
THE FISHES OF THE STREAMS TRIBUTARY TO
TOMALES BAY, CALIFORNIA



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INTRODUCTION.

The larger coastal streams of California which enter the ocean at points between the Klamath and Carmel Rivers are in most cases inhabited by one or more species of fluvial fishes which are either identical with forms found in the Sacramento-San Joaquin system or are very closely related to them. Beginning at the north and enumerating these streams, it is found that Redwood Creek has no fresh-water fishes. Bear, Eel, and Mad Rivers are inhabited by a single species, *Catostomus humboldtianus*, a representative of the common Sacramento sucker. Mattole, Noyo, and Big Rivers and the smaller streams which drain the region between Bear and Navarro Rivers have no fluvial species. Navarro and Gualala Rivers each has a single species of *Hesperoleucus* (*Rutilus symmetricus* of authors generally), a minnow measurably differentiated from *H. venustus* of the Russian and Sacramento Rivers, while Garcia River, about as large as either of these and draining a basin between them, has no minnows. Russian River has several species of minnows and one sucker, all of which are Sacramento forms. The streams entering San Pablo and San Francisco Bays have fishes identical with those of the Sacramento; in fact, they form a part of the great Sacramento-San Joaquin system, the waters of the bay not constituting a barrier sufficient at all times to prevent the passage of fresh-water fishes. The small creeks between the Golden Gate and Monterey Bay are not known to have fluvial fishes. In the streams tributary to Monterey Bay are found Sacramento species and others closely allied to them.

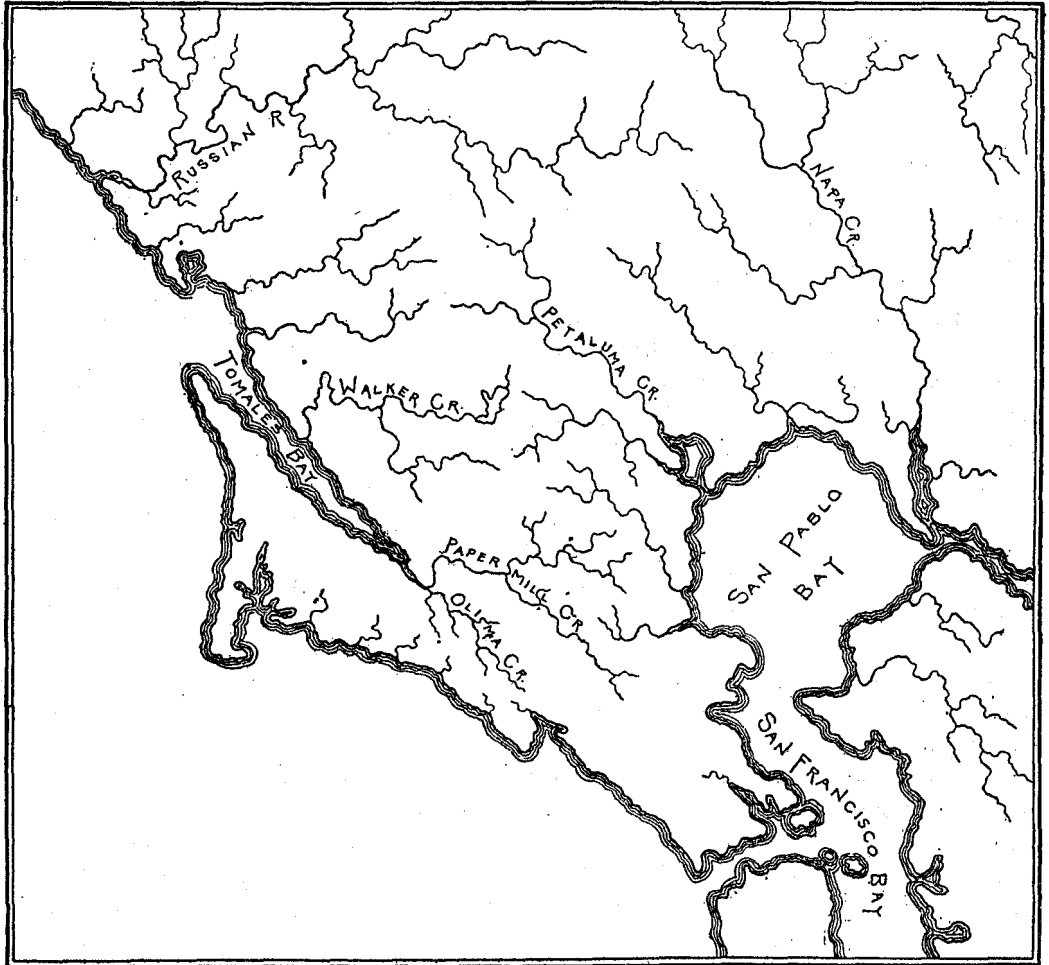
Faunal reports have appeared from time to time dealing with the various basins of this entire region except that including the streams which enter Tomales Bay, and it is the purpose of this paper to present an account of the fishes which inhabit them.^a

Only two streams flow into Tomales Bay which are large enough to support fishes, Papermill Creek, with Olima and Bear Valley Creeks as tributaries, which enters the southern end of the bay, and Walker Creek, which flows into the northern part. A recent examination of these streams shows that the fishes living there are specifically identical with those of near-by basins. Besides forms able to withstand salt water, as the trout, cottoids, and sticklebacks (no salmon were seen), there are found here a sucker, *Catostomus occidentalis*, and a minnow, *Hesperoleucus venustus*,^b the latter occurring in all the streams, while the sucker is apparently absent from Walker Creek.

^a Under the direction of the Bureau of Fisheries the writer and Lee R. Dice visited the creeks tributary to Tomales Bay in the latter part of October, 1920, and while searching for young salmon made a collection of fishes on which this account is based.

^b Through some oversight Evermann and Latimer (Barton Warren Evermann and Homer Barker Latimer: On a collection of fishes from the Olympic Peninsula, together with notes on other west coast species; Proceedings of the Biological Society of Washington, vol. XXXIII, p. 133) record *Rutilus bicolor* as having been taken in Walker Creek. This species is indigenous to the Klamath system.

No important differences have been detected between the fishes of the streams entering Tomales Bay and those of Russian River or the Sacramento. There is then no zoological evidence to offer concerning the origin of the Tomales Bay fauna further than that it was probably derived from either the Russian River Basin or from some stream tributary to San Pablo Bay, for it will be observed from the map that the catchment basin of Tomales Bay is bounded on the north and east by the territory drained by Russian River and the



Map of Tomales Bay, showing tributary streams large enough to support fishes.

small creeks which flow into San Pablo Bay.^a Furthermore, it is separated from rivers farther up the coast by a barrier of sea water which can not be traversed by fluvial species.

SYSTEMATIC DISCUSSION.

Catostomus occidentalis Ayres. Sacramento sucker.

This species was observed in Olima and Papermill Creeks but not in Walker Creek. Specimens have been collected in Olima Creek at its mouth. On the 20th of October and on the following day,

^a Of interest in this connection is a paper by Prof. Ruliff S. Holway, *The Russian River, a characteristic stream of the California coast ranges*. University of California publication, in *Geography*, vol. 1, no. 1, Apr. 8, 1913.

when the water was low and clear, the stream was carefully examined for a distance of 3 or 4 miles above its mouth, and although minnows and trout were plentiful, no suckers were seen. Neither is the species well represented in Papermill Creek, which has a considerably larger volume of water. Much time was spent in carefully observing the stream above Tocaloma before any individuals were seen. Specimens were later obtained only with great difficulty, as they were uncommonly shy, seeking shelter under driftwood and overhanging banks, usually disappearing long before the trout or minnows were disturbed.

When compared with examples of the species from Russian River and the Sacramento Basin, a slight degree of differentiation appears in the Papermill Creek specimens. The dorsal fin is a little higher, the caudal seems to be somewhat longer, and the scales a little larger. In numerous specimens from the Russian and Sacramento Rivers, between which no differences have been detected, the dorsal measures 0.15 to 0.21 of the length, while the Papermill Creek specimens have a dorsal measuring 0.19 to 0.23. The caudal of Sacramento examples measures 0.21 to 0.27, that of Papermill Creek specimens 0.24 to 0.29. Sacramento individuals have 13 to 17 scales above the lateral line, while those from Papermill Creek have 11 to 13. These measurements have been based on only 15 specimens from Papermill Creek and are not sufficient in number to be of real value. It is of interest, however, that the apparent differentiation of these specimens is in the direction of that exhibited by *C. humboldtianus* of Bear, Eel, and Mad Rivers.

Measurements of 10 specimens follow:

MEASUREMENTS OF TEN SPECIMENS OF CATOSTOMUS OCCIDENTALIS, PAPERMILL CREEK.

Length of body.....mm.	210	210	198	180	112	138	140	121	111	110
Length head.....	0.225	0.235	0.23	0.24	0.24	0.23	0.23	0.225	0.24	0.25
Depth body.....	.22	.22	.21	.22	.23	.24	.25	.24	.25	.24
Depth caudal peduncle.....	.09	.085	.09	.09	.08	.09	.08	.09	.08	.09
Length caudal peduncle.....	.165	.175	.15	.165	.17	.15	.16	.15	.16	.16
Length snout.....	.11	.11	.10	.11	.11	.11	.11	.10	.11	.11
Diameter eye.....	.04	.04	.04	.04	.05	.04	.035	.04	.045	.05
Interorbital width.....	.10	.095	.10	.10	.10	.09	.09	.095	.09	.095
Depth head.....	.16	.165	.165	.17	.165	.16	.17	.17	.17	.17
Snout to occiput.....	.20	.20	.20	.20	.21	.22	.21	.20	.22	.21
Snout to dorsal.....	.49	.495	.50	.51	.52	.49	.50	.49	.50	.50
Snout to ventral.....	.55	.565	.565	.57	.60	.575	.57	.58	.58	.59
Length base of dorsal.....	.17	.175	.19	.16	.19	.19	.185	.18	.17	.18
Length base of anal.....	.08	.09	.08	.075	.09	.08	.075	.07	.08	.07
Height dorsal.....	.19	.20	.22	.20	.23	.21	.20	.20	.21	.21
Height anal.....	.24	.27	.21	.20	.20	.21	.18	.18	.19	.18
Length pectoral.....	.21	.23	.23	.21	.23	.21	.20	.21	.20	.20
Length ventral.....	.175	.18	.17	.155	.18	.175	.17	.17	.17	.18
Length caudal.....	.26	.26	.28	.25	.29	.26	.24	.27	.26	.24
Dorsal rays.....	13	13	14	13	13	12	13	12	12	12
Anal rays.....	7	8	8	7	8	8	8	7	8	7
Scales lateral line.....	69	68	64	62	66	63	59	62	63	60
Scales above lateral line.....	12	12	12	13	13	12	11	12	12	11
Scales below lateral line.....	10	9	10	10	10	9	8	8	9	9
Scales before dorsal.....	32	30	31	30	29	.....	.....	.....	.....	.....

Hesperoleucus venustus Snyder. San Francisco roach.

Examples of this species resemble those of the Russian River in the trim, slender body, rather pointed snout, slender caudal peduncle, and long fins. They have usually 9 dorsal and 8 anal rays, the number counted in 167 specimens being as follows:

	Dorsal rays.			Anal rays.	
	8	9	10	7	8
Papermill Creek.....	.....	78	2	1	79
Bear Valley Creek.....	.....	37	.....	.....	37
Walker Creek.....	5	45	.....	3	47
	5	160	2	4	163

Where 8 rays are recorded the last is cleft to the base, the distinction in this case being somewhat arbitrary. The scales in the lateral series number from 49 to 59, the most usual number being 50 to 56.

Scales lateral line.....	49	50	51	52	53	54	55	56	57	58	59
Papermill Creek.....	1	5	5	8	14	11	13	10	5	6	1
Bear Valley Creek.....	2	3	2	6	7	7	4	4	2	1	1
Walker Creek.....	2	5	6	8	7	6	7	6	2	1	.....
	5	13	13	22	28	24	24	20	9	8	2

In shape the scales are more or less quadrangular, although elongate and spatulate specimens often occur. The basolateral angles are strong and well marked. The apicolateral angles are usually weak. Lateral radii are not common, and not over two have been observed on one side of a scale. The apical radii number from 11 to 25.

This form differs from those of the Navarro and Gualala Rivers in being more slender in outline, in having somewhat longer and more pointed fins, and a different number of fin rays, *H. navarroensis* having generally 8 dorsal and 8 anal rays, and *H. parvipinnis* 8 dorsal and 7 anal rays.

Minnows were seen in large numbers in the pools of Olima, Bear Valley, Papermill, and Walker Creeks. They were especially abundant in Walker Creek, where they were considerably smaller than those of Papermill Creek. In the latter stream specimens were collected October 21 which measured 130 millimeters, something more than 5 inches in length. An attempt was made to determine the age of some of these from an examination of the scales, and it appeared that fishes measuring from 100 to 130 millimeters in length were in their third year; those measuring from 70 to 110 millimeters were in their second year; individuals hatched in the previous spring were from 70 to 110 millimeters long. None was seen which appeared to be older than the third year.

Measurements of 10 specimens from Papermill Creek are here given.

MEASUREMENTS OF TEN SPECIMENS OF MINNOWS, PAPERMILL CREEK.

Length of body.....mm.	87	85	85	80	81	78	80	81	76	70
Length head.....	0.25	0.25	0.26	0.27	0.26	0.255	0.25	0.25	0.26	0.24
Depth body.....	.277	.27	.26	.28	.26	.26	.27	.26	.29	.25
Depth caudal peduncle.....	.10	.11	.11	.105	.105	.10	.11	.105	.10	.11
Length snout.....	.09	.09	.10	.10	.085	.085	.08	.09	.09	.085
Diameter eye.....	.055	.06	.055	.06	.06	.06	.06	.06	.06	.065
Interorbital width.....	.10	.09	.09	.10	.09	.09	.09	.10	.10	.09
Depth head.....	.19	.20	.19	.185	.20	.18	.19	.20	.19	.19
Snout to occiput.....	.21	.21	.21	.22	.21	.21	.21	.22	.21	.22
Snout to dorsal.....	.58	.59	.58	.58	.58	.58	.58	.58	.59	.57
Snout to ventral.....	.51	.52	.53	.54	.52	.53	.53	.53	.53	.52
Length base of dorsal.....	.14	.135	.14	.135	.13	.125	.13	.13	.125	.13
Length base of anal.....	.10	.10	.11	.10	.10	.095	.09	.10	.09	.10
Height dorsal.....	.18	.19	.18	.19	.19	.18	.20	.18	.18	.20
Height anal.....	.165	.18	.16	.18	.17	.16	.18	.17	.17	.18
Length pectoral.....	.18	.18	.18	.21	.20	.19	.19	.19	.185	.23
Length ventral.....	.15	.16	.14	.16	.16	.14	.15	.16	.145	.17
Length caudal.....	.25	.27	.27	.29	.28	.265	.27	.28	.275	.275
Dorsal rays.....	9	9	9	9	9	9	9	9	9	9
Anal rays.....	8	8	8	8	8	8	8	8	8	8
Scales lateral line.....	56	54	58	54	53	57	55	56	53	52
Scales above lateral line.....	14	13	13	13	13	13	14	13	13	13
Scales below lateral line.....	8	7	7	8	7	7	8	8	8	8
Scales before dorsal.....	31	32	32	30	32	33	33	32	32	33

Salmo irideus Gibbons. Rainbow trout.

Small trout were plentiful in Papermill and Olima Creeks. A few were seen in Walker Creek. Large steelheads come in from the bay immediately following the first heavy rains of winter.

Gasterosteus cataphractus (Pallas). Alaska stickleback.

This species enters all the streams which flow into Tomales Bay.

Cottus asper Richardson. Prickly bullhead.

Found in the deeper and more quiet pools in the lower courses of the streams, and especially common near their mouths.

Cottus gulosus (Girard). Rifflefish.

Two small specimens were collected on the rocky bottom of Papermill Creek several miles above Tocaloma.

This is the rifflefish of the miners, known to them because it frequently lodged above the riffles or cross slats of their sluices, and by its vigorous flopping sometimes caused fine particles of gold to pass over.

C. aleuticus was not seen.



FIG. 1.—Main laboratory, with storage reservoir in foreground. Fisheries biological station, Fairport, Iowa.