

THE FISHES OF THE SACRAMENTO-SAN JOAQUIN BASIN, WITH  
A STUDY OF THEIR DISTRIBUTION AND VARIATION

By CLOUDSLEY RUTTER

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103



# THE FISHES OF THE SACRAMENTO-SAN JOAQUIN BASIN, WITH A STUDY OF THEIR DISTRIBUTION AND VARIATION.

By CLOUDSLEY RUTTER.<sup>a</sup>

The following report embodies the results of studies conducted incidentally to an investigation of the natural history of the young salmon. The primary object was to determine the distribution of the various species of fishes found in the Sacramento-San Joaquin basin, but the identification of the species necessitated a study of their variations, which has proved of equal interest. The determinations are based on large collections made in 1898 and 1899 by the author with Mr. Fred M. Chamberlain, of the Bureau of Fisheries, Mr. N. B. Scofield, ichthyologist of the California Fish Commission, and Mr. W. S. Atkinson, a student at Stanford University, as associates.

The report includes notes on the geography of the basin, with a synopsis of the streams in which collections were made; a review of the various papers in which other collections from this region have been recorded; a key to the species known to inhabit the basin; detailed discussion of the variations and the local distribution of the native species; a list of the anadromous species; and a list of the species that have been introduced.

## GEOGRAPHY OF THE BASIN.

The great central basin of California, drained by the Sacramento and San Joaquin rivers, has for its eastern rim the Sierra Nevada and for its western the coast ranges. Spurs from these two ranges form the southern boundary of the basin, and the ranges themselves meet at the north, culminating in Mount Shasta, and form the northern boundary. The outlet of the basin is through a notch in the middle of the western rim, occupied by San Pablo and San Francisco bays. The shape of the basin is that of a long ellipse, with its major axis curved concentric with the coast line. Its length is about 450 miles and its width about 125 miles. Altogether the Sacramento-San Joaquin basin, including Pitt River drainage but excluding Goose Lake and San Pablo and San Francisco bays and their immediate drainage, has an area of 58,250 square miles, which is greater by 1,600 square miles than the state of Illinois. Its northern

<sup>a</sup>The manuscript for this report, submitted by Mr. Rutter at the completion of the studies upon which it is based, had not, at the time of his death, in 1903, been arranged in final form for printing. The information it contains, however, is considered of interest and value, and the paper is accordingly presented with such revision as is possible under the circumstances, the modifications that have been made relating chiefly to the form and order in which the material is presented.

extremity lies in nearly the same latitude as Chicago and its southern in about that of Memphis, Tenn. The distance from either of the extreme river sources to the Golden Gate is nearly as great as that from Chicago to Cairo, Ill. The general direction of the San Joaquin, or southern portion of the basin, is southeast to northwest, that of the Sacramento portion nearly north to south.

Part of the table-land of northeastern California is drained by Pitt River, which cuts through the Sierra Nevada near the northern end of the range and joins the Sacramento in the foothills at the northern end of the valley. This adds a considerable area to the central drainage system. The tributaries draining the west side of the basin are small, and are dry in their lower courses for most of the year. The eastern tributaries are numerous and several of them are of considerable size. The larger tributaries of the Sacramento, named in the order of their size, are: (1) Pitt River, (2) Feather River, (3) McCloud River, and (4) Fall River (the latter two being tributaries of Pitt River), (5) Upper Sacramento (above mouth of Pitt River), (6) Battle Creek, and (7) American River. Those of the San Joaquin are (1) Kings, (2) Upper San Joaquin, (3) Merced, (4) Mokelumne, (5) Kern, (6) Tuolumne, and (7) Stanislaus rivers.

#### SYNOPSIS OF STREAMS.

Following is a list of the principal streams of the basin, italics indicating those in which collections have not been made. Smaller streams are mentioned if fishes have been reported from them. The tributaries are named in order, beginning with the lowest of the right bank drainage and going upstream and around the basin, coming down on the left bank. Secondary tributaries are named in the same order. The indentions indicate the relation of the various streams. When the particular point from which fishes have been reported is known, it is given after the name of the stream. If fishes have been reported from more than one point, the different stations are listed in order, beginning with the lower.

Suisun Bay (Benicia, Martinez, Dutton).

Sacramento River (Collinsville, Rio Vista, Ryde, Walnut Grove, mouth of American River, mouth of Feather River, Knights, 20 miles below Grimes, Wilson Farm, 4 miles above Grimes, Colusa, 5 miles below Princeton, Butte City, Jacinto, Chico, mouth of Deer Creek, mouth of Thomas Creek, Tehama, 6 miles below Red Bluff, Red Bluff, mouth of Battle Creek, near Fort Reading, mouth of Clear Creek, Redding).

Fresh-water lagoons (locality not stated).

Putah Creek.

Ætna Springs.

Cache Creek.

Clear Lake.

Allen Springs.

Stoney Creek.

Thomas Creek (at mouth).

*Elder Creek.*

*Red Bank Creek.*

Cottonwood Creek (Cottonwood).

Clear Creek (at mouth).

Upper Sacramento River (Sims, Dunsmuir, Sisson, at source).

Lake (near source of river).

Cliff Lake.

## Sacramento River, etc.—Continued.

Cedar Lake.

Gumboot Lake (the source of Sacramento River).

*North Fork Sacramento River.*

Sullaway Creek (Sissons).

Hazel Creek (near mouth).

*Pitt River, lower.*

McCloud River (Baird, lower falls, Big Bend, Bartlets).

*Squaw Creek.*

Fall River (Fall River Mills, Dana, Bear Creek, on road from Bartlets to Dana).

*Pitt River, upper (Pittville, Bieber, Canby).*

North Fork Pitt River (near Alturus, at mouth of Joseph Creek).

Goose Lake (several places; Davis Creek, Davis Creek P. O.).

Joseph Creek (at mouth).

*Packer Creek.*

South Fork Pitt River (South Fork P. O., Jesse Valley).

Ash Creek (Aden).

Rush Creek (on road from Aden to Canby).

*Beaver Creek.*

Hat Creek (Cassel).

Burney Creek (Burneyville).

Cow Creek (Fort Reading).

Battle Creek (United States hatchery).

*North Fork.*

South Fork (Longs, Battle Creek Meadows).

*Antelope Creek.*

Mill Creek (Morgan Springs).

Deer Creek (at mouth).

*Chico Creek.*

Feather River (Marysville, Oroville).

North Fork (Big Meadows, near source).

Warner Creek (Johnsons).

Duck Lake (near Big Meadows).

Indian Creek (Crescent Mills, Genesee Valley).

Wolf Creek (Greenville).

Squaw Queen Creek (at mouth).

Clover Creek (Clover Creek Canyon, lower edge of Clover Valley, upper edge of Clover Valley).

Spanish Creek (Quincy).

Gausner Creek (Quincy).

Middle Fork (Nelson Point, Beckwith).

*Sierra Valley Marshes.**Hamlin Creek.*

Cole or Buffin Creek (near source).

Gold Lake.

*South Fork.**Yuba River.*

North Fork (Bullards Bar).

Lower Salmon Lake.

Middle Salmon Lake.

Upper Salmon Lake.

Bassett Creek (Bassett Hotel).

*Middle Fork.**South Fork.*

## Sacramento River, etc.—Continued.

Feather River (Marysville, Oroville)—Continued.

*Bear River.*

Wolf Creek (near Grass Valley).

Rattlesnake Creek (near Grass Valley).

*Coon Creek.*

South Fork of Dry Creek (near Auburn).

*Dry Creek.*

Antelope Creek (near Auburn).

Secret Ravine (Rocklin).

American River (Folsom).

Arcade Creek (Arcade).

*North Fork.**Middle Fork.*

Rubicon River (Gerlé, Rubicon Springs).

Miller Creek (Miller Pass).

South Fork (Placerville).

Silver Creek (near Orelli).

South Fork Silver Creek (Jones).

San Joaquin River (lower) (Black Diamond, Marsh Landing, Jersey Landing).

*Mokelumne River.**Consumne River.*

North Fork (Pleasant Valley).

*South Fork.**North Fork Mokelumne River.*

Middle Fork Mokelumne River (West Point).

South Fork Mokelumne River (Railroad Flat).

Licking Creek (near mouth?).

Stockton Sloughs (locality not given).

*Calaveras River.*

San Antonio Creek (near Calaveras Grove).

*French Camp Creek.*

Stanislaus River (Parrot Ferry).

Tuolumne River (Modesto, Baker Ford).

*North Fork.**Middle Fork.**Upper Tuolumne River.*

South Fork (near mouth).

Merced River (Livingston, Benton Mill).

North Fork (Bower Cave).

*South Fork.**Bear Creek.**Mariposa River.*

Mariposa Creek (Mariposa).

Chouchilla River (near Raymond).

Fresno River (near Raymond).

Upper San Joaquin River (Pollasky, Fort Miller).

*South Fork San Joaquin River.**Kings River.**North Channel* (near Centerville).

China Slough.

Middle Channel (near Centerville).

South Channel (near Centerville).

*Middle Fork Kings River.**South Fork Kings River.*

San Joaquin River, etc.—Continued.

Kaweah River (Four Creeks).

St. Johns Channel (Lemon Cove).

Tule River (Porterville).

Poso Creek (near foothills).

Kern Lake (of Tulare Valley).

Kern River (near Bakersfield).

Whitney Creek = Volcano Creek.

Kern Lake.

South Fork Kern River.

Caliente Creek.

*Posa Chino Creek.*

*Los Gatos Creek.*

*Big Panoche Creek.*

*Los Banos Creek.*

*Orestimber Creek.*

Martinez Creek (hills back of Martinez).

#### DESCRIPTIVE NOTES.

The Sacramento River takes its rise in a group of small lakes in an elevated basin about 20 miles west of Sissons, Siskiyou County. The lakes are from 100 to 300 yards across and are separated by spurs of the mountains. On account of the heavy growth of timber and underbrush they are almost inaccessible. One, Cliff Lake, is deep; the others are quite shallow and evidently formed by glacial moraines. The shores of all are thickly strewn with fallen trees. The one known as Gumboot Lake lies farther to the westward and is the true source of the Sacramento River.

The river makes a rapid descent from the lakes to Box Canyon near Sissons, but there are no falls over 6 feet high. At the head of Box Canyon it receives Sullaway Creek, which is almost as large as the river itself at that point. It is in Sullaway Creek that the fry salmon from Sisson hatchery are planted.

The river continues in a narrow canyon almost to Redding, and is a typical mountain stream, a succession of rapids and pools. At Redding it leaves the mountains and passes through the foothills, becoming broader with fewer rapids. The last rapid of any moment is a few miles above Red Bluff, where the river cuts through a range of hills by what is known as Iron Canyon.

Below Iron Canyon the river becomes broader, though short rapids or riffles occur during the low water of summer. The current is swift throughout its length. Boats ascend as far as Red Bluff. The lower portion flows through a broad valley, and the floods from the winter rains have to be held in by levees. It is affected by the tides nearly 100 miles from its mouth, though the water is entirely fresh, as is also that of the upper portions of Suisun Bay into which the river empties.

The San Joaquin has much the same character as the Sacramento. The two rivers enter Suisun Bay side by side.

Pitt River is the largest tributary of the Sacramento, being much larger than the upper Sacramento. It is formed by the junction of the North and South Forks at Alturus, Modoc County.

North Fork of Pitt River rises immediately south of Goose Lake, and there is no doubt that in recent years it has drained the lake. The only barrier to the lake's drainage now is a gravel bank less than 8 feet high. This has evidently been formed

by ice bringing débris to the lower end of the lake, which it does even now, the lake, which is quite shallow, being less than 16 feet deep anywhere within 15 miles of the southern end.<sup>a</sup> On account of the evident recent connection between Goose Lake and Pitt River, as well as the identity of their faunas, the fishes of the lake are listed with those of the Sacramento-San Joaquin Basin.

North Fork of Pitt River, when seen in September, 1898, was a small stream, almost dry. There were a few pools where fishes lived, where even trout were found, but it was a very insignificant stream. A sawmill near its source fills the water with sawdust and doubtless does much damage to the fishes, though it is doubtful whether there are ever many valuable fishes in the stream.

South Fork of Pitt River is a larger stream, with pure water, but it is almost drained by irrigation ditches.

The upper Pitt River, above the mouth of Fall River, was nearly dry in August, 1898. What water it contained was of a slightly milky color. The rocks on the bottom were covered with a spongy slime. Such fishes as trout or salmon would not live in it at that time of year. This portion of the river traverses a high barren table-land. On the south are hills covered with sagebrush and scattered junipers; on the north are the lava beds known as the Devil's Garden. A hot spring is found near Canby, about 20 miles below Alturus.

At Fall River Mills, Pitt River receives Fall River, a stream about 100 feet wide and 4 feet deep, with a strong current, but only about 15 miles long. Fall River takes its rise in two or three large springs near Dana, and flows several times as much water as Pitt River above their union. The water is clear and cool and the bottom gravelly, making an excellent spawning stream for salmon, but difficult to attain on account of the steep rapid at its mouth as well as the fall in Pitt River.

Above the mouth of Fall River for a few miles, Pitt River is broad and deep, but without any perceptible current. Below the mouth of Fall River its character changes entirely. It is broad but shallow, very swift, with many rapids, and makes a rapid descent to the falls. Pitt River Falls, which are 65 feet high, are thought by many to rival in beauty any to be seen in the Yosemite Valley. The middle portion is a sheer fall, but each side is broken by ledges, so that it is possible in high water for fish to pass. A fish ladder has been blasted out of the rock near the left bank, and salmon now go over the falls in considerable numbers.

From the falls to its junction with the Sacramento a few miles above Redding, Pitt River has much the same character as the upper Sacramento, but is a much larger stream. A few miles below the falls Pitt River receives Hat Creek and Burney Creek. The former is a salmon stream of some importance, but it has a number of rapids that make its ascent difficult. Burney Creek has a fall near its mouth about 180 feet high.

McCloud River is the largest tributary of Pitt River. It is a clear and cool stream, twice the size of the upper Sacramento, and receives the southern and eastern drainage of Mount Shasta. There are three falls in the middle portion of

<sup>a</sup>The above statements concerning Goose Lake are made on the authority of several persons living near its southern end, some claiming that the barrier is only 3 feet high. In the account of the explorations of the Wheeler Survey in 1877, the following statement is made: "Goose Lake is merely a sink, as it has not run out by its old outlet, Pitt River, for many years. From the best evidence I could obtain, I found that it did run out through the river eight years ago [1869]."



the river, the lowest being 12 feet high. Adult salmon were seen immediately below this fall, but it is said that none pass it. McCloud River is an important salmon stream, and a government hatchery is situated at Baird, about 2 miles above its mouth.

Battle Creek is a swift mountain stream, rising by two branches and draining the western slope of Lassen Buttes. It empties into the Sacramento about midway between Redding and Red Bluff. It is the most important salmon stream of the basin, and a government hatchery is located at its mouth.

Feather River, next to Pitt River, is the largest tributary of the Sacramento. It drains the region between Lassen Buttes and Truckee, and is formed by the union of several secondary tributaries.

Duck Lake lies just west of Big Meadows and is tributary to North Fork of Feather River. It is a shallow lake, but is an important breeding place for trout.

Gold Lake lies high in the mountains east of Sierra Valley and is tributary to Middle Fork of Feather River. There are many other lakes in the vicinity, the more important being the Salmon Lakes and Sardine Lakes, tributary to a branch of Yuba River. They are so named from the salmon-colored trout found in the one and the small size of the trout found in the other.

The name Basset Creek is here used for the first time, designating the branch of North Fork of Yuba River whose course is followed by the Sierraville-Sierra City stage road.

American River drains the mountains west and south of Lake Tahoe and empties into the Sacramento near the city of Sacramento. It is almost dry in its lower course during the summer. The streams farther south, the Mokelumne, Stanislaus, Merced, and upper San Joaquin, are similar to the American, but larger. They rise near the crest of the Sierras, are formed by the union of north, middle, and south forks, flow at right angles to the San Joaquin, into which they empty, and have but little water in their lower courses during the summer.

North Fork of Merced River is separated from the main Merced River by a 12-foot fall. Mariposa Creek is a mere brook that during the summer empties into the dry bed of Mariposa River. Chouchilla and Fresno rivers are small streams that are lost in the sand long before they reach the San Joaquin.

Kings, Kaweah, Tulle, and Kern rivers drain the west slope of the southern portion of the Sierras. Their water hardly ever, or never, reaches the San Joaquin, being used largely for irrigation.

Tulare Lake, which at one time furnished fish to San Francisco markets, is now dry.

Two Kern Lakes have been recognized by collectors. One is in Tulare Valley and receives the drainage of Kern River during the rainy season; the other is an enlargement of the channel of Kern River near Mount Whitney, just below the mouth of Volcano Creek.

#### BIBLIOGRAPHICAL REVIEW.

The following bibliography includes all known records for this basin, with the names of the collectors wherever possible. Species recorded as new are distinguished in the tabulated lists by means of italics. A synonymy which includes the reference to the original description, a reference to each synonym that has been applied

to specimens reported from this territory, and page references to Jordan & Evermann's Fishes of North and Middle America, is given at the head of the notes on each species, in the later portion of the paper.

AGASSIZ, ALEXANDER.

1861-62. Notes on the described species of Holconoti found on the western coast of North America. Proceedings of the Boston Society of Natural History, vol. VIII, 1861-62, p. 122-133.

The paper is chiefly a list of synonyms, to which the author adds another, giving as his excuse that certain specimens had been so labeled and that doubtless other specimens similarly labeled had been sent to other museums. *Hysterochrysurus traski* and *Sargosomus fluviatilis* (given as a synonym) are recorded (p. 130) from the Sacramento region. Both are now identified as *Hysterochrysurus traskii*.

AGASSIZ, LOUIS.

1855. Synopsis of the ichthyological fauna of the Pacific slope of North America, chiefly from the collections made by the United States Exploring Expedition under the command of Capt. C. Wilkes, with recent additions and comparisons with eastern types. American Journal of Science and Arts, 1855, p. 71-99 and p. 215-231.

The author makes an extensive study of the genera of suckers and minnows. He noted only two of his species, *Catostomus occidentalis* and *Ptychocheilus major*, in the Sacramento-San Joaquin basin, and both of these he described as new. *Catostomus occidentalis*, however, had but a few weeks previously been described under the same name by Ayres. *Ptychocheilus major* (p. 229) is the present *P. grandis*. Agassiz's specimens were collected by F. G. Cary, jr.

AYRES, W. O.

1854a. Daily Placer Times and Transcript, May 30, 1854. Five new species are described, all of them collected by Dr. Ayres in the San Francisco markets. The paper is reviewed by Dr. Jordan in Proceedings of the U. S. National Museum for 1880, p. 325-327.

Species as reported.	Present identification.
<i>Leuciscus gibbosus</i> .....	<i>Leuciscus crassicauda</i> .
<i>Leuciscus microlepidotus</i> .....	<i>Orthodon microlepidotus</i> .
<i>Leuciscus gracilis</i> .....	<i>Ptychocheilus grandis</i> .
<i>Leuciscus macrolepidotus</i> .....	<i>Pogonichthys macrolepidotus</i> .
<i>Catostomus occidentalis</i> .....	<i>Catostomus occidentalis</i> .

1854b. New species of California fishes. Proceedings of the Boston Society of Natural History, vol. v, 1854, p. 94-103.

Describes on page 99 *Centrarchus maculosus*, now identified as *Archoplites interruptus*. Based on his own collections.

1854-57. Proceedings California Academy of Natural Sciences, vol. i, 1854-57.

In this volume appear a number of descriptions of fishes submitted by Dr. Ayres at various times. He had already described four of these species in the Daily Placer Times and Transcript, but lists them in the Academy Proceedings as if they were new, and to one, *Leuciscus gracilis*, he gives a new name, *Gila grandis*. The work is based on his own collections and specimens of trout collected by Dr. Winslow.

Page.	Species as reported.	Present identification.
8	<i>Centrarchus maculosus</i> .....	<i>Archoplites interruptus</i> .
18	<i>Catostomus occidentalis</i> .....	<i>Catostomus occidentalis</i> .
18	<i>Gila grandis</i> .....	<i>Ptychocheilus grandis</i> .
20	<i>Lavinia gibbosa</i> .....	<i>Leuciscus crassicauda</i> .
21	<i>Lavinia compressa</i> .....	<i>Lavinia exilicauda</i> .
21	<i>Gila microlepidota</i> .....	<i>Orthodon microlepidotus</i> .
32	<i>Catostomus labiatus</i> .....	<i>Catostomus occidentalis</i> .
33	<i>Mylopharodon robustus</i> .....	<i>Mylopharodon conocephalus</i> .
43	<i>Salmo rivularis</i> .....	<i>Salmo irideus</i> .
44	<i>Petromyzon ciliatus</i> .....	<i>Entosphenus tridentatus</i> .
47	<i>Gasterosteus serratus</i> .....	<i>Gasterosteus cataphractus</i> .
47	<i>Gasterosteus microcephalus</i> .....	<i>Gasterosteus cataphractus</i> .
47	<i>Gasterosteus plebeus</i> .....	<i>Gasterosteus cataphractus</i> .

## BEAN, TARLETON H.

1880. Check list of duplicates of North American fishes distributed by the Smithsonian Institution in behalf of the United States National Museum, 1877-1880. Proceedings of the U. S. National Museum, 1880, p. 75-116.

Page.	Species as reported.	Present identification.
106	<i>Salmo irideus</i> .....	<i>Salmo irideus</i> .
106	<i>Oncorhynchus quinnot</i> .....	<i>Oncorhynchus tshawytscha</i> .
107	<i>Salvelinus bairdii</i> .....	<i>Salvelinus malma</i> .

## COPE, EDWARD D.

1883. On the fishes of the Recent and Pliocene lakes of the western part of the Great Basin and of the Idaho Pliocene lake. Proceedings of the Academy of Natural Sciences of Philadelphia, 1883, p. 134-165.

In addition to the list of species are given notes on the geography and geology of the region, with a map. Collections by himself.

Page.	Species as reported.	Present identification.
143	<i>Myloleucus parovanus</i> .....	<i>Rutilus bicolor</i> .
144	<i>Myloleucus thalassinus</i> .....	<i>Rutilus bicolor</i> .
150	<i>Catostomus labiatus</i> .....	<i>Catostomus occidentalis</i> .

## EIGENMANN, C. H., and EIGENMANN, R. S.

1889a. Fishes of Aetna Springs, Napa County, Cal. West American Naturalist, 1889, p. 149.

Describes from this region (p. 149) *Phoxinus clevelandi*, later identified as *Leuciscus egregius*. Collected by D. Cleveland.

1889b. Fishes of Allen Springs, Lake County, California. West American Naturalist, 1889, p. 149. Collector, D. Cleveland.

Page.	Species as reported.	Present identification.
149	<i>Ptychocheilus oregonensis</i> .....	<i>Ptychocheilus grandis</i> .
149	<i>Salmo irideus</i> .....	<i>Salmo irideus</i> .
149	<i>Uranidea semiscaber centropleura</i> .....	<i>Cottus gulosus</i> .

## EIGENMANN, C. H., and ULREY, ALBERT B.

1892. A review of the Embiotocidæ. Bulletin U. S. Fish Commission, vol. XII, 1892, p. 382-400.

Gives a complete synonymy for each species of the family. Records (p. 399) *Hysteroecarpus traskii* from this region.

## GIBBONS, W. P.

1854a. Descriptions of new species of viviparous fishes from Sacramento River and the Bay of San Francisco. Daily Placer Times and Transcript, May 18, 1854.

Among the descriptions here given is the first description of new species based on specimens from Sacramento basin. Only one species, *Hysteroecarpus traskii*, came within our notice. Collected by a Mr. Morris, and forwarded by Dr. J. B. Trask. Locality not given.

1854b. Description of new species of viviparous fishes from Sacramento River and the Bay of San Francisco. Proceedings Academy of Natural Sciences of Philadelphia, 1854, p. 105-106.

One fresh-water species described (p. 105), with a form called "var. B." This is *Hysteroecarpus traskii*, which had been previously described in the Daily Placer Times and Transcript May 18, 1854.

1854c. Description of new species of viviparous marine and fresh-water fishes from the Bay of San Francisco, and from the river and lagoons of the Sacramento. Proceedings Academy of Natural Sciences of Philadelphia, 1854, p. 122-126.

Describes several new genera and species, among which is the genus *Hysteroecarpus* (p. 124). *Hysteroecarpus traskii* is redescribed, the variation called "var. A" instead of "var. B," as on page 106.

## GILL, THEODORE.

1862. Note on some genera of fishes of western North America. Proceedings of the Academy of Natural Sciences of Philadelphia, 1862, p. 329-332.

A list of names without localities. The only point in which this paper touches the present report is in furnishing (p. 331) an additional synonym for one of the lampreys. This is a name merely, without description or locality—*Entosphenus epihexodon*, now *Entosphenus tridentatus*.

## GIRARD, CHARLES.

1854. Description of new fishes collected by Dr. A. L. Heermann, naturalist attached to the survey of the Pacific Railroad route, under Lieut. R. S. Williamson, U. S. A. Proceedings Academy of Natural Sciences of Philadelphia, 1854, p. 129-140.

Page.	Species as reported.	Present identification.
129	<i>Centrarchus interruptus</i> .....	<i>Archoplites interruptus</i> .
129	<i>Cottopsis gulosus</i> .....	<i>Cottus gulosus</i> .
133	<i>Gasterosteus microcephalus</i> .....	<i>Gasterosteus cataphractus</i> .
135	<i>Gila conocephala</i> .....	<i>Mylopharodon conocephalus</i> .
136	<i>Pogonichthys inaequilobus</i> .....	<i>Pogonichthys macrolepidotus</i> .
136	<i>Pogonichthys symmetricus</i> .....	<i>Rutilus symmetricus</i> .
137	<i>Lavinia exilicauda</i> .....	<i>Lavinia exilicauda</i> .
137	<i>Lavinia crassicauda</i> .....	<i>Leuciscus crassicauda</i> .
137	<i>Lavinia conformis</i> .....	<i>Leuciscus conformis</i> .
137	<i>Leucosomus occidentalis</i> .....	<i>Rutilus symmetricus</i> .

1856. Researches upon the cyprinoid fishes inhabiting the fresh waters of the United States of America west of the Mississippi Valley, from specimens in the Museum of the Smithsonian Institution. Proceedings of the Academy of Natural Sciences of Philadelphia, 1856, p. 165-209.

Page.	Species as reported.	Present identification.
169	<i>Mylopharodon conocephalus</i> .....	<i>Mylopharodon conocephalus</i> .
169	<i>Mylopharodon robustus</i> .....	<i>Mylopharodon conocephalus</i> .
174	<i>Catostomus occidentalis</i> .....	<i>Catostomus occidentalis</i> .
182	<i>Orthodon microlepidotus</i> .....	<i>Orthodon microlepidotus</i> .
183	<i>Algansea bicolor</i> .....	<i>Rutilus bicolor</i> .
183	<i>Algansea formosa</i> .....	<i>Rutilus symmetricus</i> .
184	<i>Lavinia exilicauda</i> .....	<i>Lavinia exilicauda</i> .
188	<i>Pogonichthys inaequilobus</i> .....	<i>Pogonichthys macrolepidotus</i> .
188	<i>Pogonichthys symmetricus</i> .....	<i>Rutilus symmetricus</i> .
206	<i>Tigoma conformis</i> .....	<i>Leuciscus conformis</i> .
207	<i>Tigoma crassa</i> .....	<i>Leuciscus crassicauda</i> .
208	<i>Siboma crassicauda</i> .....	<i>Leuciscus crassicauda</i> .
209	<i>Ptychocheilus grandis</i> .....	<i>Ptychocheilus grandis</i> .

1857. In Pacific Railway Survey Reports, vol. x, Zoological report no. 4, 1857.

Under Lieut. E. G. Beckwith's report of the survey of the 38th and 39th parallel, on the fishes collected, are listed (p. 23) *Lavinia exilicauda* and *Pogonichthys inaequilobus* (now *P. macrolepidotus*) from the Sacramento River. Collected by Dr. A. L. Heermann.

1857. In Pacific Railway Survey Reports, vol. vi, 1857, pt. iv, Zoological report no. 1.

Under Lieut. Henry L. Abbot's report of explorations for a railway from the Sacramento Valley to the Columbia River, among the fishes recorded are the following from the Sacramento basin. Collected by Dr. J. S. Newberry, with assistance of Dr. J. F. Hammond.

Page.	Species as reported.	Present identification.
9	<i>Ambloplites interruptus</i> .....	<i>Archoplites interruptus</i> .
10	<i>Cottopsis gulosus</i> .....	<i>Cottus gulosus</i> .
26	<i>Hysteroecarpus traskii</i> .....	<i>Hysteroecarpus traskii</i> .
27	<i>Mylopharodon robustus</i> .....	<i>Mylopharodon conocephalus</i> .
28	<i>Catostomus occidentalis</i> .....	<i>Catostomus occidentalis</i> .
28	<i>Orthodon microlepidotus</i> .....	<i>Orthodon microlepidotus</i> .
29	<i>Lavinia exilicauda</i> .....	<i>Lavinia exilicauda</i> .
30	<i>Tigoma crassa</i> .....	<i>Leuciscus crassicauda</i> .
31	<i>Ptychocheilus grandis</i> .....	<i>Ptychocheilus grandis</i> .
33	<i>Salar iridea</i> .....	<i>Salmo irideus</i> .

GIRARD, CHARLES—Continued.

1858. Pacific Railway Survey Reports, vol. x, pt. iv, Fishes, 1858.

Most of the new species had been previously described in various papers. Twenty-one nominal species are recorded from the Sacramento-San Joaquin basin. The collections were made by Dr. Heermann, Dr. Newberry, Dr. Kennerly, and Dr. Hammond, as indicated specifically in subsequent pages of this paper.

Page.	Species as reported.	Present identification.
10	<i>Ambloplites interruptus</i> .....	<i>Archoplites interruptus</i> .
53	<i>Cottopsis gulosus</i> .....	<i>Cottus gulosus</i> .
54	<i>Cottopsis parvus</i> .....	<i>Cottus asper</i> .
91	<i>Gasterosteus microcephalus</i> .....	<i>Gasterosteus cataphractus</i> .
190	<i>Hysteroecarpus traskii</i> .....	<i>Hysteroecarpus traskii</i> .
216	<i>Mylopharodon conocephalus</i> .....	<i>Mylopharodon conocephalus</i> .
216	<i>Mylopharodon robustus</i> .....	<i>Mylopharodon conocephalus</i> .
224	<i>Catostomus occidentalis</i> .....	<i>Catostomus occidentalis</i> .
237	<i>Orthodon microlepidotus</i> .....	<i>Orthodon microlepidotus</i> .
239	<i>Algansea formosa</i> .....	<i>Rutilus symmetricus</i> .
241	<i>Lavinia exilicauda</i> .....	<i>Lavinia exilicauda</i> .
245	<i>Pogonichthys inaequilobus</i> .....	<i>Pogonichthys macrolepidotus</i> .
246	<i>Pogonichthys symmetricus</i> .....	<i>Rutilus symmetricus</i> .
280	<i>Luxilus occidentalis</i> .....	<i>Lavinia exilicauda</i> .
289	<i>Tigoma conformis</i> .....	<i>Leuciscus conformis</i> .
293	<i>Tigoma crassa</i> .....	<i>Leuciscus crassicauda</i> .
296	<i>Siboma crassicauda</i> .....	<i>Leuciscus crassicauda</i> .
299	<i>Ptychocheilus grandis</i> .....	<i>Ptychocheilus grandis</i> .
321	<i>Salmo iridea</i> .....	<i>Salmo trideus</i> .
377	<i>Petromyzon tridentatus</i> .....	<i>Entosphenus tridentatus</i> .
378	<i>Petromyzon ciliatus</i> .....	<i>Entosphenus tridentatus</i> .

1859a. In Pacific Railway Survey Reports, vol. x, pt. vi, Zoological report no. 5, 1859.

In Lieutenant Whipple's report of the survey of the 35th parallel is recorded (p. 47) the occurrence of *Ambloplites interruptus*, now *Archoplites interruptus*. Collector Dr. C. B. Kennerly.

1859b. In Pacific Railway Survey Reports, vol. x, Zoological report no. 4.

In the report of the survey near the 32d parallel the following species are recorded from the Sacramento-San Joaquin basin. Collector Dr. A. L. Heermann.

Page.	Species as reported.	Present identification.
83	<i>Ambloplites interruptus</i> .....	<i>Archoplites interruptus</i> .
84	<i>Cottopsis gulosus</i> .....	<i>Cottus gulosus</i> .
85	<i>Gasterosteus mlercephalus</i> .....	<i>Gasterosteus cataphractus</i> .
88	<i>Mylopharodon robustus</i> .....	<i>Mylopharodon conocephalus</i> .
88	<i>Mylopharodon robocephalus</i> .....	<i>Mylopharodon conocephalus</i> .
88	<i>Algansea formosa</i> .....	<i>Rutilus symmetricus</i> .
89	<i>Lavinia exilicauda</i> .....	<i>Lavinia exilicauda</i> .
89	<i>Pogonichthys inaequilobus</i> .....	<i>Pogonichthys macrolepidotus</i> .
89	<i>Pogonichthys symmetricus</i> .....	<i>Rutilus symmetricus</i> .
89	<i>Luxilus occidentalis</i> .....	<i>Lavinia exilicauda</i> .
90	<i>Tigoma conformis</i> .....	<i>Leuciscus conformis</i> .
90	<i>Tigoma crassa</i> .....	<i>Leuciscus crassicauda</i> .
90	<i>Siboma crassicauda</i> .....	<i>Leuciscus crassicauda</i> .

JORDAN, DAVID STARR.

1878. A synopsis of the family Catostomidae. Bulletin 12, U. S. National Museum, 1878, p. 97-237.

A comprehensive review, with localities, synonymy, bibliography, and index. Describes a nominal species from this basin, *Catostomus arcopus* (p. 173), and reports *Catostomus occidentalis* (p. 172). *C. arcopus* is now identified with *C. occidentalis*.

1892. A description of the golden trout of Kern River, California. Proceedings of the U. S. National Museum, 1892, p. 481.

Reports, on page 481, *Salmo mykiss aqua-bonita*, now called *Salmo trideus aqua-bonita*, collected in Whitney Creek by "Mr. Harvey, of Lone Pine, Cal."

JORDAN, DAVID STARR—Continued.

1894. Descriptions of new varieties of trout. Thirteenth Biennial Report of the California Fish Commission 1894, p. 142-143, with plates of each species described. Collections by C. H. Gilbert, 1893, and by Livingston Stone at various times.

Page.	Name as reported.	Present identification.
142	<i>Salmo irideus stonet</i> .....	<i>Salmo irideus</i> .
142	<i>Salmo gairdneri shasta</i> .....	<i>Salmo irideus</i> .
143	<i>Salmo gairdneri gilberti</i> .....	<i>Salmo irideus</i> .

1896. Notes on fishes little known or new to science. Proceedings of the California Academy of Science, 1896, p. 201-244.

Describes *Cottus shasta* Jordan & Starks, which is now identified as *Cottus gulosus*. Collected by E. C. Starks in McCloud River, 1894.

JORDAN, D. S., and GILBERT, C. H.

1881. Notes on the fishes of the Pacific coast of the United States. Proceedings of the U. S. National Museum, 1881, p. 29-70. Collector, Livingston Stone.

Page.	Species as reported.	Present identification.
38	<i>Salmo irideus</i> .....	<i>Salmo irideus</i> .
38	<i>Salmo gairdneri</i> .....	<i>Salmo gairdneri</i> .
39	<i>Oncorhynchus choulcha</i> .....	<i>Oncorhynchus tshawytscha</i> .
39	<i>Oncorhynchus gorbuscha</i> .....	<i>Oncorhynchus gorbuscha</i> .
51	<i>Hysterocarpus traski</i> .....	<i>Hysterocarpus traskii</i> .
69	<i>Gasterosteus microcephalus</i> .....	<i>Gasterosteus cataphractus</i> .

1881. Description of a new species of *Ptychocheilus* (*Ptychocheilus harfordi*) from Sacramento River. Proceedings of the U. S. National Museum, 1881, p. 72-73.

Describes on page 72 *Ptychocheilus harfordi*, now identified as *P. grandis*.

1894. List of the fishes inhabiting Clear Lake, California. Bulletin U. S. Fish Commission, vol. xiv, 1894, p. 139-140. Collections by the authors.

Page.	Species as reported.	Present identification.
139	<i>Entosphenus tridentatus</i> .....	<i>Entosphenus tridentatus</i> .
139	<i>Catostomus occidentalis</i> .....	<i>Catostomus occidentalis</i> .
139	<i>Lavinia exilicauda</i> .....	<i>Lavinia exilicauda</i> .
139	<i>Orthodon microlepidotus</i> .....	<i>Orthodon microlepidotus</i> .
139	<i>Leuciscus crassicauda</i> .....	<i>Leuciscus crassicauda</i> .
139	<i>Ptychochellus oregonensis</i> .....	<i>Ptychochellus grandis</i> .
139	<i>Ptychochellus harfordi</i> .....	<i>Ptychochellus grandis</i> .
139	<i>Pogonichthys macrolepidotus</i> .....	<i>Pogonichthys macrolepidotus</i> .
139	<i>Salmo mykiss irideus</i> .....	<i>Salmo irideus</i> .
140	<i>Gasterosteus microcephalus</i> .....	<i>Gasterosteus cataphractus</i> .
140	<i>Archoplites interruptus</i> .....	<i>Archoplites interruptus</i> .
140	<i>Cottus gulosus</i> .....	<i>Cottus gulosus</i> .
140	<i>Hysterocarpus traski</i> .....	<i>Hysterocarpus traskii</i> .
140	<i>Cyprinus carpio</i> .....	<i>Cyprinus carpio</i> .
140	<i>Amelurus nebulosus</i> .....	<i>Amelurus nebulosus</i> .
140	<i>Amelurus catus</i> .....	<i>Amelurus catus</i> .
140	<i>Micropterus dolomieu</i> .....	<i>Micropterus dolomieu</i> .

JORDAN, D. S., and HENSHAW, H. W.

1878. Annual Report U. S. Geological Survey, 1878, app. NN, p. 187-205, Wheeler Survey, Zoology, Report of the fishes collected. H. W. Henshaw, collector.

Page.	Species as reported.	Present identification.
188	<i>Catostomus arcopus</i> .....	<i>Catostomus occidentalis</i> .
193	<i>Leucos formosus</i> .....	<i>Rutilus symmetricus</i> .
194	<i>Salmo irideus</i> .....	<i>Salmo irideus</i> .
196	<i>Salmo tsuppitch</i> .....	<i>Salmo irideus</i> .
197	<i>Salmo henshawi</i> .....	<i>Salmo irideus</i> .
198	<i>Salmo pleuriticus</i> .....	<i>Salmo irideus</i> .
199	<i>Ambloplites interruptus</i> .....	<i>Archoplites interruptus</i> .
199	<i>Uranidea gulosa</i> .....	<i>Cottus gulosus</i> .

JORDAN, D. S., and JOUY, PIERRE L.

1881. Check list of duplicate fishes from the Pacific coast of North America, distributed by the Smithsonian Institution in behalf of the United States National Museum. Proceedings of the U. S. National Museum, 1881, p. 1-18.

Page.	Species as reported.	Present identification.
1	<i>Gasterosteus microcephalus</i> .....	<i>Gasterosteus cataphractus</i> .
5	<i>Cottopsis gulosus</i> .....	<i>Cottus gulosus</i> .
5	<i>Cottopsis asper</i> .....	<i>Cottus asper</i> .
10	<i>Hysterocarpus traskii</i> .....	<i>Hysterocarpus traskii</i> .
12	<i>Archoplites interruptus</i> .....	<i>Archoplites interruptus</i> .
14	<i>Salmo irideus</i> .....	<i>Salmo irideus</i> .
14	<i>Oncorhynchus kisutch</i> .....	<i>Oncorhynchus kisutch</i> .
14	<i>Oncorhynchus choulcha</i> .....	<i>Oncorhynchus tshawytscha</i> .
15	<i>Orthodon microlepidotus</i> .....	<i>Orthodon microlepidotus</i> .
15	<i>Squalus gibbosus</i> .....	<i>Leuciscus crassicauda</i> .
15	<i>Ptychocheilus oregonensis</i> .....	<i>Ptychocheilus grandis</i> .
15	<i>Ptychocheilus harfordi</i> .....	<i>Ptychocheilus grandis</i> .
16	<i>Pogonichthys macrolepidotus</i> .....	<i>Pogonichthys macrolepidotus</i> .
16	<i>Mylopharodon conocephalus</i> .....	<i>Mylopharodon conocephalus</i> .
16	<i>Catostomus occidentalis</i> .....	<i>Catostomus occidentalis</i> .
16	<i>Amiurus catus</i> .....	<i>Amelurus catus</i> .

LOCKINGTON, W. N.

1878-9. Report upon the food fishes of San Francisco. Report of the California Fish Commission, 1878-9, p. 17-58.

Lists the food fishes observed by the author in the San Francisco markets, excepting the salmon, giving notes and descriptions. At the close of the report is a table giving the relative abundance of the various fishes during each of the 12 months ending September 30, 1879. The following are listed from the Sacramento-San Joaquin basin.

Page.	Species as reported.	Present identification.
21	<i>Archoplites interruptus</i> .....	<i>Archoplites interruptus</i> .
50	<i>Gila grandis</i> .....	<i>Ptychocheilus grandis</i> .
50	<i>Pogonichthys inaequalis</i> .....	<i>Pogonichthys macrolepidotus</i> .
50	<i>Orthodon microlepidotus</i> .....	<i>Orthodon microlepidotus</i> .
50	<i>Siboma crassicauda</i> .....	<i>Leuciscus crassicauda</i> .
50	<i>Lavinia exilicauda</i> .....	<i>Lavinia exilicauda</i> .
50	<i>Catostomus occidentalis</i> .....	<i>Catostomus occidentalis</i> .

## KEY TO THE FISHES OF THE SACRAMENTO BASIN.

- A. Body eel-shaped, no lower jaw. Lampreys.  
 B. Supra-oral lamina with 3 teeth, the middle one large. Size large. Anadromous lamprey.  
     ENTOSPHEMUS TRIDENTATUS  
 BB. Supra-oral lamina with a tooth at each end, none or a very small one in middle. Size small.  
     Brook lamprey ..... LAMPETRA CIBARIA  
 AA. Body not eel-shaped; lower jaw present.  
 C. Skin smooth or covered with prickles.  
 D. Dorsal and pectoral fins each with a strong spine. Catfishes..... AMEIURUS  
 E. Caudal fin truncate or rounded..... AMEIURUS NEBULOSUS  
 EE. Caudal fin forked or deeply emarginate..... AMEIURUS CATUS  
 DD. Pectoral fin without spines.  
 F. Ventral rays 1, 4 ..... COTTUS  
 G. Skin entirely asperate..... COTTUS ASPER  
 GG. Skin smooth except for a patch of prickles behind pectorals..... COTTUS GULOSUS  
 GGG. Skin entirely smooth.  
 H. Eye large, .3 of head..... COTTUS MACROPS  
 HH. Eye smaller, less than .3 of head..... COTTUS BELDINGII  
 FF. Ventral rays 1, 3 ..... COTTUS ASPERRIMA  
 CC. Sides crossed by a few vertical bony plates..... GASTEROSTEUS CATAPHRACTUS  
 CCC. Body scaly.  
 I. No teeth in mouth.  
 J. Lips very large and covered with coarse papillæ. Suckers.  
 K. Edges of jaws with hard cartilaginous sheaths; a notch at corner of mouth  
     between upper and lower lips..... PANTOSTEUS LAHONTAN  
 KK. Mouth and lips not as above..... CATOSTOMUS  
 L. Fontanelle almost obliterated in specimens 6 inches long  
     CATOSTOMUS MICROPS  
 LL. Fontanelle large.  
 M. Dorsal with 10 or 11 rays; scales small, 80 to 95 in lateral line  
     CATOSTOMUS TAHOENSIS  
 MM. Dorsal with 12 to 14 rays, scales larger, 60 to 80 in lateral line  
     CATOSTOMUS OCCIDENTALIS  
 JJ. Lips not large nor papillose.  
 N. Anal fin short (in species here considered), with fewer than 15  
     rays. Minnows.  
 O. Dorsal with a serrated spine..... CYPRINUS CARPIO  
 OO. Dorsal without spine. Native minnows.  
 P. Scales very fine, over 100 in lateral line. ORTHODON MICROLEPIDOTUS  
 PP. Fewer than 100 scales in lateral line.  
 Q. Upper lip with a frenum..... MYLOPHARODON CONOCEPHALUS  
 QQ. Upper lip without frenum.  
 R. Mouth large, maxillary extending to below eye; large pike-  
     like fishes..... PTYCHOCEILUS GRANDIS  
 RR. Mouth small, body more or less compressed.  
 S. Pharyngeal teeth in two rows..... LEUCISCUS  
 T. Tail very deep.  
     U. Anal with 8 or 9 rays, tail much compressed  
         LEUCISCUS CRASSICAUDA  
     UU. Anal with 10 or 11 rays, tail not so much compressed  
         LEUCISCUS CONFORMIS



- TT.* Tail more slender, sides with a red stripe. Size about 4 inches.....LEUCISCUS EGREGIUS
- SS.* Pharyngeal teeth in one row.  
*V.* Body much compressed, anal rays 11 or 12  
 LAVINIA EXILICAUDA
- VV.* Body but little compressed. Anal rays about 8.  
*W.* Pharyngeal teeth 5-5 or 4-5.....RUTILUS
- X.* Body more compressed, tail heavier, its depth about .12 of body length.....RUTILUS BICOLOR
- XX.* Body more nearly round; tail more slender, about .09 of body.....RUTILUS SYMMETRICUS
- WW.* Pharyngeal teeth 4-4. Small fishes, less than 4 inches long.....AGOSIA ROBUSTA
- NN.* Anal fin with about 20 rays. Shad.....ALOSA SAPIDISSIMA
- II. Jaws with teeth.**
- a.* Adipose fin present, fins without spines.
- b.* Scales small, over a hundred in lateral line. Salmons and trouts.
- c.* Anal fin with 14 to 17 rays .....ONCORHYNCHUS
- d.* Scales very fine, over 200 cross series above lateral line  
 ONCORHYNCHUS GORBUSCHA
- dd.* Scales larger, 138 to 155 cross series, pyloric caeca about 150.  
*e.* Anal 13 or 14, black spots obsolete, branchiostegals 13 or 14  
 ONCORHYNCHUS KETA
- ee.* Anal 16, back and upper fins with smaller black spots, branchiostegals 15 to 19 .....ONCORHYNCHUS TSCHAWYTSCHA
- ddd.* Scales large, 125 to 135 cross series, pyloric caeca 50 to 80  
 ONCORHYNCHUS KISUTCH
- cc.* Anal fin with 9 to 12 rays.  
*f.* Scales 115 to 175.....SALMO IRIDEUS
- ff.* Scales about 240.....SALVELINUS MALMA
- bb.* Scales large, about 70 in lateral line.....OSMERUS THALEICHTHYS
- aa.* No adipose fin; dorsal and anal with spines.  
*g.* Scales cycloid; viviparous .....HYSTEROCARPUS TRASKII
- gg.* Scales ctenoid; oviparous.  
*h.* Side of body without longitudinal stripes  
 ARCHOPLITES INTERRUPTUS
- hh.* Side of body with longitudinal stripes.....ROCCUS LINEATUS

## NATIVE FRESH-WATER SPECIES.

1. *Entosphenus tridentatus* (Gairdner). *Lamprey*.

- Petromyzon tridentatus* Gairdner, in Richardson, Fauna Boreali-Americana, p. 293, 1836, Falls of the Willamette.
- Petromyzon ciliatus* Ayres, Proc. Cal. Ac. Sci., 1885, p. 44, San Francisco.
- Entosphenus ciliatus* Gill, Proc. Ac. Nat. Sci. Phila., 1862, p. 331, San Francisco.
- Entosphenus epixezodon* Gill, Proc. Ac. Nat. Sci. Phila., 1862, p. 331, Fort Reading.
- Lampetra*, sp. *incert.*, Jordan & Henshaw, Wheeler Survey, Report U. S. Geological Survey, 1878, p. 187, Goose Lake.
- Entosphenus tridentatus*, Jordan & Evermann, Fishes of North and Middle America, Bulletin 47, U. S. Nat. Mus., p. 13, 1896.

This is an anadromous species that has become landlocked in Goose Lake and Clear Lake. A specimen 7 inches long from Goose Lake has the fringe of the buccal disk a little heavier than a specimen of the same length from Pacific Grove; otherwise the two can not be distinguished. Jordan & Henshaw's larval *Lampetra* from Goose Lake was doubtless this species.

The adults can be distinguished from *Lampetra cibaria* by the presence of a tooth in the middle of the supra-oral lamina in addition to one at each end.

## LOCAL DISTRIBUTION.

Locality.	Stream or lake.	Collector.	Name as reported.	Authority.
San Francisco.....	San Francisco Bay.....	Ayres.....	Petromyzon ciliatus.....	Ayres, 1854-1857.
do.....	do.....	do.....	do.....	Girard, 1858.
Sissons.....	Sullaway Creek.....	Rutter & Chamberlain.....	Entosphenus tridentatus.....	Jordan & Henshaw.
	Goose Lake.....	Henshaw.....	Lampetra sp.....	
South Fork post-office.....	South Fork Pitt River.....	Rutter & Chamberlain.....	Entosphenus tridentatus.....	Girard, 1858.
Fort Redding.....	Cow Creek.....	Heermann.....	Petromyzon tridentatus.....	
	do.....	do.....	Entosphenus ephexodon.....	Gill.
	Clear Lake.....	Jordan.....	Entosphenus tridentatus.....	Jordan & Gilbert, 1894.
Parrot Ferry.....	Stanislaus.....	Rutter & Atkinson.....	do.....	

2. *Lampetra cibaria* (Girard). *Western Brook Lamprey.*

*Petromyzon plumbeus* Ayres, Proc. Cal. Ac. Nat. Sci. 1854, p. 28, San Francisco.

*Ammocetes cibarius* Girard, Pac. Ry. Survey, p. 383, 1859, larva, Puget Sound.

*Lampetra cibaria*, Jordan & Evermann, Fishes of North and Middle America, pt. 1, p. 13, 1896.

Diameter of buccal disk 3.3 in head in front of first gill opening. Supraoral lamina with a tooth at each end, none in middle; middle denticle of lingual tooth enlarged; infraoral lamina crescent shaped with 7 teeth, the 2 outer bicuspid; 3 teeth on each side of mouth, the middle one of each series tricuspid, the others bicuspid; several incuspid teeth above mouth; diameter of eye 1.5 in distance from eye to first gill opening; head in front of first gill opening 8.5 in body; dorsal fins separated by one-seventh the length of the anterior fin; a broad notch in second dorsal near posterior end; greatest depth equal to length of snout.

## LOCAL DISTRIBUTION.

Locality.	Stream.	Basin division.	Collector.	Name as reported.	Authority.
San Francisco.....	San Francisco Bay.....	Sacramento ..	Ayres.....	Petromyzon plumbeus	Ayres, 1854-1857.
At mouth of Feather River.	Sacramento River.....	do.....	Rutter & Chamberlain.	Lampetra cibaria.....	

3. *Pantosteus lahontan* Rutter.

*Pantosteus lahontan* Rutter, Bul. U. S. Fish Comm. for 1902 (March 31, 1903), p. 146, Suisun River (type no. 50587, U.S.N.M.) Coll. Rutter & Chamberlain.

Taken only in the headwaters of North Fork of Feather River—Warner Creek at Johnsons, and North Fork of Feather River at Big Meadows, by Rutter and Chamberlain. Largest specimen 3.7 inches long.

4. *Catostomus microps* Rutter, new species.

Head 4.5 in length; depth 4.7; eye 6.5 in head (6-inch specimen), 2.2 to 2.3 in interorbital space, which equals snout; dorsal 11; anal 7; scales 17-81 to 87-14, lateral line complete; body heavy; head small, conical; snout blunt; interorbital space rounded, cross section of head being nearly circular; eye small, in middle of head; mouth small, lips thick, 2 rows of papillæ on upper; lower lip deeply incised, 1 row of papillæ across symphysis, 5 cross rows on lobes; cartilaginous sheaths well developed in both jaws; fontanelle almost obsolete in specimens 6 inches long; origin of dorsal in middle of body, its height 1.5 in head, its margin slightly rounded anteriorly; anal reaching rudimentary caudal rays; ventrals about 1.5 in head; pectorals 1.2; caudal 1 to 1.2, deeply emarginate or slightly forked; depth of caudal peduncle 2.7 in head; peritoneum dusky.

Differs from the related species, *occidentalis*, found in the same region and from *snyderi* from the Klamath region in the very small eye, small conical head, and small scales, and in the nearly closed fontanelle. The lips are not notched at the corner, as in *Pantosteus*.

Three specimens from Rush Creek, a small tributary of Ash Creek, near Aden, Modoc County, Cal., collected by Rutter and Chamberlain, September 1, 1898. Type no. 58496, U. S. National Museum. Their measurements, in hundredths of the body length, are given in the following table:

Length of body.....mm.	134	103	89	Insertion anal .....	0.79	0.78	0.79
Length head.....	.22	.23	.23	Length dorsal.....	.15	.15	.15
Depth.....	.205	.22	.22	Height dorsal.....	.16	.16	.165
Diameter orbit.....	.035	.04	.04	Dorsal rays.....	11	10	11
Interorbital space.....	.09	.09	.09	Anal rays.....	7	7	7
Length snout.....	.105	.10	.10	Scales in lateral line.....	82	81	81
Depth caudal peduncle.....	.085	.09	.09	Scales above lateral line.....	15	16	16
Length caudal peduncle.....	.17	.16	.16	Scales below lateral line.....	11	11	11
Insertion dorsal.....	.49	.51	.51	Scales before dorsal.....	40	40	41
Insertion ventral.....	.50	.57	.58				

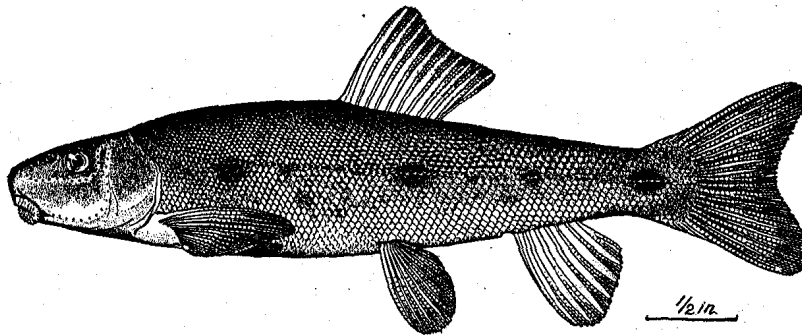


Fig. 1.—*Catostomus microps*, new species. Type.

5. *Catostomus tahoensis* Gill & Jordan. *Tahoe Sucker*.

*Catostomus tahoensis* Gill & Jordan, Bul. U. S. Nat. Mus., XII, p. 173, 1878. Jordan and Evermann, *Fishes of North and Mid. Amer.*, pt. I, p. 177, 1896.

Head 4.4 in length; depth 4.7; eye 5.5 in head, 2.4 in snout, 2.5 in interorbital space, and 1.6 in distance between eye and upper end of gill opening. Interorbital 2.4 in top of head; width of isthmus 4.8 in head, 1.5 in distance between eye and gill opening, 1.6 in width of operculum, and equal to distance between corners of mouth. (Measurements made on a specimen 6.5 inches long.) Dorsal 10 or 11, scales 16-90-14.

Body heavy, profile gradually arched from snout to dorsal; mouth rather small, lips rather large, but somewhat variable in size, covered with coarse tubercles; upper lip with two rows of tubercles and a few scattered ones representing a third outer row; lower lip with one row across symphysis (3 in one specimen with extra large lips), 3 or 4 rounded tubercles and 3 or 4 others coalesced into a continuous ridge in a longitudinal row through lobes; lower lip deeply incised, the margin of lobes hardly reaching vertical through edge of anterior nostril. Orbital rim well developed, leaving a slight groove between it and the middle ridge of interorbital, but the thick skin preventing the groove from showing, the interorbital space being evenly rounded. Origin of dorsal in middle of body, its length about 1.2 in its height. Insertion of ventrals under fourth or fifth ray of dorsal, their length less than height of dorsal. Caudal 1.2 in head, not deeply forked, the middle rays 1.3 in longest. Anal high, reaching well upon caudal, height equal to length of caudal; pectoral a little shorter than caudal. Caudal peduncle compressed, its thickness above end of anal 0.7 its least depth, which is 2.6 in head. Lateral line straight, complete. Peritoneum silvery, thickly dusted with black. Sides often reddish.

Description based on 4 specimens 5 to 6.5 inches long from Warner Creek, a tributary of North Fork of Feather River. The following table gives the variation in the number of scales in the lateral line in specimens from four localities:

Scales.	Warner Creek.	Duck Lake.	Beckwith.	Miller Creek.	Scales.	Warner Creek.	Duck Lake.	Beckwith.	Miller Creek.
	<i>Specimens.</i>	<i>Specimens.</i>	<i>Specimens.</i>	<i>Specimens.</i>		<i>Specimens.</i>	<i>Specimens.</i>	<i>Specimens.</i>	<i>Specimens.</i>
80.....			1	1	89.....			2	1
81.....				1	90.....				3
82.....					91.....			1	1
83.....				1	92.....			1	1
84.....				1	93.....			1	2
85.....				1	94.....			1	
86.....	1			1	95.....		1		2
87.....				2	96.....	1			
88.....				2					

## LOCAL DISTRIBUTION.

Locality.	Stream or lake.	Basin division.	Collector.
Johnsons ranch.....	Warner Creek.....	Lahontan.....	Rutter & Chamberlain.
Big Meadows.....	North Fork Feather River.....	do.....	do.
Do.....	Duck Lake.....	do.....	do.
Beckwith.....	North Fork Feather River.....	do.....	Rutter & Atkinson.
Miller Pass.....	Miller Creek.....	do.....	do.

The specimens from Miller Creek were obtained at its source in Miller Pass, at an elevation of 7,100 feet, with several miles of impassable waterfalls either on the Lake Tahoe or Sacramento side. Trout from Lake Tahoe have been planted in the stream, and it may be that suckers were accidentally introduced at the same time.

6. *Catostomus occidentalis* Ayres. *Western Sucker.*

*Catostomus occidentalis* Ayres, Daily Placer Times and Transcript, May 30, 1854, San Francisco markets. Agassiz, Amer. Jour. Sci. Arts 1855, p. 94. Jordan & Evermann, Fishes of North & Mid. Amer., pt. 1, p. 178, 1896.

*Catostomus labiatus* Ayres, Proc. Cal. Ac. Sci. 1855, p. 32, Stockton.

*Catostomus areopus* Jordan, Bul. U. S. Nat. Mus. 1878, p. 173, South Fork Kern River.

Head 4.1 in body; depth 5; eye 5.5 in head, 2.7 in snout, 2 in interorbital; snout 2 in head. (Measurements on a specimen 218 mm., or 8.5 inches, long, not including caudal fin.)

In general the head is rather slender and somewhat conical. The lips are of moderate size (for the genus), the lobes of the lower extending about to vertical through nostrils; about 7 rows of papillæ on upper lip, those of the middle rows larger; one row of papillæ across symphysis of lower lip and about 9 in a row through lobes. Eye in posterior half of head. Gillrakers few and short. Dorsal outline of body regularly curved, the scales enlarged posteriorly, as is usual with the genus. Dorsal fin inserted about in middle of body, but varying from 0.50 to 0.53 of the body length from tip of snout; rays 12 or 13, sometimes 14; its height greater than base, margin slightly concave. Lateral line straight; pectorals reaching almost to vertical through origin of dorsal; ventrals inserted below middle of body, not quite reaching vent; anal about reaching rudimentary caudal rays, its base about half its height; lobes of caudal about equal, the middle rays about 1.5 in longest; depth of caudal peduncle slightly less than width of interorbital.

The type of this species was secured in the San Francisco markets, and probably came from the lower Sacramento or San Joaquin or their lowland tributaries. Cache Creek is the nearest stream to the probable type locality, from which many specimens have been preserved, and we have based our description on specimens from that stream. They were collected by Mr. Snyder in 1899.

The extremes of measurements, expressed in hundredths of the body, are as follows:

Head.....	0.22-0.27	Length of caudal peduncle.....	0.155-0.17
Depth.....	.18-.24	Origin of dorsal from snout.....	.49-.54
Eye.....	.035-.055	Insertion of ventrals.....	.50-.58
Interorbital.....	.085-.11	Origin of anal.....	.77-.80
Snout.....	.11-.13	Base of dorsal.....	.15-.185
Depth of caudal peduncle.....	.08-.095	Height of dorsal.....	.155-.22

There is little correspondence between the variation of the head and the size of the fish, but frequently the smaller specimens have the larger head. It will also be noticed from the same table that specimens from certain localities have distinctively large or small heads, as the case may be. Thus specimens from Sacramento River at Redding and Middle Fork of Feather River at Nelson Point have heads smaller than the average, while specimens from Wolf Creek, Indian Valley, South Fork Tuolumne River, and St. John Channel of Kaweah River have heads larger than the average. These places are all widely separated, except the Wolf Creek and Nelson Point stations, which are both in the Feather River basin.

The size of the mouth and lips varies greatly. Specimens from North Fork Yuba River at Bullards Bar have the lips enormously developed. Those from North Fork Consumne River and Big Silver Creek are intermediate between the Yuba specimens and those from Wolf Creek, which are larger than the average. Decreasing in size from the latter are specimens from South Fork Tuolumne River, Sacramento River at Redding, Merced River at Benton Mill, and Middle Fork Feather River at Nelson Point. Specimens from Cache Creek and many other stations have lips of about the same size as those from the latter point, which seems to be the typical size for the species. Taking specimens of nearly the same size from the various stations and arranging them in a decreasing series with reference to the size of the lips, we have the following as intermediate between the Nelson Point, or typical specimens, and Olema specimens, which have the smallest lips known to the species: Fresno River; American River at Placerville; Clover Creek, Genesee Valley; Stanislaus River, Parrot Ferry; Middle Fork Feather River, Beckwith; Pitt River, Canby; South Fork Pitt River; Tule River; Feather River, Oroville; Sacramento River, Red Bluff; Sacramento River, Knights Landing; Ash Creek, Aden; and Olema Creek (tributary to Tomales Bay). This series shows that there is no relation between the size of the lips and the portion of the basin, though it may be said that those specimens with the largest lips come from the foothill streams tributary to the lower portion of the Sacramento or San Joaquin River. It is worthy of note that all variations from below the typical to the largest are found in tributaries of Feather River. Olema Creek, where specimens with the smallest lips were found, is not tributary to the Sacramento-San Joaquin basin.

The accompanying outline drawings show the variations in size of lips. The drawings are made from specimens of nearly equal size, and for each specimen the outline has been drawn to a scale corresponding to a body length of 10 inches.



Fig. 2.—Diagram showing size of lips in *Catostomus occidentalis* from (a) Wolf Creek, Indian Valley, (b) North Fork Yuba River, Bullard's Bar, (c) Olema Creek, tributary to Tomales Bay, and (d) Middle Fork Feather River, Nelson Point.

The rays of the dorsal vary from 11 to 14. We have counted 393 specimens from 36 localities in the basin. Forty-two specimens have 11 rays in the dorsal, 271 have 12, 86 have 13, and 4 have 14.

The number of scales in the lateral line varies from 60 to 84, 66 to 71 being the prevailing number.

There is no relation between any particular variation and the division of the basin in which the specimens were taken. One or two peculiarities, however, are worth noticing. Beginning with Middle Fork of Feather River at Nelson Point and going south to Big Silver Creek the scales become coarser. The next station, North Fork Consumne River at Pleasant Valley, shows the finest scales in the collection; while the next one after that shows the coarsest.

Taken as a whole, the species is exceedingly variable. Specimens from one locality often have a distinct physiognomy and can, as a whole, be readily distinguished. For example, Pleasant Valley specimens are remarkable for big lips and fine scales, while North Yuba specimens have big lips and coarse scales. The Wolf Creek specimens have large heads, while Sacramento River specimens have small heads, and so on.

## LOCAL DISTRIBUTION.

Locality.	Stream or lake.	Basin division.	Collector.	Name as reported.	Authority.
San Francisco markets.	Sacramento and San Joaquin rivers.	Sacramento	Ayres, Newberry, Cary, Lockington.	<i>Catostomus occidentalis</i> .	Ayres 1854a & 1854-7; Girard 1856; L. Agassiz; Jordan & Jouy; Lockington.
Stockton	Sacramento River	do.	Ayres	<i>C. labiatus</i>	Ayres 1854-7.
	San Joaquin River	do.	do.	do.	do.
	Goose Lake	Pitt River	Cope	do.	Cope.
	Do.	do.	Rutter & Chamberlain.	<i>C. occidentalis</i>	
At mouth of Joseph Creek.	North Fork Pitt River.	do.	do.	do.	
Near Alturus.	do.	do.	do.	do.	
South Fork Post-office.	South Fork Pitt River.	do.	do.	do.	
Canby.	Pitt River.	do.	do.	do.	
Aden.	Ash Creek.	do.	do.	do.	
Baird.	McCloud River.	do.	Stone; Rutter & Chamberlain.	do.	
Redding.	Sacramento River.	Sacramento	do.	do.	
Do.	Clear Creek.	do.	do.	do.	
Anderson.	Cottonwood Creek.	do.	Snyder.	<i>Catostomus occidentalis</i> .	MS.
United States hatchery.	Battle Creek.	do.	Rutter & Scofield.	do.	
Red Bluff.	Sacramento River.	do.	do.	do.	
Tehama.	Thomas Creek.	do.	do.	do.	
Vina.	Deer Creek.	do.	Rutter & Chamberlain.	do.	
Chico.	Sacramento River.	do.	do.	do.	
Jacinto.	do.	do.	do.	do.	
Wilson's Farm.	do.	do.	do.	do.	
20 miles below Grimes.	do.	do.	do.	do.	
	Stoney Creek.	do.	Snyder.	do.	MS.
	Cache Creek.	do.	do.	do.	MS.
	Clear Lake.	do.	Jordan & Gilbert.	do.	Jordan & Gilbert.
	Putah Creek.	do.	Snyder.	do.	MS.
Knights Landing.	Sacramento River.	do.	Rutter & Scofield.	do.	
Oroville.	Feather River.	do.	Rutter & Chamberlain.	do.	
Crescent Mills.	Indian Creek.	do.	Rutter & Atkinson.	do.	
Greenville.	Wolf Creek.	do.	do.	do.	
Genesee.	Clover Creek.	do.	do.	do.	
Do.	Squaw Queen Creek.	do.	do.	do.	
Beckwith.	Middle Fork Feather River.	Lahontan	do.	do.	
Nelson Point.	do.	Sacramento	do.	do.	
Bullards Bar.	North Fork Yuba River.	do.	do.	do.	
Gerle.	Rubicon River.	Lahontan	do.	do.	
Placerville.	South Fork American River.	Sacramento	Rutter & Chamberlain.	do.	
Near Orelli.	Silver Creek.	Lahontan	Rutter & Atkinson.	do.	
Pleasant Valley.	North Fork Consumne River.	Sacramento	do.	do.	
Parrot Ferry.	Stanislaus River.	do.	do.	do.	
Baker Ford.	Tuolumne River.	do.	do.	do.	
Near mouth.	South Fork Tuolumne River.	do.	do.	do.	
Benton Mill.	Merced River.	do.	do.	do.	
Livingstone.	do.	do.	do.	do.	
Mariposa.	Mariposa Creek.	do.	do.	do.	
Raymond.	Chouchilla River.	do.	do.	do.	
Do.	Fresno River.	do.	do.	do.	
Pollasky.	San Joaquin River.	do.	do.	do.	
Centerville.	Kings River.	do.	do.	do.	
Lemon Cove.	Kaweah River, St. John Channel.	do.	do.	do.	
Porterville.	Tule River.	do.	do.	do.	
Bakerfield.	Kern River.	do.	do.	do.	
	Kern Lake of the Mountains.	do.	Gilbert.	do.	
	South Fork Kern River.	do.	Henshaw.	<i>Catostomus areopus</i> .	Jordan 1878; Jordan & Henshaw.

7. *Orthodon microlepidotus* (Ayres). Greaser Blackfish.

*Leuciscus microlepidotus* Ayres, Daily Placer Times and Transcript, 1854, May 30, San Francisco.

*Gila microlepidota* Ayres, Proc. Cal. Ac. Nat. Sci., vol. 1, 1855, p. 21, Sacramento and San Joaquin rivers.

*Orthodon microlepidotus*, Pac. Ry. Surv., vol. x, 1859, p. 237. Jordan & Evermann, Fishes of North & Mid America, pt. 1, p. 207, 1896.

Head 3.8 in body, depth 4; eye 6 in head; interorbital 2.4; snout 3; dorsal 11; anal 9; pectoral 16; ventral 10; scales 27-97-11; teeth 6-6. (Measurements based on a specimen 184 mm. long from Sacramento River at Butte City.)

Body long, slightly compressed; head small, the snout broad, wedge-shaped; mouth small, nearly horizontal, lower jaw included, the maxillary falling far short of eye, 4.5 in head; teeth 6-5 or 6-6; origin of dorsal in middle of body, over insertion of ventrals; ventrals reaching vent. Dusky, nearly black above.

A large minnow of little value, distinguished by the small mouth and fine scales.

The following is a table of measurements of 4 specimens:

Locality.	Sacramento River, Butte City.	Sacramento River, Colusa.	San Joaquin River, Black Diamond.	Kings River, Centerville.	Locality.	Sacramento River, Butte City.	Sacramento River, Colusa.	San Joaquin River, Black Diamond.	Kings River, Centerville.
Length of body.....mm.	182	140	154	123	Depth caudal peduncle.....	.085	.085	.085	.09
Length of head.....	.27	.26	.26	.26	Length caudal peduncle.....	.21	.22	.21	.20
Depth.....	.25	.25	.25	.25	Scales above lateral line.....	26	26	25	24
Diameter orbit.....	.052	.055	.055	.06	Scales on lateral line.....	103	98	99	95
Interorbital.....	.115	.11	.11	.11	Scales below lateral line.....	13	13	12	13
Length snout.....	.09	.08	.08	.08					

LOCAL DISTRIBUTION.

Locality.	Stream or lake.	Collector.	Name as reported.	Authority.
San Francisco markets.....	Sacramento and San Joaquin rivers.	Ayres.....	<i>Leuciscus microlepidotus</i> , <i>Gila microlepidota</i> .	Ayres, 1854a.
Do.....	do.....	Newberry.....	<i>Orthodon microlepidotus</i> .	Girard, 1856.
Do.....	do.....	Lockington.....	do.....	Lockington.
	Sacramento River.....	Jordan.....	do.....	Jordan & Jouy.
	Clear Lake.....	Rutter & Scofield.....	do.....	Jordan & Gilbert.
Butte City.....	Sacramento River.....	do.....	do.....	
Colusa.....	do.....	do.....	do.....	
Arcade.....	Arcade Creek.....	Rutter & Atkinson.....	do.....	
Ryde.....	Sacramento River.....	Rutter & Chamberlain.....	do.....	
	do.....	do.....	do.....	
Rio Vista.....	Suisun Bay.....	do.....	do.....	
Black Diamond.....	China Slough.....	do.....	do.....	
Centerville.....	Kings River.....	Rutter & Atkinson.....	do.....	
Do.....				

8. *Lavinia exilicauda* Baird & Girard.

*Lavinia exilicauda* Baird & Girard, Proc. Ac. Nat. Sci. Phila., 1854, p. 137, Sacramento River. Jordan & Evermann, Fishes of North & Mid. Amer., pt. 1, p. 209, 1896, and p. 2799, 1898.

*Leucosomus occidentalis* Baird & Girard, l. c., Poso Creek.

*Lavinia compressa* Proc. Cal. Ac. Nat. Sci., 1854, p. 21, San Francisco.

*Luxilus occidentalis* Jordan & Evermann, l. c., p. 247.

Head 4 in body, depth 8.5; eye 3.6 in head; snout 3.6; interorbital 3; dorsal 11, anal 13, scales 13-56-6, teeth 5-5, long and hooked. (Measurements based on a specimen 98 mm. long from Sacramento River at Jacinto.)

In general the head is pyramidal, slightly broader above than below, snout pointed, premaxillary protractile; maxillary slipping under preorbital, without barbel; lower jaw with or without horny sheath; distance between nostrils equal to their distance from tip of snout; eye anterior, large, placed low, a line from tip of snout to tip of opercle passing through middle of pupil (in specimens about 100 mm. long); snout equal to eye; body deep and compressed, regularly tapering to both extremities; caudal peduncle slender, its depth 2.8 in head; lateral line decurved, almost concentric with ventral outline; scales 54 to 62 in lateral line, 12 to 14 above, and 6 or 7 below. Pectorals not reaching ventrals, of 15 or 16 rays; ventrals of 10 rays, inserted under middle of body, extending to vent; dorsal with 11 or 12 rays, rarely 10 or 13, its origin slightly behind insertion of ventrals; anal with 11 to 14 rays, usually 13, margin slightly concave, its origin under end of dorsal; caudal fin large, nearly a half longer than head, deeply cleft, the middle rays 2.2 in longest, lower lobe longer than upper. Color, plain dusky above, pale below, older specimens darker. (Description based on specimens from Jacinto.)

The following tables show the variations in this species:

MEASUREMENTS OF HEAD.

Size.	Number of specimens with head—						
	0.22.	0.22½.	0.23.	0.23½.	0.24.	0.24½.	0.25.
<i>Millimeters.</i>							
58-69.....					8		5
70-79.....			3		3		4
80-89.....		1	5		3	1	1
90-99.....			1	1	8		2
100-109.....	1	1			6		
110-119.....			5		2		1
120-129.....			2				
130-139.....		1	1		1		
156.....		1					

SUMMARY OF THE VARIATIONS IN SIZE OF EYE, SHOWING ITS RELATION TO SIZE OF FISH.

Size.	Number of specimens with eye—				
	0.05½.	0.06.	0.06½.	0.07.	0.07½.
<i>Millimeters.</i>					
58-69.....		1	2	9	1
70-79.....		1	2	7	
80-89.....		5	3	3	
90-99.....		6	5	1	
100-109.....	1	4	3		
110-119.....	5	2		1	
120-129.....	2				
130-139.....	1	2			
156.....	1				

The size of the caudal peduncle as given in the table of measurements varies considerably. The variation in its depth is partly due to the method of preservation and partly to the size of the specimens. There may also be a slight locality variation, specimens from southern localities apparently having the caudal peduncle slightly deeper. Only 7 of the 68 specimens measured have the caudal peduncle over 0.17, and 5 of these are from Tule River. The following table shows that there is some relation between the size of the specimen and the depth of the caudal peduncle, the depth being slightly greater in smaller specimens. The length of the caudal peduncle does not vary with the size of the fish.



MEASUREMENTS OF CAUDAL PEDUNCLE.

Size.	Number of specimens with caudal peduncle having—												
	Depth—						Length—						
	0.07½.	0.08.	0.08½.	0.09.	0.09½.	0.10.	0.14.	0.15.	0.16.	0.17.	0.18.	0.19.	0.20.
<i>Millimeters.</i>													
58-69.....		2		9		2		1	4	3	4	1	
70-79.....		1	1	7		1		2	3	3			1
80-89.....		2	1	7		1	2	1	2	6			
90-99.....		2	3	6		1		1	7	4			
100-109.....		1	4	3				1	3	4			
110-119.....		4	2	2					4	4			
120-129.....		1	1					1		1			
130-139.....	1	1	1					1	2				
156.....			1							1			

The extreme variations in other measurements are: Depth, 0.24-0.30; interorbital, 0.07-0.09; snout, 0.06-0.07½; insertion of dorsal, 0.56-0.61.

VARIATION IN SCALES OF THE LATERAL LINE.

Locality.	Number of specimens having scales in lateral line—									
	54.	55.	56.	57.	58.	59.	60.	61.	62.	
Battle Creek hatchery.....									2	
Sacramento River:										
Red Bluff.....					1	1			2	
Chico.....			1		2					
Jacinto.....		3	1	2	1	1		1		
20 miles below Grimes.....					1					
Feather River, Oroville.....							1			
American River, Folsom.....		1		1						
Antelope Creek, Peryn.....			2							
Merced River, Livingstone.....	2		2		1					
China Slough, Centerville.....	1	4	1	1	1				1	
Kings River, Centerville.....	1	2	1	3	1	1		1		
Kaweah River, St. John Channel.....	1	3	3	1	2					
Tule River, Porterville.....	2	1	1							
Total.....	7	14	12	8	11	3	1	4	3	

VARIATION IN FIN RAYS.

Locality.	Number of specimens having—							
	Dorsal—				Anal—			
	10.	11.	12.	13.	11.	12.	13.	14.
Battle Creek hatchery.....		1	1					2
Sacramento River:								
Red Bluff.....		2	2					4
Chico.....		1	1	1				3
Jacinto.....		7	3					7
20 miles below Grimes.....		1						1
Feather River, Oroville.....			2					2
American River, Folsom.....			2					1
Antelope Creek, Peryn.....			2					1
Sacramento River, Rio Vista.....		1						1
San Joaquin River, Black Diamond.....		1						1
Merced River, Livingstone.....			5					5
China Slough, Centerville.....		2	8			1	1	6
Kings River, Centerville.....		2	8			2	2	7
Kaweah River, St. John Channel.....		6	4			1	1	7
Tule River, Porterville.....	2	2	1					1
Total.....	2	26	39	1	2	4	48	8

The teeth are usually 5-5, but sometimes 4-5 in specimens from Kings River at Centerville.

The horny sheath of the lower jaw is developed in a few of the specimens from almost every locality. Its presence is a remarkable feature and one that is ordinarily considered of generic value. It is, however, indifferently present or absent in this species and in *Rutilus symmetricus*.

## LOCAL DISTRIBUTION.

Locality.	Stream.	Basin division.	Collector.	Name as reported.	Authority.
	Sacramento River	Sacramento	Heermann	<i>Lavinia exilicauda</i>	Girard, 1854 and 1858.
	do.	do.	Ayres	<i>L. compressa</i>	Ayres, 1854a.
	San Joaquin River	do.	Newberry	<i>L. exilicauda</i>	Girard, 1857.
San Francisco market.	do.	do.	Lockington	do.	Lockington.
	Clear Lake	do.	Jordan	do.	Jordan & Gilbert.
United States hatchery.	Battle Creek	do.	Rutter & Scofield	do.	
Red Bluff	Sacramento River	do.	do.	do.	
Chico Bridge	do.	do.	do.	do.	
Jacinto	do.	do.	do.	do.	
Wilson's Farm	do.	do.	do.	do.	
20 miles below Grimes	do.	do.	do.	do.	
Mouth of Feather River.	do.	do.	do.	do.	
Marysville	Feather River	do.	Rutter & Chamberlain	do.	
Oroville	do.	do.	do.	do.	
Grass Valley	Antelope Creek	do.	Rutter & Atkinson	do.	
Sacramento	Sacramento River	do.	Rutter & Scofield	do.	
Folsom	American River	do.	Rutter & Chamberlain	do.	
Rio Vista	Sacramento River	do.	do.	do.	
Collinsville	do.	do.	do.	do.	
Black Diamond	Suisun Bay	do.	Rutter	do.	
Antioch	San Joaquin River	do.	Rutter & Chamberlain	do.	
Parrot Ferry	Stanislaus	do.	Rutter & Atkinson	do.	
Livingstone	Merced River	do.	do.	do.	
Raymond	Fresno River	do.	do.	do.	
Folsom	San Joaquin	do.	do.	do.	
Centerville	China Slough	do.	do.	do.	
Do	Kings River	do.	do.	do.	
St. John Channel	Kaweah River	do.	do.	do.	
Four Creeks	do.	do.	Heermann	<i>Leucosomus occidentalis</i> .	Girard, 1854, 1858, and 1859.
Porterville	Tule River	do.	Rutter & Atkinson	<i>Lavinia exilicauda</i> .	
	Posa Creek	do.	Heermann	<i>Leucosomus occidentalis</i> .	Girard, 1854, 1858, and 1859.

9. *Mylopharodon conocephalus* (Baird & Girard). *Bluefish; Hardhead.*

*Gila conocephala* Baird & Girard, Proc. Ac. Nat. Sci. Phila. 1854, p. 135, San Joaquin River.

*Mylopharodon robustus*, Ayres, Proc. Cal. Ac. Nat. Sci. 1855, p. 33, San Francisco.

*Mylopharodon conocephalus*, Jordan & Evermann, Fishes of North & Mid. Amer., pt. 1, p. 219, 1896.

Head 4 in body; depth 4.6; eye 4.5 in head, interorbital 3, snout 3; depth of caudal peduncle 2.8 in head, its length 1.2; dorsal 9; anal 9; pectoral 15; ventral 9; scales 18-74-8; teeth 2, 5-4, 2, the last two of the first row molar, the others hooked. (Measurements based on a specimen 163 mm. long, from Merced River at Benton Mill.)

The body is heavy, slightly compressed, regularly tapering to the short conical head and the slender caudal peduncle, mouth slightly oblique, terminal, the premaxillary not protractile, the lower jaw slightly shorter than the upper, the maxillary extending almost to vertical through anterior margin of eye; the lateral line slightly decurved; origin of dorsal about in middle of body, high anteriorly, its longest ray 1.4 in head; ventrals inserted slightly in advance of dorsal, their tips reaching anal; caudal broad, deeply forked, the middle rays nearly 2 in longest, the lobes equal.

A large minnow resembling *Ptychocheilus* but readily distinguished by the ridge of skin connecting the premaxillary with the top of the head. The head is also much shorter. This is the most abundant fish in the upper Pitt River and in some of the localities in the foothills.

The following table shows the variation in the number of scales in the lateral line:

Locality.	Number specimens having scales in lateral line—							
	69.	70.	72.	73.	74.	75.	76.	77.
Pitt River.....			1			1		
Sacramento River.....					2			
Feather River.....						1		
Squaw Queen Creek.....			1	1				
Tuolumne River.....				1		2	1	1
South Fork Tuolumne River.....			1					
Merced River.....						2		
Kings River.....			1	2				
Kaweah River.....						1		
Tule River.....	2	1						
Total.....	2	1	4	4	2	7	1	1

The number of scales above the lateral line was 18 or 19 in the 22 specimens counted, and 8 or 9 below.

The number of rays in both dorsal and anal fins was invariably 9 in the 22 specimens counted.

LOCAL DISTRIBUTION.

Locality.	Stream.	Basin division.	Collector.	Name as reported.	Authority.
San Francisco.....		Sacramento	Newberry	<i>Mylopharodon conocephalus</i> .	Girard, 1856.
Do.....		do	do	<i>M. robustus</i> .....	Girard, 1856, 1857.
	Sacramento River.....	do		<i>M. conocephalus</i> .....	Jordan & Jouy.
	San Joaquin River.....	do	Heermann.	<i>Gila conocephala</i> .....	Girard, 1854.
	do.....	do	Ayers.	<i>M. robustus</i> .....	Ayres, 1854-57.
Alturus.....	N. Fk. Pitt River.....	Pitt River	Rutter & Chamberlain.	<i>M. conocephalus</i> .....	
Canby.....	Pitt River.....	do	do	do	
Aden.....	Ash Creek.....	do	do	do	
Bieber.....	Pitt River.....	do	do	do	
Pittville.....	do.....	do	do	do	
Redding.....	Sacramento River.....	Sacramento	do	do	
At mouth of Clear Creek.....	do.....	do	do	do	
United States hatchery Red Bluff.....	Battle Creek.....	do	Rutter & Scofield.	do	
6 miles below Red Bluff.....	Sacramento River.....	do	Rutter.	do	
Tehama.....	do.....	do	Rutter & Scofield.	do	
Do.....	do.....	do	Rutter.	do	
Chico.....	Thomas Creek.....	do	Rutter & Scofield.	do	
Jacinto.....	Sacramento River.....	do	do	do	
Grimes.....	do.....	do	do	do	
20 miles below Grimes.....	do.....	do	do	do	
Mouth of Feather River.....	do.....	do	do	do	
Oroville.....	Feather River.....	do	Rutter & Chamberlain.	do	
Crescent Mills.....	Indian Creek.....	do	Rutter & Atkinson.	do	
Genesee.....	Squaw Queen Creek.....	do	do	do	
Sacramento.....	Sacramento River.....	do	do	do	
Folsom.....	American River.....	do	Rutter & Chamberlain.	do	
Placerville.....	S. Fk. American River.....	do	do	do	
Collinsville.....	Sacramento River.....	do	do	do	
Ward Ferry.....	Tuolumne River.....	do	Rutter & Atkinson.	do	
Near mouth.....	S. Fk. Tuolumne River.....	do	do	do	
Livingstone.....	Merced River.....	do	do	do	
Benton Hill.....	do.....	do	do	do	
Raymond.....	Fresno River.....	do	do	do	
Pollasky.....	San Joaquin River.....	do	do	do	
Centerville.....	China Slough.....	do	do	do	
Do.....	Kings River.....	do	do	do	
St. John Channel.....	Kaweah River.....	do	do	do	
Porterville.....	Tule River.....	do	do	do	
Bakerfield.....	Kern River.....	do	do	do	

10. *Pogonichthys macrolepidotus* Ayres. *Split-tail*.

*Leuciscus macrolepidotus*, Ayers, Daily Placer Times and Transcript, 1854, May 30, San Francisco.  
*Pogonichthys inaequilobus*, Baird & Girard, Proc. Ac. Nat. Sci. Phila. 1854, p. 136, San Joaquin River.  
*Pogonichthys macrolepidotus*, Jordan & Evermann, Fishes North & Mid. Amer., pt. 1, p. 223, 1896.

Head 4 in body; depth 4.2; eye 4 in head; interorbital 3; snout 3.2; dorsal 10, anal 9, pectoral 15, ventral 10; scales 11-59-6; teeth 2, 5-5, 2; upper lobe of caudal 2.4 in body. (Measurements based on a specimen 140 mm. long, from Pollasky.)

In general the head is somewhat conical, the eye is rather large and placed anteriorly; the mouth is nearly horizontal, the lower jaw included, the maxillary reaching a vertical between nostril and eye, a small barbel at its tip. The gillrakers are somewhat longer than in other western minnows. Body long, scarcely compressed, but little arched; caudal peduncle deep, half as deep as body; lateral line slightly decurved. Dorsal inserted in middle of body, its anterior rays equal to head and twice as long as posterior rays; anal similar to dorsal, but smaller; ventrals inserted under third ray of dorsal; caudal very large, deeply forked, the upper lobe much longer than the lower and nearly twice as long as the head. Length 12 inches. Readily distinguished by the long upper lobe of caudal fin.

The extremes of measurements are:

Head.....	0.24- 0.27	Depth of caudal peduncle.....	0.11-0.12
Depth.....	0.22- 0.25	Length of caudal peduncle.....	0.15-0.18
Eye.....	0.06- 0.075	Upper lobe of caudal fin.....	0.42-0.45
Interorbital.....	0.075-0.08	Lower lobe of caudal fin.....	0.33-0.36
Snout.....	0.07- 0.08		

The following summary of head measurements shows the relations between the size of the head and the length of the fish:

Length of fish.	Number of specimens having head—						
	0.24.	0.245.	0.25.	0.255.	0.26.	0.265.	0.27.
<i>Millimeters.</i>							
70-79.....						1	1
80-89.....			3	1	2		
90-99.....					2		
110-119.....	1	1	1				
120-129.....			3				
130-142.....	1	2	2				

The variation in the size of the eye with reference to the size of the fish is shown in the following:

Length of fish.	Number of specimens having eye—			
	0.06.	0.065.	0.07.	0.075.
<i>Millimeters.</i>				
70-79.....				2
80-89.....			4	2
90-99.....			1	1
110-119.....	2		1	
120-129.....	3			
130-142.....	5			

The difference between the lengths of the caudal lobes varies with the size of the fish, being greater in larger specimens, as shown in the following table:

Length of fish.	Number of specimens having difference between lobes of caudal fin amounting to—			
	0.07.	0.08.	0.09.	0.10.
<i>Millimeters.</i>				
70-79.....	1			
80-89.....	1	2	1	
110-119.....			1	
120-129.....			2	1
130-142.....			1	3

The number of rays in the dorsal is uniformly 10 in the 21 specimens examined; 20 have the anal with 9 rays, and one with 8; teeth 2, 5-5, 2 in all specimens examined. The following is a statement of the number of scales in the lateral line:

	Specimens.		Specimens.
56 scales.....	2	59 scales.....	3
57 scales.....	2	60 scales.....	6
58 scales.....	7	61 scales.....	1

There are 11 or 12 scales above the lateral line and 6 or 7 below.

One of the most abundant fishes of the lower rivers and in Suisun Bay. At Battle Creek fishery it feeds on the waste eggs from the spawning platform and from the hatchery. It is also very destructive to salmon eggs on the spawning beds. As many as 50 split-tails may be seen following a spawning salmon. There is no doubt that it also destroys great numbers of salmon alevins.

This species is one of the few minnows that enter brackish water, being very abundant in Suisun Bay, and occasionally taken in San Pablo Bay in nearly pure sea water.

LOCAL DISTRIBUTION.

Locality.	Stream or lake.	Collector.	Name as reported.	Authority.
San Francisco.....		Ayres.....	Leuciscus macrolepidotus.	Ayres 1854a.
		Lockington.....	Pogonichthys inaequallobus.	Lockington.
Redding.....	Sacramento River.....	(?)	P. macrolepidotus.....	Jordan & Jouy.
	do.....	Rutter & Chamberlain.	do.....	
Fort Reading.....	do.....	Newberry.....	P. inaequallobus.....	Girard 1857.
United States hatchery.....	Battle Creek.....	Rutter & Scofield.....	P. macrolepidotus.....	
Red Bluff.....	Sacramento River.....	do.....	do.....	
6 miles below Red Bluff.....	do.....	do.....	do.....	
Tehama.....	do.....	do.....	do.....	
Chico Bridge.....	do.....	do.....	do.....	
Jaclnto.....	do.....	do.....	do.....	
Grimes.....	do.....	do.....	do.....	
Wilson Farm.....	do.....	do.....	do.....	
20 miles below Grimes.....	do.....	do.....	do.....	
Knights Landing.....	do.....	do.....	do.....	
Mouth of Feather River.....	Clear Lake.....	Jordan & Gilbert.....	do.....	Jordan & Gilbert.
	Sacramento River.....	Rutter & Scofield.....	do.....	
Oroville.....	Feather River.....	Rutter & Chamberlain.	do.....	
Sacramento.....	Sacramento River.....	Rutter & Scofield.....	do.....	
Folsom.....	American River.....	Rutter & Chamberlain.	do.....	
Ryde.....	Sacramento River.....	do.....	do.....	
Rio Vista.....	do.....	do.....	do.....	
Collinsville.....	do.....	do.....	do.....	
Benicia.....	Carquinez Straits.....	do.....	do.....	
Black Diamond.....	Suisun Bay.....	Rutter.....	do.....	
Antioch.....	San Joaquin River.....	Rutter & Chamberlain.	do.....	
Livingstone.....	Merced River.....	Rutter & Atkinson.....	do.....	
Pollasky.....	San Joaquin River.....	do.....	do.....	
Fort Miller.....	do.....	Heermann.....	P. inaequallobus.....	Girard 1854 & 1856.

11. *Ptychocheilus grandis* (Ayres). *Sacramento Pike.*

*Gila gracilis* Ayres, Daily Placer Times and Transcript, 1854, May 30, San Francisco.

*Gila grandis* Ayres, Proc. Cal. Ac. Nat. Sci. 1854, p. 18, San Francisco.

*Ptychocheilus major*, Agassiz, Am. Jour. Sci. Arts 1855, p. 279, San Francisco.

*Ptychocheilus harfordi* Jordan & Gilbert, Proc. U. S. Nat. Mus. 1881, p. 72, Sacramento River.

*Ptychocheilus oregonensis* (Richardson), Jordan & Evermann, Fishes of North & Mid. Amer., pt. 1, p. 224, 1896.

*Ptychocheilus grandis* (Ayres) Jordan & Evermann, op. cit., pt. III, p. 2796, 1898.

Head 3.7 in length; depth 5.5; eye 6.3 in head; interorbital 3.8; snout 2.9; depth of caudal peduncle 3.1 in head; dorsal 9, anal 9, pectoral 15, ventral 10; scales 14-73-7; teeth 2.5-4.2. (Measurements on a specimen 184 mm. long from Pollasky.)

Body long and slender, head long; mouth large, terminal, jaws even, maxillary extending to below anterior margin of eye, no barbel; eye in anterior half of head; scales small, lateral line nearly straight; dorsal inserted behind ventrals, which are behind middle of body; pectorals extending half way to ventrals.

The following are the extremes of measurements:

Head.....	0.28-0.31	Snout.....	0.09-0.11
Depth.....	0.18-0.22	Depth of caudal peduncle.....	0.085-0.10
Eye.....	0.05-0.07	Length of caudal peduncle.....	0.18-0.22
Interorbital.....	0.07-0.085		

The summary of head measurements indicates the relation between the size of the head and the length of the fish, though there is not enough variation in the size of the specimens to make the table of particular value. In specimens ranging from 80 to 150 mm. the size of the head apparently bears but little relation to the size of the fish.

Length of fish.	Number of specimens having the head—						
	0.28.	0.285.	0.29.	0.295.	0.30.	0.305.	0.31.
<i>Millimeters.</i>							
80-89.....	1				6		2
90-99.....	1	3	6		7		2
100-109.....	4	2	2	2	1	2	
110-119.....	7	4	7		3		
120-129.....	2		4		2		
130-139.....	4				1		
140-149.....	2						
180-190.....		1					

Measurements, however, vary inversely with the size of the fish, as is indicated by the following summary table of eye measurements:

Length of fish.	Number of specimens having the eye—				
	0.05.	0.055.	0.06.	0.065.	0.07.
<i>Millimeters.</i>					
80-89.....				3	4
90-99.....			8	7	
100-109.....			14		
110-119.....		2	20		
120-129.....		6	4		
130-139.....		3	1		
140-149.....		3			
150-159.....	2				
180-190.....	1				

The number of scales in the lateral lines of 77 specimens varies from 65 to 78, as follows:

	Specimens.		Specimens.
65 scales.....	2	72 scales.....	9
66 scales.....	3	73 scales.....	10
67 scales.....	3	74 scales.....	8
68 scales.....	9	75 scales.....	4
69 scales.....	5	76 scales.....	3
70 scales.....	8	77 scales.....	2
71 scales.....	10	78 scales.....	1

The number of scales in an oblique row backward and downward from the origin of the dorsal to the lateral line is 13 or 14, and from the ventrals to the lateral line 6 or 7. The scales in the type of *Ptychocheilus harfordi* are 15-87-10.

The dorsal fin in one of the 77 specimens has 10 rays, in the others 9. The anal is uniformly of 9 rays.

The teeth of 21 specimens are 2, 5-4, 2; 2 specimens from Pollasky have the teeth 3, 4-4, 2.

## LOCAL DISTRIBUTION.

Locality.	Stream.	Collector.	Name as reported.	Authority.
San Francisco	Sacramento and San Joaquin rivers.	Ayres	<i>Gila gracilis</i>	Ayres, 1854a and 1854-7.
Do		Newberry	<i>G. grandis</i>	
Do		Cary	<i>Ptychocheilus grandis</i>	Girard, 1856, 1857, 1858.
Do		Lockington	<i>P. major</i>	L. Agassiz.
Do	Sacramento River	Jordan and Gilbert	<i>G. grandis</i>	Lockington.
	do		<i>P. harfordi</i>	Jordan and Gilbert.
	Joseph Creek	Rutter and Chamberlain	<i>P. oregonensis, P. harfordi</i>	Jordan and Jouy.
Alturus	N. Fk. Pitt River	do	do	
Canby	Pitt River	do	<i>P. grandis</i>	
Aden	Ash Creek	do	do	
Bieber	Pitt River	do	do	
Pittville	do	do	do	
Fall River Mills	Fall River	do	do	
Redding	Sacramento River	do	do	
At mouth of	Clear Creek	do	do	
United States hatchery	Battle Creek	Rutter and Scofield	do	
Red bluff	Sacramento River	do	do	
6 miles below Red Bluff	do	do	do	
Tehama	do	do	do	
At mouth of	Thomas Creek	do	do	
Vina	Sacramento River	do	do	
Chico Bridge	do	do	do	
Jacinto	do	do	do	
Grimes	do	do	do	
Wilson Farm	do	do	do	
20 miles below Grimes	do	do	do	
	Clear Lake	Jordan and Gilbert	<i>P. oregonensis, P. harfordi</i>	Jordan and Gilbert.
	Allen Spring	Cleveland	<i>P. oregonensis</i>	Eigenmann and Eigenmann.
Knights Landing	Sacramento River	Rutter and Scofield	<i>P. grandis</i>	
At mouth of Feather River	do	do	do	
Marysville	Feather River	Rutter and Chamberlain	do	
Oroville	do	do	do	
Crescent Mills	Indian Creek	Rutter and Atkinson	do	
Greenville	Wolf Creek	do	do	
Genesee	Squaw Queen Creek	do	do	
Bullards Bar	N. Fk. Yuba River	do	do	
Sacramento	Sacramento River	do	do	
Placerville	American River	Rutter and Chamberlain	do	
Walnut Grove	Sacramento River	Rutter	do	
Rio Vista	do	Rutter and Chamberlain	do	
Benicia	Carquinez Straits	do	do	
Antioch	San Joaquin River	do	do	
Modesto	Tuolumne River	Rutter and Atkinson	do	
At mouth of	S. Fk. Tuolumne River	do	do	
Parrot Ferry	Stanislaus River	do	do	
Livingstone	Merced River	do	do	
Benton Mill	do	do	do	
Raymond	Chouchilla River	do	do	
Do	Fresno River	do	do	
Pollasky	San Joaquin River	do	do	
Centerville	China Slough	do	do	
Do	Kings River	do	do	
St. John Channel	Kaweah River	do	do	
Porterville	Tule River	do	do	
Bakersfield	Kern River	do	do	

12. *Leuciscus crassicauda* (Baird & Girard). *Sacramento Chub*.

*Leuciscus gibbosus* Ayres, Daily Placer Times and Transcript, May 30, 1854, San Francisco.

*Lavinia crassicauda* Baird & Girard, Proc. Ac. Nat. Sci. Phila., 1854, p. 137, San Joaquin River.

*Lavinia gibbosa* Ayres, Proc. Cal. Ac. Nat. Sci. 1854, p. 20, San Francisco markets.

*Tigoma crassa* Girard, Proc. Ac. Nat. Sci. Phila., 1856, p. 207, Sacramento River.

*Siboma crassicauda* Girard, op. cit., p. 208.

*Squalius gibbosus*, Jordan & Gilbert, Synopsis Fishes of North Amer., p. 239, 1882.

*Squalius crassus* Jordan & Gilbert, op. cit., p. 241.

*Leuciscus crassicauda*, Jordan & Evermann, Fishes N. & Mid. Amer., pt. 1, p. 231, 1896.

Of this species we have two specimens, 4 and 9 inches long. The measurements of the larger are:

Head 3.8 in body, depth 3.7; eye 6 in head, snout 3.1; teeth 2, 5-4, 2; dorsal 9, anal 9; scales 12-54-6. For the smaller specimen: Head 3.6 in body, depth 3.9; eye 4.6 in head, snout 3.2; teeth 2, 5-4, 1; dorsal 8, anal 9, scales 10-53-6.

Head conical, profile straight, snout acuminate, mouth oblique, jaws even, maxillary extending to vertical through nostrils, slipping under preorbital. Body elongate, somewhat compressed, the dorsal outline strongly arched at occiput in larger specimen (regularly arched from snout to dorsal in smaller specimen); caudal peduncle very deep and compressed, 1.9 in head, not at all expanding at base of caudal; origin of dorsal midway between tip of snout and tip of middle caudal rays, ventrals inserted under or slightly in advance of origin of dorsal, origin of anal entirely behind dorsal; margin of dorsal and anal convex; caudal fin shorter than head, forked, middle rays 1.6 in longest, lobes equal; lateral line nearly straight. Dusky above, changing to silvery below. Young with a black spot at base of caudal.

## LOCAL DISTRIBUTION.

Locality.	Stream or lake.	Collector.	Name as reported.	Authority.
San Francisco.....	.....	Hammond.....	<i>Lavinia crassicauda</i> ..	Girard, 1854.
Do.....	.....	Ayres.....	<i>L. gibbosa</i> .....	Ayres, 1854, 1854-7.
Do.....	.....	Lockington.....	<i>Siboma crassicauda</i> ..	Lockington.
Fort Reading.....	Sacramento River.....	Newberry.....	<i>Squalius gibbosus</i> .....	Jordan and Jouy.
Mouth of Feather River..	do.....	Rutter & Scofield.....	<i>Tigoma crassa</i> .....	Girard, 1856, 1857, 1858.
	Clear Lake.....	Jordan & Gilbert.....	<i>Leuciscus crassicauda</i>	.....do.....
	San Joaquin River.....	Heermann.....	<i>Siboma crassicauda</i> ..	Jordan & Gilbert.
	Merced River.....	do.....	do.....	Girard, 1856.
St. John Channel.....	Kaweah River.....	Rutter & Atkinson..	<i>Leuciscus crassicauda</i>	Do.

There is some doubt as to the validity of the nominal species *Leuciscus conformis*. Girard's notes and descriptions are entirely conflicting, and his type is the only specimen ever reported. His comparative statement of the differences between *crassicauda* and *conformis* is just the opposite of the differences found in his descriptions of the two species.

The two nominal species are represented in our collection by four specimens, two of which are *crassicauda*, as noted above. The other two are different, apparently, and we place them provisionally under the name *Leuciscus conformis* (Baird & Girard).

13. *Leuciscus conformis* (Baird & Girard).

*Lavinia conformis* Baird & Girard, Proc. Ac. Nat. Sci. Phila. 1854, p. 137, Poso Creek, Tulare Valley.

*Tigoma conformis* Girard, Pacific Ry. Survey, vol. x, p. 239, 1858.

*Leuciscus conformis* Jordan & Evermann, Fishes North & Mid. Amer., pt. 1, p. 231, 1896.

Of this species we also have two specimens, one 7 inches long, the other 3.5. The measurements of the larger specimen are:

Head 4 in body; depth 3.5; eye 4.5 in head; snout 3.6; dorsal 10, anal 11, scales 12-57-7. The smaller specimen has the eye 4 in head, dorsal 11; anal 11; scales 12-60-5; teeth 1, 5-5, 1.

The head is conical, the profile slightly convex, the snout rather pointed; the mouth is oblique, the lower jaw included; the maxillary extends to vertical through middle of nostril, slipping under preorbital. The body is rather deep, compressed, regularly tapering to both extremities; the caudal peduncle is deep, 2.2 in head, expanded at base of caudal as usual in minnows. The origin of the dorsal is midway between tip of snout and middle of middle caudal rays; ventrals inserted slightly in



advance of dorsal; origin of anal under posterior ray of dorsal; margin of dorsal and anal straight; caudal fin longer than head, forked, the middle ray 1.6 in longest, upper lobe longer than lower. Lateral line decurved anteriorly, scales heavily scored. Young with a black spot at base of caudal.

The specimens here described as *conformis* differ from *crassicauda* in having the caudal peduncle less deep, the caudal fin longer than head and its upper lobe longer than the lower, longer dorsal and anal fins, finer scales, even jaws, and heavier striation on scales. Some of these distinctions are just the opposite of those given by Girard. The following are his distinctions: "The general appearance of the fish [*Tigoma conformis*] is suggestive of *Lavinia crassicauda*; the body is deeper and proportionately less elongated, the eye much smaller, and the scales larger." In his descriptions, however, he says, of *Tigoma conformis*, "Eye moderate sized; its diameter entering nearly five times in the length of the side of the head," and of *Siboma crassicauda*, "Eye rather small, subcircular, its diameter entering nearly six times in the length of the side of the head." His comparison of the eye does not agree with his descriptions, and there may be a similar discrepancy with regard to the other characters.

LOCAL DISTRIBUTION.

Locality.	Stream or lake.	Collector.	Name as reported.	Authority.
20 miles below Grimes.....	Sacramento River.....	Rutter & Scofield....	<i>Leuciscus conformis</i> ..	} Girard 1854, 1856, 1858.
St. John Channel.....	Kaweah River.....	Rutter & Atkinson....	do.....	
Tulare Valley.....	Posa Creek.....	Heermann.....	<i>Lavinia conformis</i> ....	
			<i>Tigoma conformis</i> ....	

14. *Leuciscus egregius* (Girard).

*Tigoma egregia* Girard, Pac. Ry. Surv., vol. x, p. 291, 1859, locality unknown.  
*Phoxinus clelandi* Eigenmann & Eigenmann, West Am. Scientist, 1889, p. 149, Aetna Springs, Napa County.  
*Leuciscus egregius* Jordan & Evermann, Fishes North & Mid. Amer., pt. 1, p. 237, 1896.

A small minnow with red sides, common in Nevada streams, but found on both sides of the Sierras in streams draining Lassen Butte. The following is a tabular statement of fin and scale counts of specimens from Warner Creek:

Counts.	No. of specimens.	Counts.	No. of specimens.
Dorsal:		Scales—Continued.	
8 rays.....	8	Along lateral line—	
9 rays.....	2	54 scales.....	1
Anal:		55 scales.....	5
8 rays.....	4	57 scales.....	2
9 rays.....	6	58 scales.....	1
Scales:		61 scales.....	1
Above lateral line—		Below lateral line—	
12 scales.....	1	7 scales.....	4
13 scales.....	3	8 scales.....	4
14 scales.....	6	9 scales.....	2

LOCAL DISTRIBUTION.

Locality.	Stream.	Basin division.	Collector.	Name as reported.	Authority.
Johnson Ranch....	Warner Creek....	Lahontan.....	Rutter & Chamberlain	<i>Leuciscus egregius</i> .	Eigenmann & Eigenmann.
	Aetna Springs....	Sacramento.....	Cleveland.....	<i>Phoxinus clelandi</i> .	

15. *Rutilus bicolor* (Girard). *Klamath Lake Roach*.

*Algansea bicolor* Girard, Proc. Ac. Nat. Sci. Phila. 1856, p. 183, Klamath Lake.  
*Myloleucus parovanus* Cope, Proc. Ac. Nat. Sci. Phila. 1883, p. 143, Goose Lake.  
*Myloleucus thalassinus* Cope, Proc. Ac. Nat. Sci. Phila. 1883, p. 143, Goose Lake.  
*Rutilus bicolor* Jordan & Evermann, Fishes North & Mid. Amer., pt. 1, p. 244, 1896.

Head 3.6 in body, depth 3.3; eye 5.6 in head, interorbital 3.1, snout 3.5, depth of caudal peduncle 2.2; dorsal 9; anal 8; scales 11-49-6; teeth 5-4. [Specimen 126 mm. long.]

Head conical, its depth at occiput about 1.6 in its length; mouth oblique, jaws even, or lower included. Top of premaxillary on level with lower edge of pupil; shortest distance across preorbital about .8 of eye. Tip of lower jaw rounded, not truncated or trenchant as in *symmetricus*. Caudal peduncle deep and compressed, but little tapering, its depth equal to snout and eye in larger specimens. Teeth 5-4, sometimes 4-4.

Description based on specimens 55 to 158 mm. long from South Fork Pitt River.

The following table indicates the variation in scale and ray counts and number of teeth:

Locality.	Specimens having—																														
	Lateral line—															Dorsal rays—			Anal rays—		Teeth 5-4.	Teeth 4-4.									
	44.	45.	46.	47.	48.	49.	50.	51.	52.	53.	54.	55.	56.	57.	58.	59.	60.	61.	8.	9.			10.	7.	8.	9.					
Goose Lake.....		4		1	1																			6			5	1	3	3	1
South Fork Pitt River.....					2	4	3																	10			9	1	2		
Pitt River, Canby.....						1		1	1					1										4	1		3	2	5	5	
Ash Creek, Aden.....	1	1		2	1		3	3		2													1	11	1	10	3	8		1	
Pitt River, Bleber.....								1																1		1					1
Fall River.....						1	2	1			1													4	1		3	2	3	5	5
Hat Creek, Cassel.....								1			2	1	2	2	1		1						3	7		1	9				5
Wolf Creek, Greenville.....			1	6	3	3	3	3	1	2													7	16		2	20	1			5
Total.....	1	5	1	9	7	9	11	9	3	5	1	2	1	3	2	1	1	11	58	4	3	60	10	30	30	10	30	30	8	8	

The head varies from 0.26½ to 0.32, being longest in specimens from Goose Lake, which vary from 0.29 to 0.32. The average size in other localities is about 0.28.

The depth varies from 0.25½ to 0.31, being least in the specimens from Wolf Creek, a tributary of Indian Creek, near Greenville, Plumas County. Goose Lake specimens have the depth slightly greater, while the deepest specimens come from South Fork Pitt River.

The eye and interorbital vary inversely with the size of the fish. The snout varies but little, and the depth of the caudal peduncle only from 0.115 to 0.13. The other measurements show considerable variation, but the variations are not characteristic of localities.

The scales range from 44 to 61, averaging about 49 or 50, being somewhat more numerous in specimens from Hat Creek. The number of scales above the lateral line is usually 11 or 12, sometimes 13; the number below is 6 or 7.

The dorsal rays are 8, 9, or 10, and the anal 7, 8, or 9, without reference to locality. The teeth are usually 5-4, but occasionally 4-4. Half of the specimens examined from Hat Creek have the teeth 4-4.

The greatest variation is in the head. Its shape is even more variable than its length, the South Fork Pitt River and Goose Lake specimens exhibiting the two extremes. The former has a short triangular head (when viewed from the side), the profile steep, the mouth oblique, but much less so than in the Goose Lake specimens, the mandibles not forming a distinct angle with the lower outline, and the nape swollen. The Goose Lake specimens have the head long and slender, appearing quadrangular when viewed from the side, the profile more nearly horizontal, the mouth very oblique, the lower jaw forming a distinct angle with the lower outline, and the nape not swollen. All possible intergradations are found in other localities, and a full series of intergradations are known from Klamath Lake.

LOCAL DISTRIBUTION.

Locality.	Stream or lake.	Collector.	Name as reported.	Authority.
Oregon.....	Goose Lake.....	Cope.....	<i>Myloleucus parovanus</i>	Cope.
California.....	do.....	Rutter & Chamberlain	<i>M. thalassinus</i> .....	
South Fork Pitt River.....	South Fork Pitt River.....	do.....	do.....	Cope.
Canby.....	Pitt River.....	do.....	do.....	
Aden.....	Ash Creek.....	do.....	do.....	
Pittville.....	Pitt River.....	do.....	do.....	
Dana.....	Fall River.....	do.....	do.....	
Cassel.....	Hat Creek.....	do.....	do.....	
Greenville, Indian Valley.....	Wolf Creek.....	Rutter & Atkinson.....	do.....	

16. *Rutilus symmetricus* (Baird & Girard). *California Roach.*

*Pogonichthys symmetricus* Baird & Girard, Proc. Ac. Nat. Sci. Phila., 1854, p. 136, San Joaquin River, Fort Miller.

*Algonsea formosa* Girard, Proc. Ac. Nat. Sci. Phila., 1856, p. 183, Merced and Mojave rivers.

*Leucos formosus* Jordan & Henshaw, Wheeler Survey, p. 193, 1878.

*Rutilus symmetricus* Jordan & Evermann, Fishes North & Mid. Amer., pt. 1, 245, 1896.

Head 4.1 in body; depth 4.4; eye 3.6 in head; interorbital and snout equal, 3 in head; depth of head at occiput 1.5 in its length. Teeth 5-4, long and hooked, the 5 being on the left side; scales 12-51-7, dorsal 10, anal 9. (Measurements on a specimen 86 mm. long from San Joaquin River at Pollasky.)

In general the head is small and conical, 0.25 to 0.27 of body; depth of body 0.23 to 0.25 of its length; mouth small, lateral cleft slightly oblique, anterior cleft horizontal (not arched), lower jaw included, more or less trenchant, and its tip often covered with a horny sheath; eye rather large, its diameter 0.06 to 0.07 of body, almost wholly in anterior half of head; snout broad and blunt, nostrils farther from each other than from tip of snout; the lower jaw with a horny or cartilaginous sheath. Ventrals inserted in middle of body, reaching to vent; dorsal of 10 rays, its origin slightly behind ventrals, 0.58 to 0.60 of body length from tip of snout, its longest ray 1.2 in head; anal inserted under last ray of dorsal, of 9 or sometimes 8 rays; caudal very large, its length one-third that of body, widely spread, with 10 rudimentary rays, deeply forked, the middle rays 2.3 in longest, upper lobe slightly longer than lower. Scales 12-48 to 51-7 or 8. Color, dusky above, gradually changing to silvery on belly, cheeks silvery, the fins nearly colorless, but the rudimentary caudal rays quite dusky. A dark stripe along middle of side is sometimes faintly separated from the dusky color of the back. (Description is based on several specimens, the largest 5 inches long, from San Joaquin River at Pollasky, about 2 miles from Fort Miller, the type locality.)

The head varies from 0.24 of the body in specimens 67 mm. long from North Fork Consumne River at Pleasant Valley, and another 85 mm. long from Thomas Creek to 0.28 in a specimen 46 mm. long from North Fork of Pitt River. The size of the head in the 96 specimens measured may be stated in tabular form as follows:

Size of head:	Specimens.	Size of head:	Specimens.
0.24.....	2	0.265.....	13
0.245.....	1	0.27.....	21
0.25.....	24	0.275.....	1
0.255.....	3	0.28.....	1
0.26.....	30		

The typical form has the head 0.27 or 0.26. Such are found in San Joaquin River at Pollasky (type locality); also in Kings, St. John or Kaweah, Tule, Chouchilla, and North Fork Merced rivers, and in Merced River at Benton Mill and Livingston. Specimens from Battle Creek, Stanislaus River, and Mariposa Creek have the head 0.26 or 0.25, and specimens from Thomas Creek and North Fork Consumne River have the head 0.25 or 0.24; but the size of the head does not correspond with other variations. The Thomas Creek and Consumne River specimens do not at all resemble each other, while the Mariposa specimens and those from North Fork Merced River do look much alike.

The eye usually measures 0.07, but is often much smaller. In specimens from Battle Creek it is 0.07 or 0.065; from Thomas Creek 0.065 or 0.06; North Fork Merced River 0.06, rarely 0.065 or 0.055; Mariposa Creek 0.055, rarely 0.06 or 0.05. The greatest variation in one locality is that of Merced River, at Benton Mill, from 0.055 to 0.07. The tip of the lower jaw is scarcely rounded and not arched. It is often more or less trenchant, and is frequently tipped with a sheath that is sometimes cartilaginous and sometimes horny. The bony sheath is deciduous in preserved specimens, which accounts for its apparent absence in some instances. It resembles that of *Acrocheilus*, but the cutting edge is thinner. It is present in all the specimens from North Fork Consumne River and in half those from North Fork Merced and from San Joaquin at Pollasky. Only a few of the specimens from the Stanislaus River, Merced at Livingston, Chouchilla River, and Mariposa Creek have the horny sheath; and it is entirely wanting in specimens from Battle Creek, Thomas Creek, and Merced River at Benton Mill. The teeth are 5-4, but sometimes 4-4. The scales of the lateral line vary from 47 to 56, the greatest variation, 48 to 56, being found in specimens from Mariposa Creek. The number above the lateral line is usually 12 or 13, but varies from 11 to 15; below lateral line 6 or 7, sometimes 8.

The following table indicates the variation in scale and ray counts, giving the number of specimens in which the various counts were made:

Locality.	Number of specimens having—															
	Scales—										Dorsal rays—			Anal rays—		
	47.	48.	49.	50.	51.	52.	53.	54.	55.	56.	8.	9.	10.	7.	8.	9.
San Joaquin River, Pollasky.....		1		2	3							6		1		5
Kings River, Centerville.....	2		1	2							2	3				5
Kaweah River, St. John Channel.....	1	1	3	4		1					2	8		3		7
Tule River, Porterville.....	3	2	3	2							8	2		8		2
Chouchilla River near Raymond.....	1	5	4								9	1		10		
Merced River, Livingstone.....	1			1								2				2
Merced River, Benton Mill.....			1	4	1	2					1	7		1		7
Stanislaus River, Parrot Ferry.....				1	1	3	1	3	1		1	9		1		9
North Fork Merced River.....						3	3	4			10			10		
Mariposa Creek.....		1		1	1	2	2			1	9			10		
North Fork Consumne River, Pleasant Valley.....				1		1				2	1	3				4
North Fork Pitt River.....					1					1			1			
Total.....	8	10	12	17	7	13	6	9	1	3	2	43	41	1	44	41

The insertion of the dorsal varies from 0.57 to 0.61 of the body length from the tip of the snout.

The dorsal rays are 10 or 9, one specimen from Mariposa Creek having but 8. Anal 8 or 9. Usually nearly all specimens from one locality have the same number. In these numbers the last double ray is counted as two when both divisions are divided.

The caudal peduncle is characteristically slender in *symmetricus*. Typically its depth is 0.09 or 0.10, which is the size in specimens from San Joaquin at Pollasky, Kings River, and St. John or Kaweah River. It is 0.10 in specimens from Thomas Creek, Stanislaus River, and Merced River at Livingston and Benton Mill; 0.10 or 0.11 from Battle Creek, North Fork Merced, Mariposa Creek, Chouchilla and Tule River; and 0.11 or 0.12 from North Fork Consumne River and North Fork Pitt River.

The size of the caudal fin varies much. Usually it is about one-third as long as the body, but in specimens from Mariposa Creek, North Fork Merced River, North Fork Consumne River, and North Fork Pitt River it is only one-fourth as long as the body. From other localities all possible intergradations may be obtained. Those specimens with the longest fin have it the most deeply forked.

The variations noted fall into three groups, though hardly of such a nature as to permit of even subspecific distinction.

First is the Mariposa form, which differs from the Pollasky or typical form in having a smaller head, smaller eye, smaller fins, especially the caudal, one ray fewer in dorsal and anal, deeper caudal peduncle, and greater variation in the number of scales, 48 to 56. Specimens from North Fork Merced River at Bower Cave are very similar, but have a slightly larger eye, and the head is of typical size. The specimens of the 2 localities have independently developed similar variations, as there is no direct connection between the two streams. Mariposa Creek is a mere brook, emptying into the dry bed of Mariposa River. Its water reaches the San Joaquin River only after heavy winter rains. Mariposa Creek is south of Merced River, so that it and North Fork Merced do not even drain opposite slopes of the same watershed. There is a fall in the latter stream below Bower Cave, which prevents the ascent of fishes from the main river, *Rutilus* and *Salmo* being the only fishes in the North Fork above the fall.

The second variation is the Pleasant Valley form. So far as measurements go this form runs close to the Mariposa form, but its general appearance is quite different. The head is slender, not conical, the depth at occiput less than in any other form, the snout very blunt. These characters show in a less degree in specimens from Tule River and Battle Creek. The caudal peduncle is deep, the caudal fin intermediate in size between that of Mariposa and Pollasky forms. The horny sheath is well developed in all specimens, the teeth 5-4 in three specimens, 4-4 in one; the lateral stripe very distinct. Represented by 4 specimens from North Fork Consumne River near Pleasant Valley. The stream is dry in its lower course during the summer.

The third or Alturus form has a long slender body, head and eye of typical size, caudal peduncle as deep as in the Pleasant Valley form, lower jaw not so much included as in other forms, and scales

more imbricated. We have but a few small specimens of this form, the longest being but 3 inches long. They were taken in North Fork of Pitt River near Alturus and at mouth of Joseph Creek, several hundred miles from where any other specimens of *symmetricus* have been taken. The form may prove not to be *symmetricus*, but we can not identify it otherwise with the material at hand.

## LOCAL DISTRIBUTION.

Locality.	Stream or lake.	Collector.	Name as reported.	Authority.
At mouth of Joseph Creek...	North Fork Pitt River....	Rutter & Chamberlain.	Rutilus symmetricus.	
Near Alturus.....	do.....	do.....	do.....	
Redding.....	Sacramento River.....	do.....	do.....	
At mouth of.....	Clear Creek.....	do.....	do.....	
United States hatchery.....	Battle Creek.....	do.....	do.....	
At mouth of.....	Thomas Creek.....	Rutter & Scofield.	do.....	
Pleasant Valley.....	North Fork Consumne River.	Rutter & Atkinson.	do.....	
Baker Ford.....	Tuolumne River.....	do.....	do.....	
Near mouth of.....	South Fork Tuolumne River.	do.....	do.....	
Parrot Ferry.....	Stanislaus River.....	do.....	do.....	
Bower Cave.....	North Fork Merced River.....	do.....	do.....	
Benton Mill.....	Merced River.....	do.....	do.....	
Livingston.....	do.....	do.....	do.....	
Mariposa.....	Mariposa Creek.....	Heermann Rutter & Atkinson.	Algonsea formosa Rutilus symmetricus.	Girard, 1856.
Raymond.....	Chouchilla River.....	do.....	do.....	
Pollasky.....	San Joaquin River.....	do.....	do.....	
Fort Miller.....	do.....	Heermann	Pogonichthys symmetricus.	Girard, 1854.
Centerville.....	Kings River.....	Rutter & Atkinson.	Rutilus symmetricus.	
St. John Channel.....	Kaweah River.....	do.....	do.....	
Porterville.....	Tule River.....	do.....	do.....	
	Kern Lake.....	Henshaw	Leucos formosus...	Jordan & Henshaw.

17. *Agosia robusta* Rutter.

*Agosia robusta* Rutter, Bul. U. S. Fish Comm., vol. xxii, collection 1902, p. 148, fig., Prosser Creek, Cal.

Body heavy, highest at shoulder, ventral outline curved almost as much as dorsal; head large, 3.75 to 4 in length; snout blunt, but little overlapping, and never projecting beyond the premaxillary; mouth oblique, barbels usually absent, present on 10 to 50 per cent of the specimens from any one locality; pectoral about equal to head behind nostril, variable; caudal moderately forked, length of middle rays two-thirds of outer; lateral line nearly always incomplete; scales 49 to 77, usually varying about 12 in one locality; usually 2 lateral stripes, the upper extending from snout to caudal, the lower branching off from the upper behind the head and ending along base of anal; cheeks abruptly silvery below lateral stripe.

This species differs from *nubila* in the heavy body, blunt rounded snout, incomplete lateral line, and in the absence of scattered brown scales. It differs from *carringtoni* also in the heavy body and incomplete lateral line, and in the shorter pectorals, the anterior rays of anal scarcely or not at all extending beyond posterior when fin is depressed, a greater development of rudimentary caudal rays which usually form short keels along caudal peduncle, and in the silvery stripe across cheeks.

In the main Sacramento River and the lower portion of its tributaries there appears to be a more slender form, but our material is too meager for accurate determinations. The only adults are from Sacramento River at Sims. They have a small head, 4.33 in body, the lateral line is complete, the scales 69 to 77; the mouth is inferior, the snout projecting, and the maxillaries with barbels; the eye is 4.5 in the head. Specimen 3.4 inches long. Young specimens similar to the young taken at Sims were secured in Battle Creek at the government fishery station, and in American River at Placerville. The Kings River specimens are more like the type of *robusta*.

The following table gives the variation in scales of lateral line and in rays of the dorsal and anal fin:

Locality.	Number of specimens having—																	
	Scales—																	
	49.	50.	51.	52.	53.	54.	55.	56.	57.	58.	59.	60.	61.	62.	63.	64.	65.	66.
Goose Lake.....													2	1				
Joseph Creek.....												1	2		1	1	1	1
South Fork Pitt River.....																		
Rush Creek.....																		3
Fall River.....							1		1	3	1						3	
Burney Creek.....	2	3	4	1	1	2	1	1	1	1	2	1						
North Fork Feather, Coppervale.....										4	2		3	2		2	2	2
Duck Lake.....										2					3	1	1	1
Clover Valley.....									1	1				1	3	1	2	2
Spanish Creek, Quincy.....										1	2	1	2		1	1	2	2
Middle Fork Feather, Beckwith.....										1	1	1			3	1	1	1
Kings River, Centerville.....										1						1		
Total.....	2	3	4	1	1	2	2	1	2	5	13	5	3	10	7	11	10	12

Locality.	Number of specimens having—																
	Scales—											Dorsal—			Anal—		
	67.	68.	69.	70.	71.	72.	73.	74.	75.	76.	77.	7.	8.	9.	6.	7.	8.
Goose Lake.....				1						1			5			5	
Joseph Creek.....	3	3	4	1	2	1					1	18	1	5	15		
South Fork Pitt River.....			1										1				1
Rush Creek.....	2	2		2		2	1	2	1	2	1		15	3		18	
Fall River.....		1			2								16			16	
Burney Creek.....												4	14	2	2	18	
North Fork Feather, Coppervale.....	3	1		1							2	17	1		19	1	
Duck Lake.....	1	2	4	2	1		2			1		20			20		
Clover Valley.....	3	2	1		1	2	2				1	19			20		
Spanish Creek, Quincy.....	1											8	2		9	1	
Middle Fork Feather, Beckwith.....		1			1							9	1		10		
Kings River, Centerville.....												1	1		2		
Total.....	13	12	10	7	7	5	5	2	1	4	1	8	142	12	7	152	3

The species is quite variable. The head varies from 3.6 to 4.3 in the body. The pectoral may be almost as long as the head, or only equal head behind pupil. The Burney Creek specimens have the shortest pectorals as well as the coarsest scales, the pectorals being equal to head behind some point in pupil. The margin of the anal fin may be straight, convex, or S-shaped with the convex portion anterior; the anterior rays usually do not overlap the posterior when the fin is depressed, though the reverse is sometimes true.

LOCAL DISTRIBUTION.

Locality.	Stream or lake.	Collector.
Davis Creek Post-office.....	Goose Lake.....	Rutter & Chamberlain.
	Davis Creek.....	do.
	Joseph Creek.....	do.
Alturus.....	North Fork Pitt River.....	do.
South Fork Post-office.....	South Fork Pitt River.....	do.
Canby.....	Pitt River.....	do.
Aden.....	Ash Creek.....	do.
Dana.....	Fall River.....	do.
Fall River Mills.....	do.....	do.
Burneyville.....	Burney Creek.....	do.
Sims.....	Sacramento River.....	do.
United States hatchery.....	Battle Creek.....	do.
Oroville.....	Feather River.....	do.
Johnsons.....	Warner Creek.....	do.
	Duck Lake.....	do.
Big Meadows.....	North Fork Feather River.....	do.
Quincy.....	Spanish Creek.....	Rutter & Atkinson.
Crescent Mills.....	Indian Creek.....	do.
Greenville.....	Wolf Creek.....	do.
Clover Valley.....	Clover Creek.....	do.
Beckwith.....	Middle Fork Feather River.....	do.
Placerville.....	American River.....	Rutter & Chamberlain.
Centerville.....	Kings River.....	Rutter & Atkinson.

18. *Salmo irideus* Gibbons. *Rainbow Trout*.

- Salmo iridea* Gibbons, Proc. Cal. Ac. Nat. Sci. 1856, p. 36, San Leandro Creek, San Francisco Bay. Jordan & Evermann, Fishes North & Mid. Amer., pt. 1, p. 500, 1896.
- Salmo rivularius* Ayres, Proc. Cal. Ac. Nat. Sci. 1856, p. 43, Martinez Creek.
- Salar iridea* Girard, Pac. Ry. Surv., vol. vi, p. 33, 1857, Chico Creek.
- Salmo tsuppitch* Jordan & Henshaw, Wheeler Survey, p. 196, 1878, Kern River and tributary of Pitt River.
- Salmo henshawi* Jordan, Wheeler Survey, p. 197, 1878, McCloud River.
- Salmo pleuriticus* Jordan & Henshaw, op. cit., p. 198, South Fork Kern River.
- Salmo mykiss irideus* Jordan & Gilbert, Bul. U. S. Fish Comm., vol. xiv, 1894, p. 139, Clear Lake.
- Salmo irideus stonei* Jordan, Thirteenth Biennial Report Cal. Fish Comm. 1894, p. 142, McCloud River. Jordan & Evermann, op. cit., p. 503.
- Salmo gairdneri shasta* Jordan, op. cit., p. 142, same place. Jordan & Evermann, op. cit., p. 502.
- Salmo gairdneri gilberti* Jordan, op. cit., p. 143, Kern River. Jordan & Evermann, op. cit., p. 502.

The most widely distributed species found in the basin. Exceedingly variable. Found in many isolated localities, in some of which it has developed into forms more or less peculiar. The following variations are worthy of note:

The common form, found throughout the basin, has the back dusky olive, lower sides and belly silvery; back and sides to below lateral line, and dorsal and caudal fins, thickly covered with small black spots; a broad, ill-defined, purplish stripe from side of head to base of caudal fin; tips of dorsal, anal, and ventrals often white.

The trout from upper McCloud River are dusky above, pale below, a reddish-brown stripe along sides, opercles washed with same; back and sides, dorsal and caudal fins thickly covered with oval or round black spots about half size of pupil; belly and lower fins yellowish; tips of dorsal, anal, and ventrals white. Very abundant. About six inches long; scales small, 146 to 165.

The form found in South Fork Battle Creek above the falls closely resembles that found in the upper McCloud River. Both forms have finer scales than the average, and those from Battle Creek have the finest scales recorded from any locality. The following is a detailed description of the Battle Creek specimens:

Head 3.7 to 4 in length, depth 4 to 4.7; eye 3.5 to 4 in head, snout 4.5 to 5; maxillary 2 to 2.2 in head, extending to below posterior margin of eye (specimens 4.5 to 5.8 inches long). Dorsal 11 or 12; anal 10 or 11; branchiostegals 10 to 12; gillrakers 5 to 7+10 to 12. Origin of dorsal in middle of body, ventrals inserted under fifth ray of dorsal. Height of dorsal 1.7 in head, anal 2.7. Scales small, not overlapping, pores in lateral line 114 to 123, cross series of scales 151 to 176, scales before dorsal 66 to 84, above lateral line 28 to 32, below lateral line 25 to 31. Margin of anal S-shaped, the anterior portion convex and longer, the longest rays overlapping shortest by 0.7 the length of the latter. Color brownish olive, very faint purplish on sides; very few spots, more numerous on dorsal and adipose fin, few or none on caudal; lower fins colorless, par marks present even in largest specimens.

Description based on 11 specimens 4.5 to 5.8 inches long.

The trout of North Fork Feather River near source, locally known as West Fork, are of two forms with regard to color. One has very fine black specks thickly scattered over back, dorsal, and caudal fins; the other has much larger spots, about the size of pupil. Some specimens have a reddish tinge on dentaries, but this is irrespective of other coloration. These variations have been noticed in other places, but never so strongly marked as in this locality.

The Goose Lake trout has the body entirely silvery, with black spots very small and widely separated, not occurring as low as the lateral line. In the few specimens secured the maxillary is longer than it is in specimens from other localities; the base of the dorsal fin is shorter, 2.2 in head (1.7 in specimens from other localities); dorsal rays 10.

The trout in a series of small lakes, known as Salmon Lakes, forming one of the sources of North Fork of Yuba River, have the sides bright red instead of purplish. The lower fins are of the same color as the sides, but edged with white. Some of the trout of Gold Lake, about a mile away from Salmon Lakes, but tributary to Middle Fork of Feather River, are red like those from Salmon Lakes; others have the ordinary color of typical *irideus*. The Gold Lake trout are badly infested with gill parasites.

The single specimen from Cliff Lake has but 116 cross rows of scales, which is also the number in the lateral line. The average number of scales for the 129 specimens counted is 147. The greatest variation in any one locality is 36, found in specimens from Sullaway Creek. Several stations have

a variety of 23 to 28. Excepting the one specimen from Cliff Lake with 116, the smallest number of scales recorded is 128, and the largest 176. The specimens from upper Sacramento and Pitt River regions average 147 scales, those from the various branches of Feather River average 143. From South Fork of Battle Creek, 163.

## LOCAL DISTRIBUTION.

Locality.	Stream or lake.	Collector.	Name as reported.	Authority.
West of Sierras	Sacramento River		Salmo iridea	Jordan & Gilbert.
	Gumboot Lake and other lakes of vicinity.	Rutter & Chamberlain.	do	Jordan & Jouy.
Sissons	Sacramento River		do	
Do	Sullaway Creek		do	
Sims	Sacramento River		do	
Bartlets	McCloud River		do	
Big Bend	do		do	
Lower Falls	do	Stone	S. henshawi	Jordan & Henshaw.
			S. iridea	Bean.
Baird	do	Stone	do	Jordan & Gilbert.
			Salmo irideus stonoi	Jordan, 1894.
			S. gairdneri shasta	do.
			S. iridea	
	Goose Lake	Rutter & Chamberlain.	do	
Davis Creek Post-Office.	Davis Creek		do	
Near source of	North Fork Pitt River		do	
Near Alturus	do		do	
South Fork Post-Office	South Fork Pitt River		do	
	Tributary of Pitt River	Henshaw	S. tsuppitch	Jordan & Henshaw.
Near Aden	Rush Creek	Rutter & Chamberlain.	S. iridea	
Cassel	Hat Creek		do	
Dana	Fall River		do	
Fall River Mills	do		do	
Near Bartlets	Bear Creek		do	
Burneyville	Burney Creek		do	
Battle Creek Meadows	Battle Creek		do	
Longs Ranch	do		do	
United States hatchery	do	Rutter	do	
Morgan Springs	Mill Creek	Rutter & Chamberlain.	do	
Jacinto	Chico Creek	Newberry	Salar iridea	Girard, 1857.
	Sacramento River	Rutter & Chamberlain.	Salmo iridea	
Princeton	do	do	do	
Lake County	Clear Lake	Jordan & Gilbert	Salmo mykiss irideus	Jordan & Gilbert.
	Allen Springs	Cleveland	Salmo iridea	Eigenmann & Eigenmann.
Martinez	Brook	Winslow	S. rivularius	Ayres, 1854-7.
Near source of	North Fork Feather River	Rutter & Chamberlain.	S. iridea	
Johnsons	Warner Creek		do	
Big Meadows	Duck Lake		do	
Do	North Fork Feather River		do	
Quincy	Spanish Creek	Rutter & Atkinson	do	
Greenville	Wolf Creek		do	
Genesee Valley	Clover Creek		do	
Clover Valley	do		do	
Nelson Point	Middle Fork Feather River		do	
	Gold Lake		do	
Sierraville	Cole Creek		do	
Near Sierra City	Three Salmon Lakes		do	
Bassett Hotel	Bassett Creek		do	
Near Grass Valley	Rattlesnake Creek		do	
Gerle	Rubicon River		do	
Orelli	Big Silver Creek		do	
Jones Ranch	Little Silver Creek		do	
Pleasant Valley	North Fork Consumne River		do	
West Point	Middle Fork Mokelumne River		do	
Railroad Flat	Licking Creek		do	
Do	South Fork Mokelumne River		do	
Calaveras Grove	San Antonio Creek		do	
At mouth of	South Fork Tuolumne River		do	
Bower Cave	North Fork Merced River		do	
Near source of	Kern River	Henshaw	Salmo iridea, Salmo tsuppitch	Jordan & Henshaw.
Do	do	Gilbert	S. gairdneri gilberti	Jordan, 1894.
Near Mount Olanche	South Fork Kern River	Henshaw	S. pleuriticus	Jordan & Henshaw.



**18a. *Salmo aqua-bonita* (Jordan). *Golden Trout of South Fork of Kern.***

*Salmo mykiss aqua-bonita* Jordan, Proc. U. S. Nat. Mus., 1892, p. 481, Volcano Creek.

*Salmo irideus aqua-bonito* Jordan & Evermann, Fishes N. & Mid. Amer., pt. 1, p. 503, 1896.

We have seen but few specimens of this species.

**19. *Salvelinus malma* (Walbaum). *Dolly Varden Trout.***

*Salmo malma* Walbaum, Artedi Piscium, p. 66, 1792, Kamchatka.

*Salvelinus bairdii* Bean, Proc. U. S. Nat. Mus., 1880, p. 707, McCloud River.

*Salvelinus malma* Jordan & Evermann, Fishes North & Mid. Amer., pt. 1, p. 507, 1896.

Reported by Bean, 1880, and by various sportsmen from the McCloud River; not otherwise known from the basin.

**20. *Gasterosteus cataphractus* (Pallas). *Stickleback.***

*Gasterosteus cataphractus* Pallas, Mem. Ac. Petersb., vol. III, 1811, p. 325, Kamchatka.

*Gasterosteus microcephalus* Girard, Proc. Ac. Nat. Sci. Phila., 1854, p. 133, Four Creeks, Tulare Valley.

The sticklebacks of California have been reported under various names, but only the name *microcephalus* has been applied to specimens from the Sacramento-San Joaquin Basin. Several other names have been given to specimens from San Francisco Bay and its smaller tributaries.

LOCAL DISTRIBUTION.

Locality.	Stream or lake.	Collector.	Name as reported.	Authority.
San Francisco.....	Rivers of California.....	.....	<i>Gasterosteus microcephalus</i> ..	Jordan & Gilbert, 1881.
United States hatchery.	Battle Creek.....	Rutter.....	do.....	Jordan & Jouy.
	Clear Lake.....	Jordan & Gilbert.....	<i>Gasterosteus cataphractus</i> ...	
Centerville.....	Kings River.....	Rutter & Atkinson.....	<i>Gasterosteus microcephalus</i> ..	Jordan & Gilbert, 1894.
	Four Creeks.....	Heermann.....	<i>Gasterosteus cataphractus</i> ...	
	Tulare Lake.....	do.....	<i>Gasterosteus microcephalus</i> ..	Girard, 1854, 1857, 1859.
			do.....	Girard, 1854.

**21. *Archoplites interruptus* (Girard). *Sacramento Perch.***

*Centrarchus interruptus* Girard, Proc. Ac. Nat. Sci. Phila., 1852, p. 129, San Joaquin and Sacramento rivers.

*Centrarchus maculosus* Ayres, Proc. Cal. Ac. Nat. Sci., vol. 1, 1854, p. 8, Sacramento River.

*Ambloplites interruptus* Girard, Pac. Ry. Surv., vol. x, p. 10.

*Archoplites interruptus* Jordan & Evermann, Fishes N. & Mid. Amer., pt. 1, p. 991, 1896.

Mouth large, oblique, the lower jaw projecting, the maxillary extending to below posterior portion of eye; eye large, 3.7 to 4.7 in head; dorsal with XII or XIII spines and 10 or 11 soft rays; anal VI, 10; scales strongly ctenoid. Color very variable; sometimes very dark with small pale blotches; or nearly plain silvery with two or three alternating rows of dusky blotches.

Rare, sometimes taken in marketable quantities near Rio Vista. An excellent food fish, formerly abundant, its disappearance charged to the introduction of carp and catfish, but probably due also to the reclamation of swamp lands.

LOCAL DISTRIBUTION.

Locality.	Stream or lake.	Collector.	Name as reported.	Authority.
San Francisco markets..	Sacramento River..	Heermann.....	<i>Centrarchus interruptus</i> .....	Girard, 1854.
Do.....	do.....	Kennerly.....	<i>Ambloplites interruptus</i> .....	Girard, 1858.
Do.....	do.....	Ayres.....	<i>Centrarchus maculosus</i> .....	Ayres, 1854-7.
Do.....	do.....	Newberry.....	<i>Ambloplites interruptus</i> .....	Girard, 1857.
Do.....	do.....	Lockington.....	<i>Archoplites interruptus</i> .....	Lockington.
Do.....	do.....	(?).....	do.....	Jordan & Jouy.
United States hatchery.	Battle Creek.....	Rutter.....	do.....	
	Clear Lake.....	Jordan & Gilbert.....	do.....	Jordan & Gilbert.
Sacramento.....	Sacramento River..	Rutter & Chamberlain.....	do.....	
Arcade.....	Arcade Creek.....	Rutter & Atkinson.....	do.....	
Rio Vista.....	Sacramento River..	Rutter.....	do.....	
	San Joaquin River..	Ayres.....	<i>Centrarchus maculosus</i> .....	Ayres, 1854-7.
	do.....	Heermann.....	<i>Ambloplites interruptus</i> .....	Girard, 1854.
	Kern Lake, Tulare Valley.	Henshaw.....	do.....	Jordan & Henshaw.

**22. *Hysterochampus traskii* Gibbons. *Fresh-water Viviparous Perch.***

*Hysterochampus traskii*, Gibbons, Proc. Ac. Nat. Sci. Phila., 1854, p. 105, lagoons of lower Sacramento River. Jordan & Evermann, Fishes N. & Mid. Amer., pt. I, p. 1496, 1898.

*Sargosomus fluviatilis* Agassiz, MS., Alexander Agassiz, Proc. Bost. Soc. Nat. Hist., vol. VIII, 1861, p. 1301, Sacramento River.

*Docentrus lucens*, Jordan, Bul. U. S. Geol. Surv. vol. IV, 1878, p. 667, Sacramento River, erroneously ascribed to Rio Grande.

Body deep and compressed, back strongly arched; mouth small, terminal, jaws even, maxillary not extending to eye; dorsal with about XVII spines and 11 soft rays; anal with 3 spines and 23 soft rays. Scales cycloid.

Not very abundant, found in sluggish water. Readily distinguished from the Sacramento perch or sunfish by the small mouth and cycloid scales.

LOCAL DISTRIBUTION.

Locality.	Stream or lake.	Collector.	Name as reported.	Authority.
San Francisco markets	Sacramento River.....		<i>Hysterochampus traskii</i>	Jordan & Jouy.
	do.....		<i>Sargosomus fluviatilis</i> .	Eigenmann & Ulrey. A. Agassiz.
Fresh-water lagoons.	do.....	Trask & Morris.....	<i>H. traskii</i> .....	Gibbons, 1854a, 1854b.
Pittville.....	Pitt River.....	Rutter & Chamberlain.	do.....	
Redding.....	Sacramento River.....	do.....	do.....	
Fort Redding.....	Cow Creek.....	Newberry.....	do.....	} Girard, 1857-58.
Do.....	do.....	Henshaw.....	do.....	
United States hatchery	Battle Creek.....	Rutter & Scofield.....	do.....	
Red Bluff.....	Sacramento River.....	do.....	do.....	
Vina.....	do.....	do.....	do.....	
Chico Bridge.....	do.....	do.....	do.....	
Jacinto.....	do.....	do.....	do.....	
Wilson Farm.....	do.....	do.....	do.....	
Marysville.....	Clear Lake.....	Jordan & Gilbert.....	do.....	} Jordan & Gilbert.
	Feather River.....	Rutter & Chamberlain.	do.....	
Pollasky.....	San Joaquin River.....	Rutter & Atkinson.....	do.....	
Centerville.....	China Slough.....	do.....	do.....	
Do.....	Kings River.....	do.....	do.....	

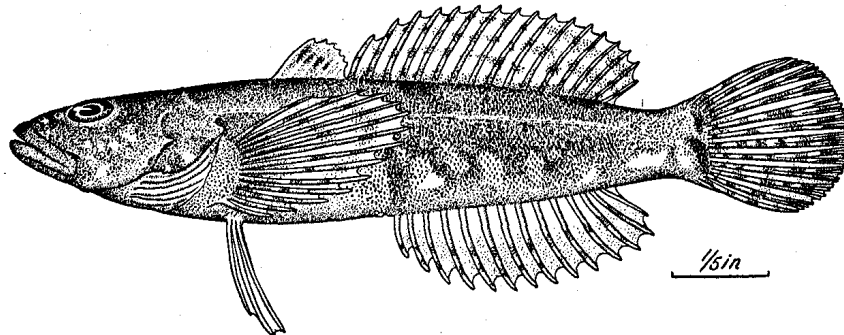


Fig. 3.—*Cottus asperrima*, new species. Type.

**23. *Cottus asperrima* Rutter, new species.**

Head 3.2 to 3.33 in length; depth 5.5; eye 3.5 to 4 in head; snout a little longer than eye; dorsal VI (or V), 18; anal 14; pectoral 14; ventral I, 3; caudal (branched rays) 7. Body slender, but not particularly compressed, width of caudal peduncle 1.25 to 1.33 in eye, its depth slightly greater than eye; maxillary 2.5 in head, extending to vertical through anterior edge of pupil; profile flat or concave back of eye; anterior nostrils with conspicuous tubes; upper preopercular spine slender, sharp, almost straight, directed slightly upward, partly covered by the skin; second much shorter, triangular, directed toward lower base of pectoral, sometimes rudimentary; third spine wanting; interorbital space 0.5 of eye; spinous dorsal low, its outline not so strongly arched as in *tenuis*, spines very weak, longest about equal to eye, only five in one specimen; longest soft ray of dorsal about 2 in head; origin of soft dorsal in or

behind middle of body; caudal convex, 1.33 to 1.43 in head; ventrals 1.6 in head, the rays graduated, the outer 0.66 length of inner; distance from snout to vent 0.54 to 0.56 of body. Fine prickles behind pectoral in all specimens, extending all over sides in two, and about half over in two others; lateral line ending under second to fifth ray from end of soft dorsal; finely mottled with dusky and gray, the dusky collecting into four or five blotches in some specimens; ventrals colorless, other fins barred.

Description based on five specimens 1.5 to 2.5 inches long from Fall River at Dana, Cal., collected by Rutter and Chamberlain. Another specimen 2.1 inches long was taken in Fall River at Fall River Mills. The latter specimen has stronger opercular spines, and the vent is but 0.52 of the body length from tip of snout. Type no. 58500, U. S. National Museum.

The following is a statement of the differences between this species and *Cottus tenuis*, as determined from the original description and drawing of the latter:

	C. asperrima.	C. tenuis.
Width of caudal peduncle into eye.....	1.25	2.5
Head into length.....	3.33	3.8
Depth into length.....	5.33	7
Distance of vent from snout.....	.55	.51
Distance of soft dorsal from snout.....	.53	.49
First ray of soft dorsal.....	Segmented.	Unsegmented.
Pectoral rays.....	14	15
Caudal rays (branched).....	7	9
Caudal margin.....	Convex.	Concave.
Outer ventral ray.....	.66 of inner.	.9 of inner.
Preopercular spine.....	Less hooked.	

24. *Cottus asper* Richardson. *Sculpin*.

*Cottus asper* Richardson, Fauna Bor. Amer., 295, 1836, Columbia River, Fort Vancouver.

*Cottopsis parvus* Girard, Proc. Ac. Nat. Sci. Phila., 1854, p. 144, Presidio.

*Uranidea semiscaber centropleura* Eigenmann & Eigenmann, West American Naturalist, 1889, p. 149, Allen Springs, Lake County.

*Cottus gulosus* (in part) Jordan & Evermann, Fishes N. & Mid. Amer., pt. II, p. 1945, 1898.

Body entirely asperate in all specimens of our collection. The following table indicates the variation in fin rays:

Locality.	Number of specimens having—								
	Dorsal—					Anal—			
	VII.	VIII.	IX.	20.	21.	16.	17.	18.	19.
Sacramento River, Redding.....	2			1	1		1		1
Mouth of Battle Creek.....		1		1			1		
Sacramento River, Red Bluff.....		1			1			1	
Sacramento River, Jacinto.....		1		1			1		
Feather River, Marysville.....			1	1			1		
Arcade Creek, Arcade.....		6	3	8	1	1	5	3	

LOCAL DISTRIBUTION.

Locality.	Stream.	Collector.	Name as reported.	Authority.
Redding.....	Sacramento River.....	Rutter & Chamberlain.	<i>Cottus asper</i> .....	Girard, 1858.
Fort Reading.....	do.....	Hammond.....	<i>Cottopsis parvus</i> .....	
Red Bluff.....	do.....	Rutter & Seofield.....	<i>Cottus asper</i> .....	
Jacinto.....	do.....	do.....	do.....	
Chico Bridge.....	do.....	do.....	do.....	
Jacinto.....	do.....	do.....	do.....	
Lake County.....	Allen Springs.....	Cleveland.....	<i>Uranidea semiscaber</i> .....	Eigenmann & Eigenmann.
Marysville.....	Feather River.....	Rutter & Chamberlain.	<i>Cottus asper</i> .....	Jordan & Jouy.
Arcade.....	Arcade Creek.....	Rutter & Atkinson.....	do.....	
Mare Island.....	San Pablo Bay.....	do.....	do.....	

25. *Cottus gulosus* (Girard). *Sculpin; Bull-head.*

*Cottopsis gulosus* Girard, Proc. Ac. Nat. Sci. Phila., 1854, p. 129, San Mateo Creek.

*Uranidea gulosa* Jordan & Henshaw, Wheeler Survey, 1878, p. 199.

*Cottus shasta* Jordan & Starks, Proc. Cal. Ac. Sci. 1896, 224, McCloud River.

*Cottus gulosus* (in part) Jordan & Evermann, Fishes N. & Mid. Amer., pt. II, p. 1944, 1898.

A widely distributed and somewhat variable species. Found throughout the basin. Specimens from Stanislaus River, Parrot Ferry, American River near Placerville, Feather River at Oroville, Warner Creek, Battle Creek at the government hatchery, McCloud River at Baird, and Sacramento River at Sims, have teeth on the palatines which are wanting in specimens from other places, and in some of the specimens from the places just mentioned. The patch of prickles behind pectoral fins is universally present. The opercular spines are variously developed; one is always present at lower end of subopercle; and one is always present at upper corner of preopercle. The two lower preopercular spines may or may not be developed; usually they are mere rounded projections and covered by the skin. When present the second preopercular spine projects downward; this is especially noticeable in the specimens from Warner Creek. The dorsal fins are continuous or very slightly joined. The size of the eye is somewhat variable.

## LOCAL DISTRIBUTION.

Locality.	Stream.	Collector.	Name as reported.	Authority.
San Francisco.....	Upper Pitt River.....	Newberry.....	<i>Cottopsis gulosus</i> .....	Jordan & Jouy.
At mouth.....	Joseph Creek.....	Rutter & Chamberlain.	do.....	Girard, 1857.
Jess Valley.....	South Fork Pitt River.....	Henshaw.....	<i>Uranidea gulosa</i> .....	Jordan & Henshaw.
South Fork Post-office.....	do.....	Rutter & Chamberlain.	<i>Cottus gulosus</i> .....	
Canby.....	Pitt River.....	do.....	do.....	
Near Aden.....	Rush Creek.....	do.....	do.....	
Fall River Mills.....	Fall River.....	do.....	do.....	
Dana.....	do.....	do.....	do.....	
Cassel.....	Hat Creek.....	do.....	do.....	
Burneyville.....	Burney Creek.....	do.....	do.....	
Sisson.....	Sullaway Creek.....	do.....	do.....	
Do.....	Sacramento River.....	do.....	do.....	
Sims.....	do.....	do.....	do.....	
Baird.....	McCloud River.....	do.....	do.....	
Do.....	do.....	do.....	do.....	Jordan & Jouy.
Do.....	do.....	Starks.....	<i>Cottus shasta</i> .....	Jordan, 1896.
United States hatchery.....	Battle Creek.....	Rutter & Scofield.....	<i>Cottus gulosus</i> .....	
Oroville.....	Feather River.....	Rutter & Chamberlain.	do.....	
Johnsons.....	Warner Creek.....	do.....	do.....	
Clear Lake.....	Clear Lake.....	Jordan & Gilbert.....	do.....	Jordan & Gilbert.
Placerville.....	American River.....	Rutter & Chamberlain.	do.....	
San Joaquin River.....	San Joaquin River.....	Heermann.....	<i>Cottopsis gulosus</i> .....	Girard, 1854.
Parrot Ferry.....	Stanislaus River.....	Rutter & Atkinson.....	<i>Cottus gulosus</i> .....	

26. *Cottus macrops* Rutter, new species.

Head 3.1; depth 4.33; eye large, 3.3 to 3.6 in head; dorsal VII or VIII, 19; anal 13 or 14; ventral I, 4. Body heavy, head large, the snout broader than in *klamathensis*; maxillary not quite reaching vertical at front of pupil, its length 2.5 in head; teeth in jaws and on vomer, none on palatines; those on sides of jaws weak, extending on upper jaw only about half way to corner of mouth; anterior nostrils in short tubes; the posterior nostrils without tubes, smaller than the mucous pores; mucous pores arranged as in *klamathensis*, two pairs above front of eyes, a single median pore posteriorly between orbits and a circle of pores behind each eye; other pores posteriorly on head; interorbital narrow, about one-half of orbit, the bony septum about one-third; top of head behind eye very slightly concave; opercular spines small, sharp; lower spines of preopercle wanting; lower spine of subopercle sharp, smaller than upper spine of preopercle, which is curved upward; tip of opercle flat, rounded; spinous dorsal low, its spines about 6. Height of soft rays, which are equal to snout and half of eye, about the same as in *klamathensis*, the two fins broadly joined for from one-third to two-thirds the height of the spinous portion. Depth and length of caudal peduncle about equal; caudal fin 1.4 to 1.6 in head, truncate or slightly rounded except when widely spread, divided rays 8, sometimes 9; length of pec-

toral 0.26 to 0.29 of body, about reaching front of anal, the upper rays but little graduated, the eighth to twelfth from bottom nearly even, the upper ray 1.75 to 1.8 in longest (2 to 2.5 in *klamathensis* and 2 to 2.5 in *gulosus*). The variation in fin rays is shown in the following table:

Locality.	Number of specimens having—							
	Spinous dorsal.		Soft dorsal.			Anal.		
	VII.	VIII.	18.	19.	20.	13.	14.	15.
Dana.....	15	4	3	13	3	5	12	2
Fall River Mills.....	1	1	.....	2	.....	.....	2	.....

Skin without prickles. Lateral line not extending beyond middle of soft dorsal. Color brownish olive with 5 or 6 dusky blotches on sides, one being at base of caudal; all fins dusky, except sometimes the ventrals; a black blotch on posterior part of spinous dorsal, a more or less brownish or dusky blotch in front of base of pectorals; all soft fins vertically barred; one or two dusky bars downward and backward from eye.

This species is most closely related to *klamathensis*, but is a heavier fish, the eye is larger, the head not so pointed, and the dorsal is inserted slightly more posteriorly. In five specimens of each species, of equal sizes, the distance from the snout to dorsal was in *macrops* 0.37, 0.38, 0.38, 0.38, and 0.39 of

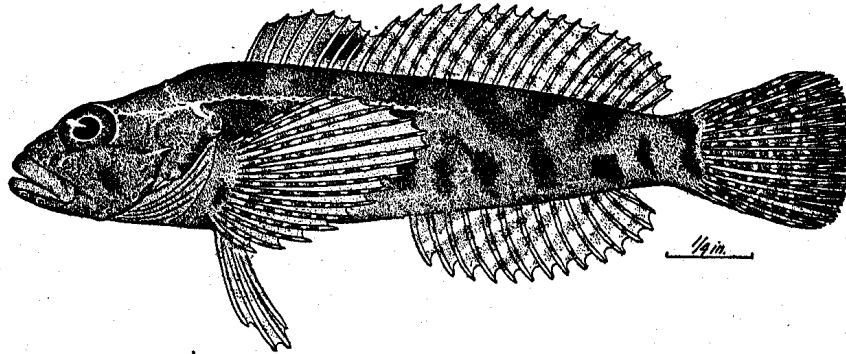


Fig. 4.—*Cottus macrops*, new species. Type.

the body length, while in *klamathensis* the same measurements were 0.36, 0.36, 0.36, 0.365, and 0.365. It differs from *gulosus*, with which it is found, in the above characters, besides having a more broadly rounded pectoral, incomplete lateral line, and a skin entirely free from prickles.

Known only from Fall River, where it is associated with *Cottus gulosus* and *Cottus asperrima*, but more common than either. Here described from 19 specimens from Fall River at Dana, collected by Rutter and Chamberlain, the largest specimen being 2.8 inches long. Named with reference to the large eyes. Type no. 58499, U. S. National Museum.

27. *Cottus beldingii* Eigenmann & Eigenmann.

*Cottus beldingii* Eigenmann & Eigenmann, Amer. Nat., vol. xxv, 1891, p. 1132, Lake Tahoe and Dormer Lake. Jordan & Evermann, Fishes N. & Mid. Amer., pt. II, p. 1958, 1898.

A Truckee Basin species with entirely smooth skin, no palatine teeth and short fins. Found in only one locality in the Sacramento Basin, Cole Creek near Sierraville, where it was collected by Rutter and Chamberlain. Fin rays as follows:

Dorsal:	Specimens.	Dorsal:	Specimens.
Spines—		Rays—	
VI.....	2	19.....	4
VII.....	17	Anal:	
VIII.....	2	12.....	8
Rays—		13.....	12
17.....	5	14.....	1
18.....	12		

## SUMMARY ON DISTRIBUTION.

Of the 27 species listed above, 14 are limited to California; 6 (*Entosphenus tridentatus*, *Lampetra cibaria*, *Salmo irideus*, *Salvelinus malma*, *Gasterosteus cataphractus*, and *Cottus asper*) have more or less ability to withstand sea water and are not of interest when studying the distribution of fresh-water fishes.

Of the 22 strictly fresh-water species, 12 (*Catostomus occidentalis*, *Orthodon microlepidotus*, *Lavinia exilicauda*, *Mylopharodon conocephalus*, *Pogonichthys macrolepidotus*, *Ptychocheilus grandis*, *Leuciscus crassicauda*, *Leuciscus conformis*, *Rutilus symmetricus*, *Archoplites interruptus*, *Hysterothorax traskii*, and *Cottus gulosus*) are typical of and have a wide distribution in the basin; 3 (*Catostomus microps*, *Cottus asperrima*, and *Cottus macrops*) are limited in distribution and known only from their type localities; *Rutilus bicolor* is common to Pitt River drainage and to the lakes and streams of southern Oregon; and 5 (*Pantosteus lahontan*, *Catostomus tahoensis*, *Leuciscus egregius*, *Agosia robusta*, and *Cottus beldingii*) are Nevada species that have crossed the Sierras into the Sacramento-San Joaquin Basin.

The last 6 mentioned need particular notice.

Besides being widely distributed in the Pitt River region, *Rutilus bicolor* is exceedingly abundant in Wolf Creek (<Indian Creek <North Fork Feather River), Indian Valley. The connection between this stream and Pitt River is not very close, as they are tributary to the Sacramento at points about 300 miles apart.

*Agosia robusta* is the only one of the Nevada species that has become widely distributed west of the Sierras.

*Leuciscus egregius* is limited to the vicinity of Big Meadows (headwaters of North Fork of Feather River), and to one locality on the opposite side of the basin near Clear Lake.

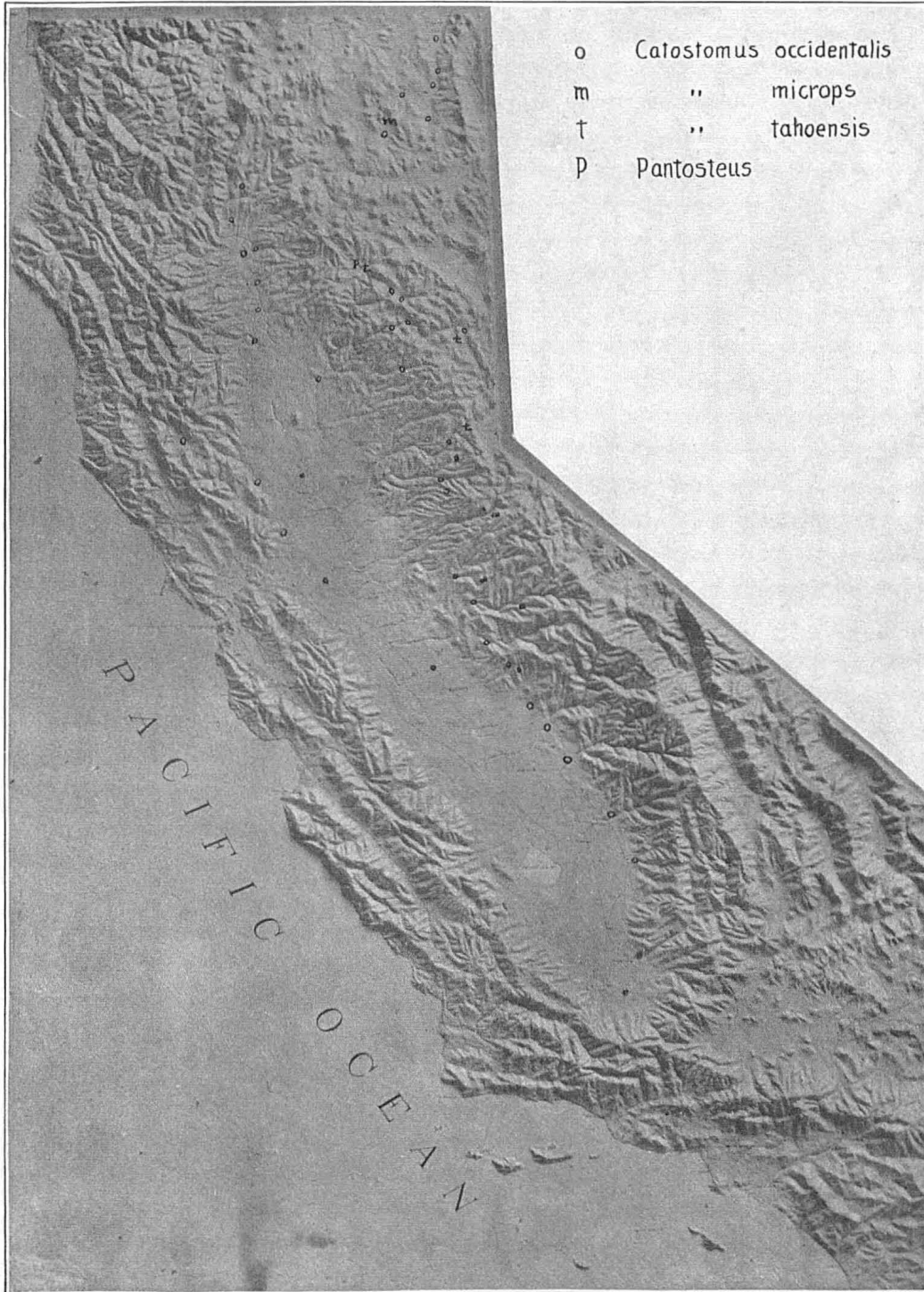
*Catostomus tahoensis* has been found only in the vicinity of Big Meadows and in Sierra Valley, though the streams connecting these two places have been fished in several places.

*Pantosteus lahontan* has been found only in Big Meadows vicinity.

*Cottus beldingii* only in Cole Creek, tributary to Sierra Valley.

The Big Meadows region has 4 Nevada species, Sierra Valley 3, 2 being common to both. The former has 2 not found in the latter, and the latter has 1 not found in the former. It seems probable that there have been at least two migrations from the Lahontan drainage into the Sacramento, though there is need of more data on that point.

The following table indicates the distribution according to the above summary. By Lahontan division is meant the Big Meadows and Sierra Valley regions. The Sacramento division includes the whole basin except that included in the Lahontan and Pitt River regions.



TOPOGRAPHICAL MAP SHOWING DISTRIBUTION OF THE CATOSTOMIDÆ IN THE SACRAMENTO-SAN JOAQUIN BASIN.

## DISTRIBUTION OF FRESHWATER FISHES IN SACRAMENTO-SAN JOAQUIN BASIN.

Species.	Basin divisions.			
	Pitt River.	Lahontan.	Sacramento.	Found only in California.
1. Entosphenus tridentatus.....	×		×	
2. Lampetra cibarica.....			×	
3. Pantosteus lahontan.....		×		
4. Catostomus microps.....	×			×
5. Catostomus tahoensis.....		×		
6. Catostomus occidentalis.....	×	×		×
7. Orthodon microlepidotus.....			×	×
8. Lavinia exilicauda.....			×	×
9. Mylopharodon conocephalus.....	×		×	×
10. Pogonichthys macrolepidotus.....			×	×
11. Ptychocheilus grandis.....	×		×	×
12. Leuciscus crassicauda.....			×	×
13. Leuciscus conformis.....			×	×
14. Leuciscus egregius.....		×	×	
15. Rutilus bicolor.....			×	
16. Rutilus symmetricus.....	×(?)		×	×
17. Agosia robusta.....	×	×	×	
18. Salmo irideus.....	×	×	×	
19. Salvelinus malma.....			×	
20. Gasterosteus cataphractus.....			×	
21. Archoplites interruptus.....			×	×
22. Hysterothorax traskii.....	×		×	×
23. Cottus asper.....	×		×	×
24. Cottus asper.....	×		×	×
25. Cottus gulosus.....	×	×	×	
26. Cottus macrops.....	×		×	×
27. Cottus beldingii.....		×	×	
Total.....	13	8	21	14
Limited to one division.....	3	3	10	

## SUMMARY OF VARIATIONS.

The following species deserve special notice on account of their remarkable variations:

*Catostomus occidentalis* varies in scales of lateral line from 60 to 84, and in rays of dorsal from 11 to 14. The size of the lips varies enormously, being almost twice as great in some localities as in others.

*Lavinia exilicauda*. The only important variation in this species is in the presence or absence of the horny sheath of the lower jaw.

*Ptychocheilus grandis*. The scales of the lateral line vary from 65 to 78, or, if *Ptychocheilus harfordi* be included, from 65 to 88.

*Rutilus bicolor* has the number of scales of the lateral line ranging from 44 to 61; but its greatest variation is in the shape of the head, which varies from triangular (side view) to quadrangular.

*Rutilus symmetricus* is the most variable species of the basin. The number of scales varies from 47 to 56; the lower jaw may or may not have a horny sheath, which is developed irrespective of age, sex, season, or locality; the shape of the head, depth of caudal peduncle, size of eye, length of fins, and general appearance all vary



greatly. In certain localities more or less isolated some of these variations are so correlated that the forms would readily be taken for distinct species or even genera were not intermediate forms found in other equally isolated localities.

*Agosia robusta* varies greatly in scales of lateral line (49 to 77), length of fins, development of barbel and lateral line, and general shape of body and head.

*Salmo irideus* varies greatly in number of scales, 116 to 176 cross rows. There are almost as many variations in color as there are streams.

#### ANADROMOUS SPECIES.

##### *Oncorhynchus gorbuscha* (Walbaum). *Humpback Salmon.*

Reported from the Sacramento River by Jordan & Gilbert. Not otherwise known from the basin.

##### *Oncorhynchus keta* (Walbaum). *Dog Salmon.*

Very rare. One or two seen each year at the canneries and hatcheries.

##### *Oncorhynchus tshawytscha* (Walbaum).<sup>a</sup> *Sacramento Salmon.*

By far the most important fish of the basin. Ascends the river in two distinct runs, one in May and June, the other in September, though a few fish may be found in the river at any time of the year. The principal spawning streams, named in the order of their importance, are: The main river between Chico and Redding, Battle Creek, McCloud River, upper Sacramento River (above mouth of Pitt River), Hat Creek, and Fall River. The importance of Pitt River below the falls as a spawning stream is unknown. A few salmon pass up Feather River and most of the other tributaries. The spring run spawns in August, the fall run in November. The young of this species begin their seaward migration as soon as they are able to swim and reach the ocean when 4 or 5 months old, though a few remain in the headwaters until they are 6 to 12 months old.

##### *Oncorhynchus kisutch* (Walbaum). *Silver Salmon.*

Reported by Jordan & Jouy, 1881, from the Sacramento River, but not otherwise known from the basin.

##### *Salmo gairdneri* (Richardson). *Steelhead.*

Reported from the Sacramento River by Jordan & Gilbert, 1881. If it is found in the basin we have been unable to distinguish it from the rainbow trout. A specimen weighing 7½ pounds, taken at Battle Creek hatchery in November, 1897, was identified by us as *Salmo irideus*. Scales in lateral line (not cross rows) 129.

##### *Osmerus thaleichthys* Ayres.

Taken in fresh water at Walnut Grove and Collinsville. The adults go up the river to spawn during February, the young come down during April.

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<sup>a</sup>For a more complete account of this fish see Rutter, Natural history of the quinnat salmon, Bulletin U. S. Fish Comm., vol. xxii, 1902, p. 65-141.

## INTRODUCED SPECIES.

A review of the history and results of the attempts to acclimatize fish and other water animals in the Pacific States is given by Dr. H. M. Smith in the Bulletin of the U. S. Fish Commission, vol. xv, 1895, p. 379-472. Thirty species are mentioned in this report. The following is a list of those planted in our territory:

Page.	Species.	Common name.	Page.	Species.	Common name.
382	<i>Ameiurus catus</i> .....	Common catfish.	438	<i>Lucius lucius</i> .....	Pike.
	<i>Ameiurus nebulosus</i> ....	Bullhead.		<i>Anguilla chrysops</i> .....	Eel.
	<i>Ictalurus punctatus</i> ....	Channel catfish	441	<i>Ambloplites rupestris</i> ..	Sunfish.
393	<i>Cyprinus carpio</i> .....	Carp.		<i>Chænobryttus gulosus</i> ..	Sunfish.
403	<i>Chanos cyprinella</i> .....			<i>Lepomis cyaneilus</i> .....	Sunfish.
404	<i>Clupea sapidissima</i> ....	Shad.		<i>Lepomis pallidus</i> .....	Sunfish.
428	<i>Coregonus clupeiformis</i> .	Whitefish.	442	<i>Micropterus dolomieu</i> ...	Small-mouthed black bass.
430	<i>Salmo salar</i> .....	Atlantic salmon.		<i>Micropterus salmoides</i> ..	Large-mouthed black bass.
431	<i>Salmo salar sebago</i> .....	Landlocked salmon.	447	<i>Perca flavescens</i> .....	Perch.
433	<i>Salmo fario</i> .....		448	<i>Stizostedion vitreum</i> ....	Pickrel.
	<i>Salmo trutta levenensis</i> .	Loch Leven trout.	449	<i>Roccus lineatus</i> .....	Striped bass.
	<i>Salvelinus fontinalis</i> ....	Eastern brook trout.		<i>Roccus chrysops</i> .....	Rock bass.

Fortunately only a few of the 24 species mentioned above have obtained a foothold in California waters. The following, and possibly others, are now a portion of the fish fauna of the state.

***Ameiurus catus* (Linnæus). Common Catfish.**

Introduced from eastern waters and now exceedingly abundant in the lower rivers and in brackish water. Distinguished from *A. nebulosus* by the deeply emarginate caudal fin. Observed in the Sacramento River at Red Bluff, Jacinto, Knights Landing, mouth of Feather River, Sacramento, Walnut Grove, Ryde, Rio Vista, and Benicia, also in the San Joaquin at Antioch, and in Carquinez Straits. Reported by Jordan & Gilbert from Clear Lake.

***Ameiurus nebulosus* (Le Sueur). Bullhead Catfish.**

Introduced into the streams of the state along with *A. catus*. Distinguished by the truncate or rounded caudal fin.

Taken in Sacramento River at Knights Landing, Arcade Creek at Arcade, South Fork Dry Creek near Grass Valley, Carquinez Straits at Benicia, and in China Slough and Kings River near Centerville. Reported by Jordan & Gilbert from Clear Lake. In the lower Sacramento much less common than *Ameiurus catus*.

***Cyprinus carpio* (Linnæus). Carp.**

A Chinese fish introduced into California from Germany, Japan, and the eastern states. For a history of the carp in California see "A review of the history and results of the attempts to acclimatize fish and other water animals in the Pacific States," by Hugh M. Smith, Bulletin U. S. Fish Commission, vol. xv, 1895, p. 379-472.

The carp is now abundant in the quiet waters throughout the lower portion of the basin, even entering brackish water. It is a sluggish fish, little esteemed as food, and an important source of food for cormorants and striped bass. Said to be less common in the Sacramento River between Red Bluff and Redding than it was a few years ago.

Observed at the following places: In Sacramento River at mouth of Pitt River, Redding, mouth of Clear Creek, Battie Creek hatchery, Red Bluff, Vina, Jacinto, Knights Landing, mouth of Feather River, Sacramento, Ryde, Rio Vista, Collinsville; in Wolf Creek near Greenville, Arcade Creek at Arcade, China Slough at Centerville, San Joaquin River at Antioch, and in Carquinez Straits at Benicia. It is one of the few of its family that can withstand strongly brackish water.

***Alosa sapidissima*** (Wilson). *Shad.*

Introduced in 1871 and now abundant. The young were taken at the following localities in the Sacramento River in May, 1898: Chico Bridge, Butte City, Princeton, Colusa, Grimes, Wilson's Farm, 20 miles below Grimes, Sacramento, and Collinsville.

***Micropterus dolomieu*** (Lacépède). *Small-mouthed Black Bass.*

Introduced into various lakes in the state. Reported from Clear Lake by Jordan & Gilbert, 1894. Reported by sportsmen from Sacramento River near Sacramento.

***Roccus lineatus*** (Bloch). *Striped Bass.*

Introduced into the waters of California in 1879 and now abundant. The young taken as far up the river as Knights Landing.