres of overflow and inundated land in the Delta have been converted to agriculture (Skinner 1972). Many remaining stream sections have been either dredged or channelized to improve navigation and to increase stream velocity during periods of flood.

The ultimate result of these alterations was the elimination of habitats that were likely essential as spawning and nursery areas for thicktail chub. The spawning habitat requirements of this chub were never investigated, but whether the species needed shallow lake bottoms or extensive areas of emergent vegetation for successful reproduction is moot since both were eliminated. The reduction of the escape cover provided by aquatic vegetation probably made thicktail chubs easily susceptible to predation by introduced piscivorous species of fish.

Introduction of Exotic Species

Since 1871, nearly 50 species of exotic fish have been successfully introduced into California (Moyle 1976b). According to Moyle (1976*b*) exotic fishes often reduce or eliminate native fishes through either competition, predation, or hybridization. Several of these introductions are notable for their remarkable success. Striped bass, *Morone saxatilis,* introduced in 1879, supported a commercial fishery that yielded 1.2 million lb in 1899 (Skinner 1962). American shad, *Alosa sapidissima,* were introduced between 1871 and 1881. By 1886, an estimated one million adult shad were harvested annually, and in 1917, 5.7 million lb were harvested (Skinner 1962). White catfish, *Ictalurus catus,* and brown bullhead, *Ictalurus nebulosus*, were introduced in 1874 and supported extensive commercial fisheries after the turn of the century (Skinner 1962).

Coincidentally, it was during this postintroduction period (the early 1900's) that the State Board of Fish Commissioners became concerned about the alarming rate at which the Sacramento perch (*Archoplites interruptus)*, another native fish of the Central Valley was declining because of reclamation and the introduction of exotic species (Skinner 1962). We believe that the decline of the thicktail chub was also underway at this time.

We find it unlikely that reduction of habitat alone would have caused the demise of the thicktail. Neither do we believe that competition for food with juvenile shad and striped bass nor predation by adult striped bass and catfish would have eliminated the thicktail chub. However, we believe that loss of habitat combined with predation and competition from rapidly expanding populations of exotic fishes are most likely causes for the extinction of the thicktail chub.

STATUS

The thicktail chub, once a common member of California's freshwater fauna, was noted as the third most abundant fish in a prehistoric Indian midden in the lower Sacramento Valley. This fish was a primary element in the native fishery. The last known collection of thicktail chub from the Sacramento-San Joaquin Delta occurred in 1957, and from Clear Lake in 1938. The failure to collect any specimens during the past 22 years, despite repeated and extensive sampling, leads to the inevitable conclusion that the species is extinct.

The thicktail chub seems to have declined to extinction because it was unable to adapt to the extreme modification of its original aquatic habitat. Drainage of large, shallow lakes and modification of stream channels are thought to have initiated its decline. Exotic predators and competitor fishes very likely caused the final decline and extinction of the thicktail chub.

RECOMMENDATIONS

1. Thicktail chub should be removed from the State endangered species list.

2. Department of Fish and Game and university personnel sampling fish in the Delta should preserve any chub-like fish for identification.

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