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INTRODUCTION.

The present paper deals with the fishes of the streams tributary to Monterey Bay, Cal. It contains a systematic record of the species, a discussion of their relationships, and an attempt to account for their present distribution. It involves some of the results of a prolonged investigation of western fluvial fishes which has been based primarily on material collected by agents of the United States Bureau of Fisheries. In connection with this study the writer has on several occasions visited the principal streams flowing into Monterey Bay, each time making observations and preserving specimens of the fishes. The early work was under the direction of Dr. Charles H. Gilbert, and assistance in the field was ably rendered by Dr. J. M. Stowell, Messrs. Wilfred H. Osgood and James A. Gunn. In the summer of 1909 the writer, assisted by Messrs. Willis H. Rich and Carl H. Gilbert, students of Stanford University, made a more complete survey of the system and collected large series of specimens. The well-preserved material obtained at this time has been most useful in determining the characteristics of the Pajaro species.

A microscopic examination of the scales has in some cases revealed reliable specific characters, and photographic illustrations are given. The proportional measurements of specimens are recorded in hundredths of the length from tip of snout to end of last caudal vertebra. They were made with considerable care by means of dividers and a proportional scale. The drawings of fishes are by Mr. W. S. Atkinson.

THE STREAMS TRIBUTARY TO MONTEREY BAY.

The streams that flow into Monterey Bay diverge from the coast like the fingers from the palm of one's hand. Beginning with the most northern, they occur in the following order: San Lorenzo River, Soquel Creek, Aptos Creek, Pajaro River, and Salinas River. Soquel and Aptos Creeks are of minor importance, as they drain very small basins and are subject to considerable desiccation during periods of long drought.

The San Lorenzo is a typical mountain stream. It drains a part of the moist western slopes of the Santa Cruz Ranges, flowing through canyons the steep sides of which are covered with trees and shrubs. Its water is clear and cool and is of large volume even during the dry season. Throughout its course the more rapid portions are broken by numerous quiet pools and broad, shallow areas with sandy or pebbly bottoms.

The Pajaro River receives the drainage from a large interior valley, flows through a narrow gorge which breaks transversely across a low range of the Coast Mountains, and enters the narrow valley which borders Monterey Bay. Its principal tributaries are Uvas and Llagas Creeks from the Santa Cruz Mountains on the northwest, San Felipe Creek from the dry Mount Hamilton Ranges on the east, and the San Benito River, which drains an elongate valley extending from southeast to northwest between the Mount Hamilton Ranges and the Gabilan Mountains. The upper courses of the Uvas and Llagas and parts of the San Benito flow through rather sparsely wooded mountain valleys. The San Benito is an uncertain and torrential stream, subject to great floods in the winter. It joins the Pajaro just before the latter enters the narrow gorge in the mountains, and brings in such quantities of sand and gravel that the Pajaro, unable to clear its channel, is so thoroughly choked up that there is no apparent current for several miles above the obstruction. Just above its junction with the San Benito, the Pajaro is from 12 to 15 feet deep, the submerged and dying branches of willows along its banks furnishing evidence of a recent rise in the water. There are indications that a shallow lake once covered an extensive area in the upper Pajaro Valley, Soap Lake, a mere pond being all that now remains of it. The lower Pajaro is a shallow stream, winding here and there over the sandy floor of a broad channel with high banks.

Salinas River flows through an elongate, narrow, and very deep valley which extends in the same general direction as the coast. Its course is parallel with that of the San Benito, from which it is separated by the Gabilan Mountains, a high and barren watershed. Between the valley of the Salinas and the ocean are the well-wooded Santa Lucia Mountains, from which the Salinas receives its principal water supply through the Arroyo Seco, San Antonio, and Nacimiento Creeks. The San Antonio and Nacimiento drain an extensive mountain area and pass down through deep canyons nearly parallel with the Salinas, presenting the very unusual case of tributaries flowing in a direction opposite to that of the main river. In their upper courses these creeks have a considerable volume of clear, cool water, which in summer is either largely consumed in irrigation or disappears in the parched sands and gravels of the valley below. The Salinas itself is an erratic and torrential stream. During the dry season its feeble current shifts here and there over broad stretches of wind-blown sand, entirely disappearing at times and again rising to the surface. After the advent of the winter rains, however, it presents a broad expanse of seething water which often threatens everything before it.

The streams tributary to Monterey Bay, which may be more briefly referred to as the Pajaro system, were described as diverging from the coast, when properly speaking they converge toward it. The mouths of the Pajaro and Salinas are in close proximity, less than 3 miles of land separating them. The San Lorenzo flows into the bay at some distance north of the Pajaro, there being between their mouths more than 15 miles of coast, much of which is high, ascending rapidly to the foothills and the mountains beyond.

THE RELATIONSHIPS AND DISTRIBUTION OF THE FISHES.

The fishes of the Pajaro system may be said to belong to two fairly distinct groups. In the first of these may be assembled the anadromous forms and others which descend freely to salt water. They are the lampreys, trout, salmon, sticklebacks, and cottoids (*Entosphenus tridentatus*, *Salmo irideus*, *Oncorhynchus tschawytscha*, *O. kisutch*, *Gasterosteus cataphractus*, *Cottus asper*, *C. gulosus*, and *C. aleuticus*). Since the ocean presents no barrier to the dispersal of these species they have a wide distribution along the coast, occurring in all the streams of sufficient volume to support them.

To the second category belong the fresh-water fishes, the suckers, minnows, sunfish, and viviparous perch (*Catostomus mniotiltus*, *Orthodon microlepidotus*, *Ptychocheilus grandis*, *Hesperoleucus subditus*, *Lavinia ardesiaca*, *Agosia carringtoni*, *Archoplites interruptus*, and *Hysterocarpus traski*). These fishes are regarded as being strictly fluvial—not able to withstand long immersion in salt water. This assumption, though not based on experimental evidence, appears to be sufficiently established to accept without further discussion. Hence these species, living in isolated basins like those of the Pajaro or Salinas, occupy positions almost exactly analogous to those of reptiles or mammals inhabiting oceanic islands.

The present study shows that the fluvial fishes of the Pajaro system are all representatives of Sacramento River forms. In fact five of them, *O. microlepidotus*, *P. grandis*, *A. carringtoni*, *A. interruptus*, and *H. traski*, appear to be identical with Sacramento species, no distinctive local peculiarities having been observed among them. On the other hand, representatives of the Sacramento forms, *Catostomus occidentalis*, *Hesperoleucus venustus*, and *Lavinia exilicauda*, have become measurably differentiated, and so modified that they may be regarded as distinct species which are characteristic of the Pajaro system. The Pajaro basin alone contains a complete representation of the fluvial fauna of the region. The Salinas has six species, *C. mniotiltus*, *O. microlepidotus*, *H. subditus*, *L. ardesiaca*, *A. carringtoni*, and *H. traski;* the San Lorenzo three, *C. mniotiltus*, *H. subditus*, and *A. carringtoni*. Soquel and Aptos Creeks, which at times nearly dry up, have no fresh-water fishes at all.

If the relationships of the Pajaro fauna have been correctly determined, then one may safely pass to the conclusion that the Pajaro system received its species from the Sacramento,[a] and it may further be assumed that there was once an open passage between them, or an intermingling of their waters which enabled fishes to migrate from one basin to the other. The Sacramento, not the Pajaro, is thought to be the region from which the migration took place, as it contains not only a full representation of the

[a] There are no fluvial species in the coastal streams between the San Lorenzo River and the Golden Gate, nor are there any in the rivers immediately south of the mouth of the Salinas.

Pajaro fauna, but other species besides, and also because it is many times larger, and in the opinion of geologists it is considerably older.

In a recent study of the topography of a district including part of the Pajaro basin, Dr. J. C. Branner[a] discovered unmistakable evidences of a former shifting of the channel of Coyote Creek, a stream of the Sacramento drainage basin, whereby its upper portion was for a time transferred to the Pajaro drainage. Coyote Creek drains the upper (southern) part of Santa Clara Valley, which is prolonged for a considerable distance southward as the San Benito Valley, the two being separated by a low divide which crosses obliquely from the southeast to the northwest. The Coyote has its origin in the mountainous district south of Mount Hamilton and has attained considerable size when it breaks from the range through a narrow gorge to enter the valley from the east. It passes near the divide just mentioned, turns abruptly northward and continues its course directly to San Francisco Bay. On the southwest side of the divide Llagas Creek emerges from the mountains to the west, enters the valley and flows southward to the Pajaro. The relative positions of these streams are shown on the map, plate XIX. Speaking of Coyote Creek, Dr. Branner says:

From the mouth of the gorge where this creek debouches on the plain a great alluvial fan spreads out toward the south and west across the entire width of the Santa Clara Valley, at this place a distance of 2½ miles. This fan forms the watershed in the valley trough between the Bay of San Francisco and the Pajaro River or the Bay of Monterey.[b] The configuration of the materials of the alluvial fan at the mouth of the gorge shows that the Coyote has been shifting its channel of late. A terrace south of the stream, and approximately parallel with it, shows that it formerly flowed toward the west, while another and still higher terrace farther south shows that at an earlier date it flowed toward the southwest; and the general form of the alluvial fan shows that the whole fan was built by the Coyote. It is a characteristic feature of streams, in the building up of such deposits, that they swing from side to side, flowing down over their own deposits in every direction, and shifting their channels as they become choked up by the deposit of their excess of load. The depth and position of the channel through which the Coyote now flows after emerging from the hills show that there has been no recent discharge of its waters toward the Pajaro. The general topography of the region about the mouth of the gorge suggests that the alluvial fan was built up a long while ago, and at a period when the stream was much more active than it now is—possibly during or toward the close of the glacial epoch. During the glacial epoch the streams of the region were much more vigorous than they have been since, for the coast stood at an elevation of two thousand or more feet higher than it does at present. There was therefore a greater precipitation, and during the winter months the Mount Hamilton Range must have been covered with snow which accumulated more than it does now and went off rather suddenly with the warm rains of early spring, producing much greater floods than we now have. It follows from the form of the alluvial fan on the plain where the stream emerges from the mountains that the Coyote must have shifted from side to side in the usual fashion, especially in the early history of the alluvial cone and during the constructive period. It flowed sometimes toward the northwest, draining into the Bay of San Francisco, and at other times toward the southeast, draining through the Pajaro into the Bay of Monterey.

The fishes of the Coyote are like those of the Sacramento, the stream itself being a part of the Sacramento system, the salt water of San Francisco Bay not being a constant barrier to the free passage of fishes from stream to stream along its shores. If a portion

[a] Branner, J. C.: A drainage peculiarity of the Santa Clara Valley affecting fresh-water faunas. Journal of Geology, vol. XV, 1907, no. 1, p. 1–10, fig.

[b] This alluvial fan is indicated by dotted lines on the map, plate XIX.

of the Coyote was at one time turned into the Pajaro, it must have carried its species into that basin where, meeting no competitors, they probably multiplied and spread with great rapidity. This account may be accepted as an explanation of the presence of Sacramento species in the Pajaro Basin. It may also be invoked to explain the absence of a complete representation of the Sacramento fauna, as only such species as were present in the upper portion of the Coyote would have been introduced into the Pajaro. The capture of the upper Coyote does not of itself account for the occurrence of some or even any of these species in the San Lorenzo or Salinas, the basins of which are separated from that of the Pajaro by an apparently impassable barrier of ocean water. This difficulty is seemingly surmounted by a further consideration of the geological history of the region as pointed out by Dr. Branner in a reference to the work of Prof. George Davidson.[a] In his paper Davidson describes many submerged valleys that have been discovered by means of numerous soundings along the coast. After considering Monterey Bay and remarking that one would naturally expect the whole bay to be occupied by a 100-fathom plateau, he continues:

Nevertheless a remarkable submerged valley * * * runs across this plateau and heads into a low-lying country immediately behind the 30 miles of shore line of Monterey Bay. It reaches into the middle of this low line of beach near the mouth of the Salinas River, and the 50-fathom line is within less than half a mile of the shore. The valley which runs east and west is narrow, and at 7 miles from the shore the 100-fathom curves are only 2 miles apart and the depth 350 fathoms where the 50-fathom would be normal. It broadens and at 11 miles has a depth of 615 fathoms. From its northern edge a short, deep valley reaches to the northwest, but the 50-fathom curve of this arm is 5 miles from the shore.

Attention may now be directed to a map constructed from a Coast and Geodetic Survey chart of Monterey Bay, plate XX, where various soundings have been connected by contour lines, thus outlining the great valley or gorge described by Davidson. Such a valley could have been formed only by stream erosion, and its presence plainly points to a time when the bed of Monterey Bay was entirely exposed and the shore line extended beyond the present 600-fathom contour. Dr. Branner believes that the formation of the alluvial fan by the Coyote was coincident with this period of elevation of the coast, which brought about a climate of greater humidity than we now have and a correspondingly large amount of stream activity. At this time the Salinas was probably the chief river of the system, and flowing down the great valley, received first the Pajaro and then the San Lorenzo from the narrow canyons which extended toward the northeast. There was then an open waterway between the rivers of the Pajaro system and any species which might chance to be introduced from the Coyote by a shift of its headwaters would soon extend its range throughout the system.

It will now be recalled that of the streams tributary to Monterey Bay, the Pajaro alone contains a full representation of the fluvial fauna of the system. The Salinas contains six species and the San Lorenzo three. The question at once arises, if these streams, being of similar character and of about the same volume, were once connected with the Pajaro, why do they not now contain all its species?

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[a] Proceedings California Academy Sciences, 3d ser., Geology, vol. I, p. 73–103.

In attempting to present a plausible answer, reference is again made to the alluvial fan between the Santa Clara and San Benito Valleys. The growth of this great deposit, which swung the course of Coyote Creek from side to side, at one time into the Pajaro basin and at another into its former channel, was probably at the height of its activity near the time of the greatest coastal elevation, and then slowly ceased as the coast subsided. The lower course of the Coyote then, as at present, probably contained a fairly complete representation of the Sacramento fishes, it having direct connection with the river itself. The upper course would perhaps at no time harbor as many forms as the main channel, although any of its species might possibly be found there at periods of high water, and at the very time when a shifting of the channel would most likely occur. The first transfer of the Coyote was presumably made when the shore of Monterey Bay was near the present 600-fathom contour, and the San Lorenzo was consequently a tributary of the Pajaro. This inflow of foreign water brought with it three species,[a] those which now inhabit the San Lorenzo and the Salinas, and all which at that particular time were contained in the captured portion of the Coyote. These forms eventually occupied the entire system, appearing in all its tributaries. The same cause which first turned the Coyote from its original channel would by its continued operation tend to shift it back again, leaving the Pajaro to itself as before. A subsidence occurring at this juncture drove the coast line back, submerging the lower part of the great valley, thus completely and permanently isolating the San Lorenzo with its three fluvial species. Again, the continued deposition of material on the plain where the Coyote emerged from the mountains turned its headwaters toward the Pajaro, bringing with it additional species, which easily reached the Salinas, but were barred from the San Lorenzo. Although the upper Coyote may have continued to swing back and forth over its growing alluvial fan, no other species succeeded in passing until by the continued subsidence of the coast and the consequent retreat of the shore line the Salinas was finally detached from the Pajaro. Further shifting of the stream over the alluvial fan enabled other species to enter the Pajaro, but the Coyote at last returned to its original channel before representatives of all its native fishes had succeeded in crossing the watershed.

It is especially significant that of the fishes which were presumably first transferred to the Pajaro, and which have consequently been longest isolated from the parent basin, three have become sufficiently differentiated to be regarded as distinct species.

[a] No account is taken of the possibility of the introduction of species which later became extinct, for the reason that the volume of the San Lorenzo and all other conditions of the river and its surroundings appear favorable to the support of at least some of the species not found there. It should be mentioned in this connection, however, that somewhat similar cases of unequal distribution do occur, in the streams tributary to San Francisco Bay, for example, for which no acceptable reason seems to present itself. The chance that species living in the basin have been overlooked is ignored also, because of the careful collecting that has been done in the region.

It is barely possible that a close connection may at one time have existed between the Pajaro and Salinas Rivers, which was not mentioned in discussing those streams. On an examination of the map, plate XX, or on an inspection of the coast between the mouths of the Pajaro and Salinas, evidence appears which seems to indicate that the mouths of both streams, and especially that of the Salinas, are subject, or have been subject, to considerable shifting. This shifting is due directly to the piling up of drift sand, which in the case of the Salinas has apparently been crowding the mouth of the river northward until it is now in comparatively close proximity to that of the Pajaro. It is conceivable that this same movement may continue until a union of the two streams takes place, and moreover one should not entirely overlook the possibility that such a union may have occurred before, and that the Salinas may even have received thereby a complete representation of the Pajaro fauna, certain species of which have since become extinct in that basin.

If the migration of these fishes from their native basin was accomplished during the glacial epoch or near its close, we have here a possible indication of the vast amount of time necessary for the appearance in nature of a slight amount of differentiation, for the Pajaro forms which have been described as distinct species differ only in a small degree from the parent forms of the Sacramento.

TABLE SHOWING DISTRIBUTION OF SPECIES IN THE PAJARO SYSTEM.

	Entosphenus tridentatus.	Catostomus mniotiltus.	Orthodon microlepidotus.	Lavinia ardesiaca.	Ptychocheilus grandis.	Hesperoleucus subditus.	Agosia carringtoni.	Salmo irideus.	Oncorhynchus tschawytscha	Oncorhynchus kisutch.	Gasterosteus cataphractus.	Archoplites interruptus.	Hysterocarpus traski.	Cottus asper.	Cottus aleuticus.	Cottus gulosus.
San Lorenzo Basin:																
San Lorenzo junction, Kings Creek								X								
San Lorenzo junction, Boulder Creek	X							X								
San Lorenzo at Brookdale		X				X	X	X								
San Lorenzo near Felton		X				X	X	X						X		X
San Lorenzo near Big Trees		X				X		X							X	
San Lorenzo near Santa Cruz	X	X				X	X	X	X	X	X			X	X	
Soquel Creek								X			X			X		
Aptos Creek								X			X			X	X	
Pajaro Basin:																
San Felipe near San Felipe		X		X	X											
Pajaro between Sargent and San Felipe				X	X	X										
Pajaro at Sargent	X	X	X	X	X	X		X			X	X	X	X		
Pajaro above junction with San Benito			X	X	X											
Pajaro at junction with San Benito		X	X	X	X			X								
Pajaro below junction with San Benito		X		X												
Pajaro 3 miles above Watsonville	X	X		X	X			X			X		X			
Pajaro near Watsonville		X	X	X	X			X			X					
Pajaro at Watsonville		X		X	X		X		X				X	X		
Pajaro 1 mile below Watsonville		X		X	X		X				X			X		
Llagas Creek in mountains		X			X	X	X	X								X
Llagas Creek in mountains		X			X	X		X								X
Llagas Creek in mountains		X			X	X		X								X
Llagas Creek near mouth		X		X												
Uvas Creek in mountains		X			X	X		X								X
Uvas Creek in mountains					X	X		X								X
San Benito near San Benito		X				X	X									
San Benito near Erie		X				X	X									
San Benito near Hollister		X														
San Benito near mouth		X				X	X				X					
Tres Pinos Creek near Tres Pinos		X				X										
Tres Pinos Creek at Tres Pinos						X	X				X					
Salinas Basin:																
Salinas at San Miguel		X	X	X		X					X					
Salinas at Bradley		X				X	X				X					
Salinas at King		X														
Salinas between Soledad and King		X				X					X					
Salinas at Soledad		X					X	X			X			X		
Salinas at Gonzales		X		X		X					X					
Salinas near Spencers		X						X						X		
Salinas near Salinas	X	X		X		X	X	X			X		X			
Salinas near Spreckles		X		X		X	X				X		X			
Salinas near Blanco		X		X							X			X	X	
Nacimiento Creek in foothills						X		X					X			X
Nacimiento Creek in mountains	X	X				X	X	X								
Nacimiento Creek in mountains								X								
San Antonio Creek near Mission		X				X	X	X			X					
San Antonio in mountains		X						X								
Arroyo Seco 1 mile above mouth		X				X					X					
Arroyo Seco 2 miles above mouth						X		X			X					
Arroyo Seco 4 miles above mouth		X				X		X								
Arroyo Seco 6 miles above mouth		X				X	X	X			X					X

SYSTEMATIC DISCUSSION OF SPECIES.

Entosphenus tridentatus (Gairdner). *Three-toothed lamprey.*

Lampreys have been taken in the San Lorenzo, Pajaro, and Salinas Rivers. They appear in large numbers in the San Lorenzo during the month of March. Young examples may be found during the summer (May–July) burrowing like earthworms in the soil of the river banks below the water line. A dead adult specimen was found in Nacimiento Creek July 16.

Catostomus mniotiltus, new species. *Pajaro sucker.*

This form, a representative of *Catostomus occidentalis,* the coarse-scaled sucker of the Sacramento system, differs from the parent species principally in having larger scales in the anterior dorsal region of the body. This difference, visible on a careful comparison of specimens from both river systems, is well illustrated by enumerating the series of scales between the occiput and dorsal fin and also between the lateral line and middle of back.

Scales above lateral line	10	11	12	13	14	15	16	17
Specimens *C. occidentalis*	....	....	....	11	24	36	25	5
Specimens *C. mniotiltus*	13	66	31	6	....	....	....	....

Scales before dorsal	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Specimens *C. occidentalis*	....	....	....	....	....	....	3	11	12	23	15	10	12	13	1
Specimens *C. mniotiltus*	2	6	16	18	27	23	16	7	1	....	....	....	....	....	....

The mouth is smaller and the lips narrower in *C. mniotiltus*, and the body appears to be more robust and stalky.

This species is not closely related to *C. microps* Rutter, of the Sacramento, the relationships of the latter being with the fine-scaled suckers *C. rimiculus* of the Klamath and *C. catostomus* of the Columbia.

Description of the type, no. 74465, United States National Museum, from Arroyo Seco Creek, Monterey County, Cal. Length, 208 millimeters.

Head 4.8 in length to base of caudal; depth 4.8; depth caudal peduncle 2.6 in head; eye 6; interorbital space 2.3; snout 2; dorsal rays 12; anal rays 7; scales in lateral line 57; between lateral line and middle of back 11; between lateral line and insertion of ventral 8; between occiput and insertion of dorsal fin 27.

The head is short and broad, the body deep and stocky; interorbital area very convex; width of mouth contained 5 times in head; upper lip with about 5 rows of papillæ; cleft of lower lip so deep that not more than 1 row of papillæ lies between it and the border of mouth; inner border of lips smooth and somewhat horny; about 4 rows of minute papillæ between valve and upper border of mouth. Length of fontanelle equal to diameter of orbit. Origin of dorsal midway between tip of snout and base of caudal; highest rays 1.5 in head, not nearly reaching tips of last rays in depressed fin. Ventrals inserted beneath middle of dorsal, their length 1.7 in head, the edges rounded. Anal 1.5 in head. Caudal lobes slightly shorter than head. Pectorals rather obtusely pointed, 1.4 in head.

Scales large and regular. Lateral line almost straight excepting a short curve immediately behind upper edge of gill opening. A row of mucous pores passes from near tip of snout, beneath and behind eye, then curves upward and turns backward to join the lateral line at upper edge of gill opening, from where it is connected with the opposite side of head by a similar row of pores across the occiput; another row of pores extends from occipital row forward above eye and near edge of nostril to near tip of snout.

Color in spirits, dark on the upper surfaces, growing lighter below the lateral line; the ventral area white. Scales of the dark areas with dusky basal spots and narrow dark margins. Dorsal, caudal, and pectorals suffused with dusky color; ventrals and anal immaculate. In life the upper parts are dark olive, the sides with brassy and silvery reflections. Young individuals have a dark spot on the opercle, a similar one immediately behind the head, a third on middle of sides above base of ventrals, and a fourth on caudal peduncle. These spots enable one to identify young suckers at a glance when they are swimming among individuals of other species.

This appears to be the most widely distributed fluvial species in the Pajaro system. It is represented in each basin by large numbers of individuals which frequent all parts of the streams, living along with the trout in the cool, rapid creeks of the mountains, appearing in the warm, shallow ripples of the valleys, and thriving especially well in deep, turbid pools where algæ and diatoms are abundant. Specimens may be seen in the brackish water near the mouths of the rivers, and they survive to the last in the detached pools of a desiccating stream.

Measurements of 20 specimens follow.

MEASUREMENTS OF TWENTY SPECIMENS OF CATOSTOMUS MNIOTILTUS.

Arroyo Seco Creek.

Length of body . . . mm.	200	220	205	198	148	152	128	124	123	122
Length head	0.24	0.245	0.25	0.245	0.24	0.25	0.25	0.25	0.25	0.25
Depth body	.25	.245	.25	.26	.22	.225	.25	.235	.25	.23
Depth caudal peduncle	.09	.095	.095	.095	.09	.09	.09	.09	.085	.09
Length caudal peduncle	.15	.15	.15	.16	.16	.15	.15	.165	.16	.15
Length snout	.12	.125	.12	.13	.12	.12	.12	.13	.12	.12
Diameter eye	.045	.04	.04	.04	.04	.045	.045	.045	.05	.045
Interorbital width	.10	.10	.10	.105	.10	.10	.10	.10	.10	.10
Depth head	.175	.18	.18	.185	.19	.18	.18	.18	.18	.18
Snout to occiput	.21	.21	.21	.21	.22	.22	.21	.23	.22	.22
Snout to dorsal	.52	.52	.52	.52	.515	.52	.53	.53	.54	.54
Snout to ventral	.565	.57	.59	.59	.585	.57	.57	.59	.58	.59
Length base of dorsal	.165	.17	.16	.17	.17	.17	.16	.16	.16	.16
Length base of anal	.08	.08	.075	.08	.075	.075	.075	.075	.075	.07
Height dorsal	.17	.165	.165	.17	.18	.17	.17	.17	.18	.18
Height anal	.18	.17	.165	.165	.16	.16	.16	.15	.17	.17
Length pectoral	.19	.20	.19	.18	.18	.19	.18	.18	.20	.20
Length ventral	.15	.15	.14	.145	.14	.14	.15	.13	.14	.15
Length caudal	.22	.22	.21	.22	.23	.23	.21	.23	.23	.24
Dorsal rays	12	12	12	12	13	12	11	12	11	12
Anal rays	8	7	7	7	8	7	7	7	7	8
Scales lateral line	60	61	60	57	62	61	60	58	57	63
Scales above lateral line	11	12	11	12	11	11	12	11	12	12
Scales below lateral line	8	9	9	9	8	8	8	8	8	8
Scales before dorsal	26	27	27	26	26	27	26	27	28	28

Pajaro River, Watsonville.

Length of body . . . mm.	162	144	133	134	128	135	121	116	107	111
Length head	0.24	0.25	0.26	0.24	0.25	0.235	0.24	0.25	0.25	0.23
Depth body	.20	.21	.22	.245	.22	.20	.23	.20	.22	.21
Depth caudal peduncle	.09	.09	.09	.09	.09	.09	.09	.09	.09	.09
Length caudal peduncle	.15	.155	.15	.16	.15	.16	.16	.15	.15	.15
Length snout	.12	.11	.125	.12	.12	.12	.11	.12	.11	.12
Diameter eye	.04	.045	.045	.045	.05	.045	.05	.05	.05	.05
Interorbital width	.10	.095	.10	.10	.10	.09	.10	.10	.09	.095
Depth head	.17	.165	.17	.175	.18	.17	.17	.17	.18	.17
Snout to occiput	.22	.21	.22	.21	.22	.20	.21	.21	.22	.21
Snout to dorsal	.52	.51	.53	.51	.52	.51	.54	.51	.52	.51
Snout to ventral	.58	.57	.58	.56	.59	.575	.59	.59	.58	.59
Length base of dorsal	.17	.16	.17	.18	.16	.16	.16	.16	.17	.16
Length base of anal	.075	.07	.08	.085	.08	.08	.07	.07	.08	.08
Height dorsal	.18	.18	.20	.18	.19	.19	.20	.18	.20	.19
Height anal	.17	.16	.19	.18	.16	.17	.17	.16	.18	.17
Length pectoral	.19	.20	.21	.20	.19	.20	.20	.20	.20	.20
Length ventral	.16	.15	.165	.16	.16	.15	.16	.16	.17	.16
Length caudal	.23	.23	.245	.23	.23	.23	.24	.24	.25	.24
Dorsal rays	12	12	11	12	12	11	11	12	11	12
Anal rays	7	7	7	7	7	7	8	7	7	7
Scales lateral line	58	62	62	57	61	59	59	57	60	60
Scales above lateral line	12	11	12	11	12	12	13	12	12	12
Scales below lateral line	10	10	10	9	9	8	9	8	8	8
Scales before dorsal	26	27	27	25	28	29	29	28	29	29

Orthodon microlepidotus (Ayres). *Blackfish.*

This is a channel fish frequenting the deep pools and never appearing in the smaller creeks. In the Pajaro Basin it does not seem to occur in large numbers. It has not been seen in the San Lorenzo and it has been taken but once in the Salinas, Dr. Gilbert and Dr. Stowell having collected specimens near San Miguel.

The dorsal rays number from 9 to 11; the anal 8 or 9; scales in lateral line 94 to 102; below lateral line 12 or 13; above lateral line 23 to 25; between occiput and dorsal 49 to 54.

The following measurements are from specimens collected at Watsonville.

MEASUREMENTS OF SPECIMENS OF ORTHODON MICROLEPIDOTUS.

Length of body .... mm..	184	190	200	195	202	185	189	182
Length head	0.25	0.26	0.27	0.26	0.26	0.26	0.255	0.27
Depth body	.245	.235	.225	.22	.22	.24	.23	.245
Depth caudal peduncle	.08	.08	.085	.08	.08	.08	.08	.09
Length caudal peduncle	.21	.21	.19	.21	.20	.21	.22	.21
Length snout	.08	.885	.09	.09	.09	.085	.085	.09
Diameter eye	.04	.045	.04	.04	.04	.045	.04	.045
Interorbital width	.10	.11	.115	.11	.11	.105	.11	.11
Depth head	.17	.17	.175	.165	.16	.17	.17	.175
Snout to occiput	.20	.19	.20	.20	.20	.21	.19	.21
Snout to dorsal	.52	.515	.535	.515	.52	.53	.53	.54
Snout to ventral	.52	.535	.535	.545	.54	.53	.535	.54
Length base of dorsal	.15	.17	.155	.145	.15	.15	.14	.135
Length base of anal	.11	.11	.10	.115	.10	.105	.10	.10
Height dorsal	.19	.185	.215	.19	.175	.20	.19	.205
Height anal	.16	.16	.165	.155	.15	.17	.16	.17
Length pectoral	.17	.18	.17	.19	.16	.21	.165	.175
Length ventral	.18	.17	.18	.18	.155	.185	.16	.17
Length caudal	.265	.26	.28	.26	.25	.28	.27	.27
Dorsal rays	10	11	10	9	10	10	10	10
Anal rays	8	8	8	8	8	8	8	8
Scales lateral line	94	94	100	102	101	95	100	102
Scales above lateral line	25	23	25	23	25	24	23	24
Scales below lateral line	13	13	13	13	13	13	13	13
Scales before dorsal	52	52	51	49	54	50	49	51

Lavinia ardesiaca, new species. *Silver minnow.*

Minnows of this type found in the Pajaro system differ from *Lavinia exilicauda* of the Sacramento River in having fewer dorsal and anal rays, a somewhat heavier and less compressed body, and in other peculiarities.

In *L. ardesiaca* the dorsal rays are usually 9 or 10 in number, most often 10, while in *L. exilicauda* they number from 10 to 12, most often 11. The anal rays of *L. ardesiaca* number from 8 to 13, the maximum number of examples having 10; the same rays of *L. exilicauda* number from 11 to 14 with 13 as the most usual. These differences are well illustrated in the tables of measurements annexed to the description of the species.

Description of the type no. 74459, United States National Museum, from the Pajaro River near Watsonville, Cal. Length 287 millimeters. (Fig. 1, text.)

Head 4.7 in length to base of caudal; depth 4.4; depth caudal peduncle 2.7 in head; eye 5.4; interorbital space 2.5; snout 3.4; dorsal rays 10; anal rays 11; scales lateral line 59; between lateral line and middle of back 14; between lateral line and base of ventral 7; between occiput and insertion of dorsal 38.

Body of symmetrical proportions, the head small and pointed, the caudal peduncle slender and round; dorsal outline rising in a nearly even curve to middle of back and then sloping gently to caudal peduncle. Eye located considerably in advance of middle of head, but not entirely above a median lateral line. Angle of mouth not reaching a vertical through anterior edge of pupil. Gillrakers on first arch, 19; each being a long, triangular, sharply pointed flap, the posterior edge of which is denticulate.

Pharyngeal teeth (cotype) 5-5, long and compressed; the tips hooked, the grinding surface well developed, though narrow. Lips with a sharp-edged, horny covering (more conspicuous in larger individuals). Lateral line with a gentle downward curve in its anterior fourth. Dorsal inserted midway between pupil and base of caudal; height of longest (first) rays 1.3 in head; edge of fin nearly straight. Height of first anal rays 1.5 in head, the last ray half as high. Ventrals rounded; 1.5 in head; not reaching vent when depressed. Caudal deeply incised, the lobes rather pointed; about an eye's diameter longer than head. Pectoral 1.3 in head, the edge rounded.

Color dark above, lighter on sides, immaculate beneath; the dark color more intense on edges of scales and forming definite dark borders on those below lateral line. In life, olive on upper parts, silvery on the sides and beneath, the silvery color especially brilliant when reflecting the sunlight in the clear water.

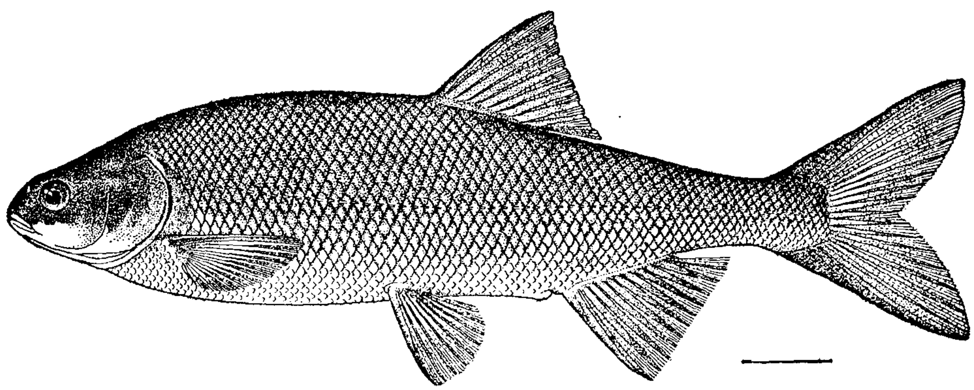

FIG. 1.—Lavinia ardesiaca, new species. Type.

NUMBER OF DORSAL AND ANAL RAYS IN SPECIMENS OF LAVINIA ARDESIACA AND LAVINIA EXILICAUDA.

Dorsal rays	8	9	10	11	12
Specimens *L. ardesiaca*	2	49	80	9	1
Specimens *L. exilicauda*	......	......	3	31	1

Anal rays	8	9	10	11	12	13	14
Specimens *L. ardesiaca*	1	20	51	38	29	1	......
Specimens *L. exilicauda*	......	......	......	1	8	25	1

The specimens of *L. exilicauda* referred to in the above tables are from Cache Creek and Putah Creek, tributaries of the Sacramento. However, the number of dorsal and anal rays here given appears to be fairly characteristic of examples of the species from various parts of its range, as is shown in a table published by Rutter[a] and here introduced.

[a] Rutter, Cloudsley: The fishes of the Sacramento-San Joaquin basin, with a study of their distribution and variation. Bulletin Bureau of Fisheries, vol. XXVII, 1907, p. 127.

VARIATION IN FIN RAYS OF LAVINIA EXILICAUDA.

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	2
20 miles below Grimes		1					1	
Feather River, Oroville			2				2	
American River, Folsom			2				1	1
Antelope Creek, Peryn			2				1	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	6	3
Kings River, Centerville		2	8		1	2	7	
Kaweah River, St. John Channel		6	4		1	1	7	1
Tule River, Porterville	2	2	1					
Total	2	26	39	1	2	4	48	8

With a decrease of the number of fin rays has come a consequent shortening of the bases of both dorsal and anal fins in *L. ardesiaca*.

DORSAL AND ANAL FIN MEASUREMENTS RECORDED IN HUNDREDTHS OF THE LENGTH TO BASE OF DORSAL.

Length base of dorsal	0.12	0.13	0.14	0.15	0.16	0.17	0.18
Specimens *L. ardesiaca*	1	6	30	43	19	3	
Specimens *L. exilicauda*			2	5	23	4	1

Length base of anal	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19
Specimens *L. ardesiaca*	1	4	11	20	24	27	6		
Specimens *L. exilicauda*					1	4	12	14	4

Examples of this species are comparatively heavy in appearance, the body being somewhat less compressed than that of *L. exilicauda*, the snout a little longer, and the head somewhat larger. These differences, though slight and not easily shown by measurements, appear when a considerable series of specimens of both species pass under one's observation.

The structure of the scales (fig. 26, pl. XXIV) does not appear to differ materially from that of *L. exilicauda*. They are more or less spatulate in outline, the nuclear area elevated, the basomedian and basolateral ridges high and rounded, the apicolateral ridges very weak or entirely absent. There are neither basal nor lateral radii. The apical radii number as follows, 50 scales from 10 individuals having been examined:

First year, 5 to 10, usually 7 to 9.
Second year, 6 to 16, usually 11 to 14.
Third year, 9 to 22, usually 14 to 19.
Fourth year, 11 to 26, usually 16 to 23.

The species is found in the Pajaro and Salinas Basins, but appears to be absent from the San Lorenzo. It frequents the lower courses of the streams, delighting in the shallow water of the ripples, where large schools may be seen moving about over the yellow sand of the bottom in the full glare of the sun. The larger individuals, which are darker in color and less silvery than the smaller ones, take refuge in the deep pools. The species is not well represented where the current is very rapid and where the water, cool and clear, plunges over and around the rocks and bowlders. In the upper courses of the streams it is not found at all. It is seldom associated with *Hesperoleucus*.

The largest specimens caught measured 13 inches in length. They were taken with baited hook in the Pajaro. They do not appear to reach such proportions in the Salinas, the river being too shallow.

An examination of the scales of a number of individuals indicates that their growth is about as follows:

First year, 60 to 85 millimeters, about 3 inches.
Second year, 95 to 110 millimeters, about 4 inches.
Third year, 150 to 210 millimeters, about 7 inches.
Fourth year, 160 to 230 millimeters, about 8.5 inches.
Fifth year, —— to 280 millimeters, about 10 inches.
Sixth year, 285 to 320 millimeters, about 12 inches.

Measurements of 20 specimens of this species follow and for comparison similar measurements of 10 examples of *L. exilicauda* are also given.

MEASUREMENTS OF 20 SPECIMENS OF LAVINIA ARDESIACA, NEW SPECIES.

Pajaro River, Watsonville.

Length of body.....mm..	162	166	133	118	112	114	100	86	84	93
Length head	0.235	0.235	0.23	0.24	0.245	0.24	0.24	0.24	0.25	0.25
Depth body	.28	.255	.27	.27	.265	.26	.25	.26	.275	.255
Depth caudal peduncle	.08	.075	.09	.085	.09	.09	.085	.08	.095	.09
Length caudal peduncle	.15	.16	.175	.15	.17	.16	.15	.165	.165	.17
Length snout	.07	.065	.07	.07	.07	.07	.065	.07	.075	.07
Diameter eye	.05	.05	.055	.055	.055	.05	.065	.055	.06	.055
Interorbital width	.085	.08	.085	.09	.085	.09	.08	.09	.095	.085
Depth head	.16	.155	.18	.18	.17	.17	.165	.18	.195	.18
Snout to occiput	.18	.175	.185	.19	.19	.185	.19	.20	.19	.20
Snout to dorsal	.575	.545	.56	.565	.57	.57	.56	.54	.58	.56
Snout to ventral	.525	.515	.51	.53	.51	.52	.50	.52	.53	.54
Length base of dorsal	.17	.155	.15	.15	.165	.15	.15	.17	......	.15
Length base of anal	.16	.16	.155	.16	.145	.14	.16	.16	.15	.16
Height dorsal	.195	.195	.19	.21	.19	.20	.22	.21	.22	.21
Height anal	.18	.165	.17	.17	.165	.17	.18	.19	.185	.19
Length pectoral	.18	.17	.17	.17	.175	.17	.20	.185	.20	.18
Length ventral	.165	.16	.15	.165	.165	.16	.18	.16	.17	.17
Length caudal	.30	.275	.29	.30	.30	.29	.275	.31	.32	.32
Dorsal rays	11	10	10	10	10	10	11	10	10	10
Anal rays	11	11	11	11	11	11	12	11	10	12
Scales lateral line	60	54	55	55	54	54	54	55	57	54
Scales above lateral line	13	14	13	13	13	13	12	13	13	14
Scales below lateral line	6	6	6	7	6	6	6	6	6	6
Scales before dorsal	35	34	32	33	33	34	33	32	33	33

Salinas River, near Salinas.

Length of body.....mm..	163	121	94	90	75	90	86	79	73	81
Length head	0.24	0.25	0.25	0.24	0.255	0.24	0.26	0.245	0.25	0.25
Depth body	.28	.265	.255	.25	.30	.25	.27	.275	.265	.275
Depth caudal peduncle	.08	.09	.08	.085	.09	.09	.09	.09	.10	.10
Length caudal peduncle	.16	.14	.14	.165	.17	.165	.16	.16	.16	.15
Length snout	.07	.065	.065	.065	.07	.065	.07	.07	.08	.07
Diameter eye	.05	.06	.06	.06	.065	.065	.07	.07	.065	.165
Interorbital width	.09	.09	.09	.09	.09	.08	.085	.085	.08	.085
Depth head	.185	.19	.175	.17	.185	.17	.185	.18	.18	.19
Snout to occiput	.18	.20	.185	.19	.21	.20	.20	.20	.20	.20
Snout to dorsal	.59	.585	.59	.57	.58	.56	.575	.58	.57	.58
Snout to ventral	.525	.55	.555	.52	.54	.51	.55	.54	.53	.54
Length base of dorsal	.14	.15	.16	.15	.14	.15	.15	.15	.16	.15
Length base of anal	.16	.17	.15	.16	.14	.17	.145	.16	.17	.16
Height dorsal	.175	.19	.21	.21	.20	.20	.22	.225	.21	.205
Height anal	.165	.17	.17	.17	.17	.18	.175	.18	.18	.19
Length pectoral	.165	.17	.17	.18	.18	.175	.19	.19	.18	.20
Length ventral	.155	.16	.17	.16	.16	.17	.17	.175	.16	.17
Length caudal	.275	.31	.305	.31	.30	.28	.31	.325	.31	.295
Dorsal rays	10	10	11	11	10	10	10	10	11	10
Anal rays	12	12	12	12	11	12	11	11	12	12
Scales lateral line	57	56	60	56	60	57	57	55	59	55
Scales above lateral line	13	12	13	13	13	12	13	13	12	12
Scales below lateral line	6	6	6	6	6	6	6	6	6	6
Scales before dorsal	34	31	34	34	32	33	31	32	32	33

MEASUREMENTS OF 10 SPECIMENS OF LAVINIA EXILICAUDA.

Cache Creek, tributary of Sacramento River.

Length of body .... mm.	166	182	178	118	118	102	102	76	103	100
Length head	0.23	0.20	0.235	0.23	0.225	0.23	0.24	0.235	0.235	0.22
Depth body	.27	.24	.24	.265	.26	.27	.27	.26	.27	.26
Depth caudal peduncle	.08	.07	.07	.085	.08	.09	.09	.09	.08	.09
Length caudal peduncle	.155	.135	.17	.155	.155	.165	.16	.175	.17	.17
Length snout	.06	.055	.065	.065	.06	.065	.06	.06	.065	.055
Diameter eye	.05	.045	.05	.06	.06	.06	.06	.06	.065	.055
Interorbital width	.085	.075	.08	.08	.08	.08	.08	.08	.08	.08
Depth head	.17	.16	.16	.17	.16	.17	.16	.17	.17	.175
Snout to occiput	.17	.17	.18	.18	.18	.19	.185	.19	.19	.19
Snout to dorsal	.565	.59	.56	.58	.57	.57	.60	.58	.57	.55
Snout to ventral	.51	.54	.52	.515	.535	.52	.53	.51	.51	.50
Length base of dorsal	.16	.145	.16	.165	.16	.165	.16	.16	.16	.16
Length base of anal	.17	.175	.16	.17	.18	.17	.16	.165	.18	.175
Height dorsal	.20	.17	.185	.21	.21	.23	.21	.23	.20	.235
Height anal	.17	.16	.17	.185	.17	.19	.18	.20	.18	.195
Length pectoral	.17	.16	.155	.18	.18	.19	.185	.195	.185	.19
Length ventral	.16	.16	.16	.175	.17	.185	.17	.18	.18	.18
Length caudal	.29	.27	.30	.32	.33	.305	.32	.36	.32	.33
Dorsal rays	11	11	11	11	11	11	11	11	11	11
Anal rays	13	14	12	12	13	12	13	13	13	12
Scales lateral line	57	59	62	56	58	58	58	57	58	58
Scales above lateral line	14	14	13	14	13	13	12	13	13	13
Scales before dorsal	37	35	37	38	38	35	35	34	34	36

Ptychocheilus grandis (Ayers). *Sacramento pike.*

P. grandis[a] occurs in the Pajaro Basin, but is not found in either the San Lorenzo or Salinas. It is the largest of the Pajaro minnows. Specimens measuring 20 inches in length were caught in the deep pools. Although a channel fish, it appears to venture up the smaller tributaries farther than *Lavinia* or *Orthodon*, but is not able to extend its range with *Hesperoleucus* or *Catostomus*.

A table of measurements is appended.

MEASUREMENTS OF SPECIMENS OF PTYCHOCHEILUS GRANDIS.

Length of body .... mm.	196	220	295	226	177	164	146	141	158	164
Length head	0.27	0.27	0.265	0.265	0.27	0.26	0.27	0.28	0.27	0.265
Depth body	.195	.205	.205	.195	.20	.22	.19	.19	.19	.20
Depth caudal peduncle	.09	.09	.095	.09	.09	.09	.08	.085	.08	.085
Length caudal peduncle	.195	.21	.19	.20	.19	.195	.19	.19	.18	.20
Length snout	.095	.09	.095	.095	.09	.09	.09	.09	.095	.095
Diameter eye	.04	.04	.035	.04	.045	.045	.045	.045	.05	.05
Interorbital width	.08	.075	.075	.075	.08	.075	.075	.08	.07	.08
Depth head	.14	.145	.135	.15	.14	.145	.14	.14	.15	.15
Snout to occiput	.21	.205	.20	.21	.21	.22	.21	.21	.22	.21
Snout to dorsal	.56	.56	.55	.56	.59	.59	.57	.58	.575	.57
Snout to ventral	.54	.545	.535	.55	.545	.55	.56	.555	.55	.54
Length base of dorsal	.105	.11	.115	.10	.12	.115	.11	.10	.11	.10
Length base of anal	.09	.95	.10	.09	.105	.95	.10	.10	.95	.95
Height dorsal	.175	.175	.165	.165	.175	.18	.175	.175	.18	.17
Height anal	.155	.16	.145	.155	.16	.16	.165	.15	.16	.165
Length pectoral	.15	.17	.14	.145	.15	.16	.15	.155	.16	.165
Length ventral	.13	.14	.14	.125	.14	.14	.135	.14	.145	.14
Length caudal	.24	.24	.235	.225	.24	.245	.24	.235	.245	.26
Dorsal rays	9	9	8	8	8	8	8	8	8	8
Anal rays	9	9	9	9	9	9	9	9	9	9
Scales lateral line	74	72	73	74	76	73	71	74	73	75
Scales above lateral line	15	14	14	14	15	15	13	14	13	14
Scales below lateral line	7	7	7	8	7	8	7	7	8	8
Scales before dorsal	36	40	36	38	39	36	38	41	39	41

[a] *Ptychocheilus rapax* Girard, said to have been collected at Monterey, Cal., is apparently a synonym of *P. grandis* and doubtless owed its assigned locality to a confusion of labels. A similar case is *Mylocheilus fraterculus* Girard taken by the same collector and also said to have come from Monterey. This is *M. lateralis* (*M. caurinus* of recent authors), the only known species of the genus, and does not occur south of the Columbia River.

HESPEROLEUCUS, new genus.

The generic name *Hesperoleucus* is here used for a small group of closely related cyprinoid fishes previously included with others in the genus *Rutilus* or *Myloleucus*. The species of *Hesperoleucus* have the insertion of the dorsal fin posterior to the ventrals, by which character they may be distinguished from *Myloleucus*. They also have a shorter head, more slender body, and a more nearly horizontal lower jaw. The pharyngeal teeth number 4–5, 4 on the right side, with a narrow but well-developed grinding surface. *Hesperoleucus symmetricus* may stand as the type of the genus.

Hesperoleucus is a genus peculiar to the Sacramento River fauna. Its species inhabit the smaller tributaries of the rivers that flow into the Sacramento and San Joaquin, some of the coastal streams north of the Golden Gate, the creeks tributary to San Francisco Bay, and the rivers flowing into Monterey Bay. They have been included in the species *Rutilus symmetricus* by recent authors, as were also several forms belonging to the genus *Myloleucus*. The latter is an assemblage of comparatively large lake and channel fishes which do not usually frequent the smaller creeks, but live mainly in the deep, sluggish pools of the rivers. They occur abundantly in certain lakes of the Great Basin, where they grow to a large size.

In a previous paper[a] the writer referred to three well-defined geographic races of *Hesperoleucus* (*Rutilus*) thus: "A minnow of this type occurs in the Navarro, Gualala, Russian, and Napa Rivers. Specimens from the Russian and Napa Rivers are alike in all respects, and they in turn agree closely with representatives from the streams tributary to San Francisco Bay. In a majority of cases the dorsal fin has 9 rays and the anal 8. The snout is rather pointed, the caudal peduncle slender, and the fins long, the whole body being trim and well proportioned. Examples from the Navarro and Gualala Rivers are distinguished from these by having generally 8 rays in the dorsal fin, a more robust body, with a deeper caudal peduncle, and a more rounded and shortened snout. The fins are also shorter and somewhat less acute. While examples from the Navarro and Gualala Rivers thus agree in differing from specimens taken in the neighboring basins, individuals from each of these streams bear a distinctive local stamp by which they may be recognized without difficulty, the Navarro examples having mostly one more ray in the anal fin, and larger scales in the series above the lateral line. It has been shown that individuals from the partly isolated rivers tributary to San Francisco Bay are alike in all points, and that these are scarcely to be distinguished in any particular from individuals from the Napa and Russian Rivers. Hence it appears that there are three well-differentiated forms of *Rutilus* in this somewhat restricted region, each of which occupies a distinct hydrographic basin or series of contiguous basins. When, however, the field is broadened and specimens from distant parts of the Sacramento and San Joaquin Basins are brought together, similar variations of a local nature are found to occur, but whether any geographical significance may be attached to these can not be known until more extensive observations have been made." Since then more material has been secured, including specimens of *H. symmetricus* from the type locality, and many examples of a well-differentiated form from the streams tributary to Monterey Bay. In order to deal intelligently with the latter it now seems best to restrict the name *symmetricus* to fishes of the genus inhabiting the rivers of the San Joaquin Valley, to recognize the form frequenting the streams in the immediate region of San Francisco Bay, and likewise that of the Navarro River, Gualala River, and of the streams tributary to Goose Lake, descriptions of which follow in the order indicated.

Hesperoleucus symmetricus (Baird and Girard)[a] is not to be confused with *Algansea formosa* Girard, *Algansea obesa* Girard, *Myloleucus pulverulentus* Cope, nor *Myloleucus parovanus* Cope. This species,

[a] Snyder, J. O.: The fishes of the coastal streams of Oregon and northern California. Bulletin Bureau Fisheries, vol. XXVII, 1907, p. 175.

[b] Jordan and Evermann: Fishes North and Middle America, Bulletin 47, U. S. National Museum, p. 246, synonymy of *Rutilus symmetricus*. Through the kindness of the National Museum authorities the writer has been permitted to examine the types of *Pogonichthys symmetricus* Baird and Girard, and also of *Algansea formosa* Girard. The latter, which is from Merced River, and in a bad state of preservation, appears to be indistinguishable from *Myloleucus thalassinus* of the upper Pit River and Goose Lake. It is a *Myloleucus*, not a *Hesperoleucus*, and if when better specimens from the Merced are examined no differentiating characters appear, *M. formosa* will stand in place of *M. thalassinus*, its known range extending from the lower San Joaquin to the northern tributaries of Goose Lake.

represented by specimens collected by Mr. Rutter near the type locality, San Joaquin River at Polasky, is a form characterized by large eyes, long head, and pointed snout, a symmetrical body with narrow caudal peduncle, and long fins. There are 9 rays in the dorsal, 8 in the anal.[a] The scales in the lateral line number from 47 to 53. A specimen 85 millimeters in length to base of caudal exhibits the following proportional measurements: Length of head, .27; depth of body, .24; depth of caudal peduncle, .10; length of snout, .09; diameter of eye, .07; interorbital width, .105; snout to dorsal, .585; snout to ventrals, .53; length of base of dorsal, .16; anal, .19; length of pectoral, .20; caudal, .32; scales in lateral line, 51; above lateral line, 13; below lateral line, 6; before dorsal, 30. Scales which appear to be typical are illustrated (fig. 1, 2, 3, and 4). The apical radii number from 13 to 22, 15 to 20 representing the usual number in individuals 2 or 3 years old. Lateral radii sometimes appear, but they are usually absent.

No exact data are at hand concerning the species of *Hesperoleucus* inhabiting the great rivers tributary to the Sacramento, and but little is known of those distributed throughout the valley of the San Joaquin.

Hesperoleucus venustus, new species. *Venus roach.*

This form inhabits the Russian River, the streams entering San Pablo, Suisun, and San Francisco Bays. It is characterized chiefly by long fins, a comparatively pointed snout, and slender caudal

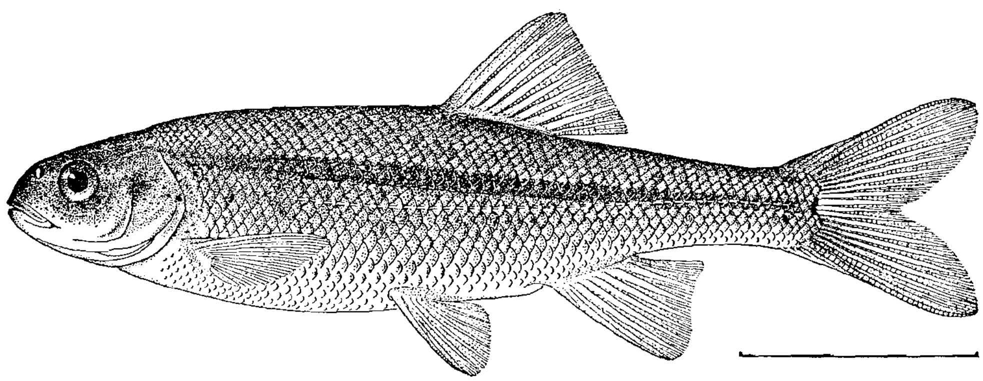

FIG. 2.—Hesperoleucus venustus, new species. Type.

peduncle, the whole body being trim and well proportioned. The dorsal and anal rays number 9 and 8, respectively.

Description of the type, no. 74476 United States National Museum, from Coyote Creek near Gilroy Hot Springs, Cal. Length, 107 millimeters (fig. 2):

Head 4.1 in length to base of caudal; depth 3.9; depth of caudal peduncle 2.5 in head; eye 4; interorbital space 2.7; snout 3; dorsal 9; anal 8; scales in lateral line 53; between lateral line and middle of back 13; between lateral line and origin of ventrals 7; between occiput and origin of dorsal 30.

Body slender, the caudal peduncle narrow, head small, snout short and rather bluntly rounded; eye not included in anterior half of head nor entirely above a median line through body; mouth reaching a vertical which passes a little anterior to orbit. Gillrakers on first arch 10, very short, pointed and widely spaced. Pharyngeal teeth (cotypes) 4–5, 4 on the right side, occasionally 5–5 or 4–4; grinding surface narrow, equal in width to the tooth; tips of teeth hooked. Lateral line with a gentle downward curve on anterior half. Origin of dorsal midway between posterior border of eye and base of caudal; anterior ray 1.3 in head, its tip when depressed not reaching as far posteriorly as that of last ray; edge

[a] Rutter (op. cit., Bulletin Bureau Fisheries, vol. XXVII, p. 138) records 10 rays in the dorsal and 9 in the anal, but an examination of some of his specimens shows that he is in the habit of enumerating the last ray as 2 when it is deeply cleft, i. e., branched.

of fin slightly concave. First anal ray 1.3 in head; edge of fin concave. Ventrals rounded, not reaching anal. Pectoral equal in length to height of dorsal; obtusely pointed. Caudal deeply cleft, the lobes acutely rounded.

Color in spirits dusky above, light beneath, the sides and under parts silvery; a narrow, light stripe extending from upper edge of gill opening to base of caudal; beneath this a conspicuous black stripe, narrow in front, somewhat wider behind, the color deepest above anal fin; several very indistinct, narrow, dark stripes beneath lateral line.

The scales are more or less quadrangular, rounded or spatulate in shape. (Fig. 5–10, pl. XXI and XXII.) The basolateral angles are prominant, and the apicolateral angles weak or entirely obliterated. There are no basal radii, and lateral radii are rarely present except in specimens from the Russian River. The apical radii number from 8 to 21, usually 10 to 18. There are from 50 to 61 scales in the lateral line, counts of a series of specimens resulting as follows:

Scales lateral line	50	51	52	53	54	55	56	57	58	59	60	61
Number of specimens	1	6	4	6	14	28	26	22	15	20	13	3

In this character it differs from *H. symmetricus*, which has from 47 to 53. It differs further from the same species in having smaller eyes and a shorter head. Measurements of many specimens have been made and published.[a]

At least one isolated basin, the Russian River, is included in the region occupied by this form, and specimens from it are somewhat peculiar. The trim, slender form characteristic of the species reaches its highest development here, and the scales usually have from 1 to 5 lateral radii. (Fig. 10, pl. XXII.) Specimens from Napa River also show slight local peculiarities, but neither these nor those from the Russian River appear to differ very much from individuals from the streams flowing into San Francisco Bay.

H. venustus appears to be the parent form of *H. navarroensis* and *H. parvipinnis*, they having become differentiated through the agencies accompanying complete isolation. It will be noted on referring to the descriptions of these species that lateral radii are present on the scales of both, and that in this respect they resemble individuals of *H. venustus* from the Russian River. The distribution of *H. venustus* in the Sacramento basin is unknown.

Hesperoleucus navarroensis, new species. *Navarro roach.*

This is a species inhabiting the Navarro Basin on the western coast of northern California. It is distinguished by its robust body, deep caudal peduncle, short snout, and rounded fins, and in having 8 rays in the dorsal and anal fins. This form is closely allied to *H. parvipinnis*, the one evidently derived from the other or both from one parent stock. *H. navarroensis* differs from *H. parvipinnis* in the number of anal fin rays and in having generally 1 less row of scales above the lateral line.

Description of the type, no. 74477, United States National Museum, from Navarro River near Philo, Cal. Length 90 millimeters.

Head 3.6 in length to base of caudal; depth 3.6; depth caudal peduncle 2.2 in head; eye 4.2; interorbital area 2.8; snout 3.1; dorsal rays 8; anal rays 8; scales lateral line 56; between lateral line and middle of back 13; between lateral line and origin of ventral 7; between occiput and origin of dorsal 30.

Body deep, particularly in the caudal region; posterior margin of eye behind a median vertical through head; lower border of eye somewhat below median line of body. Gillrakers on first arch 8, very short and stumpy. Pharyngeal teeth (cotypes) 4–5, 4 on the right side; a grinding surface equal to width of tooth; the tips slightly hooked. No material variation appears in the teeth of a number of

[a] Snyder, J. O.: Op. cit., Bulletin Bureau Fisheries, vol. XXVII, 1907, p. 176; Notes on the fishes of streams flowing into San Francisco Bay, Appendix to Report Commissioner of Fisheries for 1904, p. 332, *Rutilus symmetricus*.

individuals. Lateral line with a slight downward curve on anterior part of body. Origin of dorsal midway between center of pupil and base of caudal; height of longest rays contained 1.4 times in head; border of fin straight; rays all reaching an equal distance posteriorly when depressed. Ventrals inserted a little anterior to dorsal, the tips reaching anal opening, the edges rounded. Anal 1.7 in head, the edge straight. Caudal deeply incised, the lobes rather pointed, equal in length to head. Pectorals rounded, 1.2 in head.

Color in spirits, dark brown above, lighter and with a silver reflection below; a straight stripe about 2 scales wide extending from upper edge of gill opening to base of caudal, entirely above lateral line; below this a dark stripe, somewhat wider, and then a series of narrow, light and dark stripes which become less distinct ventrally and finally disappear.

Of 72 specimens examined, 68 had 8 anal rays, 3 had 7, and 1 had 9, while all had 8 dorsal rays. There are usually from 51 to 59 scales in the lateral line and 11 to 13 above it. The scales (fig. 11-13) are generally spatulate in form, mostly longer than broad; the apical edge very convex or even pointed, lateral edges usually sloping somewhat toward apex, basal edge double concave with a rather pronounced median prolongation which is the base of a strong median ridge; basolateral ridges prominent, apicolateral ridges more or less indistinct; apical region of scales located notably near the basal edge; basal slope abrupt; apical slope gentle. Basal radii absent; lateral radii weak and irregular, sometimes absent on one or both sides, numbering from 1 to 5; apical radii 14 to 24, usually 16 to 20.

Measurements of a series of 10 specimens of this species are given in "The Fishes of the Coastal Streams of Oregon and Northern California" (Snyder, Bulletin of the Bureau of Fisheries, vol. XXVII p. 177, *Rutilus symmetricus* near Philo, Cal.).

Hesperoleucus parvipinnis, new species. *Short-finned roach.*

This form, found in the Gualala River basin, is characterized by the robust body, deep caudal peduncle, short snout, short, rounded fins, and by having 8 and 7 rays in the dorsal and anal fins.

Description of the type, no. 74466, United States National Museum, Gualala River, Sonoma County, Cal. Length 83 millimeters.

Head 3.9 in length to base of caudal; depth 3.9; depth caudal peduncle 2.2 in head; eye 4.2; interorbital space 2.8; snout 3; dorsal 8; anal 7; scales in lateral line 59; between lateral line and middle of back 13; between lateral line and origin of ventral 8; between occiput and origin of dorsal 30.

Body deep, the caudal peduncle deep and heavy; eye not altogether in anterior part of head, and projecting a little below a median line alongside of body. Gillrakers on anterior arch 8, very short and stumpy. Pharyngeal teeth (cotypes) 4-5, 4 on the right side, the grinding surface no wider than the main shaft of the tooth; well defined hooks present. No variation appeared on an examination of the teeth of a number of specimens. Anterior third of lateral line with a gentle downward curve, the remainder straight. Origin of dorsal midway between posterior margin of eye and base of caudal fin; anterior rays highest, 1.4 in length of head, falling somewhat short of tips of posterior rays in depressed fin. Ventrals inserted anterior to a vertical through origin of dorsal, reaching anal opening when depressed, their edges rounded. Anal 1.5 in head; rounded. Caudal deeply emarginate, the lobes rounded; the length slightly less than that of head. Pectoral rounded, 1.2 in head.

Color in spirits dusky above, lighter below; a light lateral stripe two scales wide extending from upper edge of gill opening to base of caudal and entirely above lateral line; below this a somewhat wider dark stripe, which in turn is followed by several narrower and very distinct dark stripes which grow lighter ventrally.

In 80 specimens of *H. parvipinnis*, 70 had 7 anal rays, 9 had 8, and 1 had 6, all having 8 dorsal rays. There are usually from 54 to 59 scales in the lateral line, and 14 to 16 rows above it. The scales (fig. 14-16, pl. XIII) are rather small, usually somewhat longer than broad, generally quadrangular, the apical and basal edges not very strongly convex; lateral edges almost parallel. Spatulate examples are not rare. The apical slope gentle, basal slope abrupt; basolateral ridges prominent, the others well marked. No basal radii present; lateral radii weak and few in number, 1 to 4; often absent; apical radii 11 to 24, usually 13 to 19.

Measurements of a series of specimens are recorded in the paper above referred to. (Snyder, Bulletin of the Bureau of Fisheries, vol. XXVII, p. 177, *Rutilus symmetricus*.)

Hesperoleucus mitrulus, new species. *Northern roach.*

This name is proposed for the form found in the streams tributary to the north end of Goose Lake, a basin properly belonging to the Sacramento system, but practically separated from it. This species has not been reported from the turbulent streams that flow into Goose Lake from the mountains on the eastern side, nor has it been taken in the lake itself. It is characterized by the short dorsal and anal, 8 and 7 rays, respectively, by having the fins lower and shorter than those of related forms, and in the peculiar cup-like shape of the scales.

Description of the type, no. 74474 United States National Museum, from Drew Creek, Lake County, Oreg. Length, 84 millimeters.

Head 4.7 in length to base of caudal; depth 4.7; depth caudal peduncle 2.4 in head; eye 4.6; interorbital area 3; snout 3; dorsal rays 8; anal rays 7; scales in lateral line 60; between lateral line and middle of back, 14; between lateral line and origin of ventral, 8; between occiput and origin of dorsal, 37.

Body rather deep and heavy, perhaps a little more slender than that of *M. navarroensis* or *M. parvipinnis;* snout short and rounded; eye entirely within anterior part of head, and not quite above a median lateral line of body. Gillrakers of first arch, 9; very small. Pharyngeal teeth (cotypes), 4–5, 4 on the right side; a grinding surface about equal in width to the shaft of tooth; small hooks at tips. Lateral line with a gentle downward curve on anterior half. Insertion of dorsal midway between center of pupil and base of caudal, the height about 1.6 in head, the edge rounded; ventrals inserted anterior to dorsal, the edges rounded, not reaching vent when fin is depressed. Anal rounded posteriorly; 1.8 in head. Caudal deeply incised, the lobes rounded; slightly longer than head. Pectorals rounded; 1.7 in head.

Color in spirits dark brown above, lighter beneath; no dark pigment on the ventral surface. A light stripe 2 scales wide passing from upper edge of gill opening to base of caudal, entirely above lateral line; beneath this a conspicuous dark stripe which is narrowed to a line anteriorly, nearly 3 scales broad posteriorly; sides anteriorly with several very narrow and indistinct dark stripes.

When examined under the microscope, the scales (fig. 17–20, pl. XXIII) are seen to be very convex, almost conical, usually though not always rounded, the basal edge scalloped. They are small in size, there being 54 to 61 in lateral series, 32 to 38 before the dorsal, and 12 to 15 above the lateral line. Basal radii are present in large number, and they are distinct and strong, occasionally entering the nuclear area of the scale. They number from 8 to 17, usually 12 to 15. The ridges of the scales being scarcely developed, there is no sharp line of demarkation between apical, lateral, or basal regions. The apical radii number from about 13 to 20, usually 15 to 18; lateral radii 3 to 9, generally 4 to 6 or 7. Measurements of 20 examples of this species were published in the paper previously referred to. (Snyder, Bulletin of the Bureau of Fisheries, vol. XXVII, p. 98, *Rutilus symmetricus.*)

Hesperoleucus subditus, new species. *Monterey roach.*

This species is related to *H. venustus* of Coyote Creek and other streams tributary to San Francisco Bay. It differs in having a somewhat more robust body, slightly shorter fins, fewer dorsal and anal rays, and a smaller number of scales in the lateral line.

Description of the type, no. 74475, United States National Museum, from Uvas Creek, Pajaro River basin, Santa Clara County, Cal. Length, 110 millimeters. (Fig. 3.)

Head 3.8 in length to base of caudal; depth 3.6; depth caudal peduncle 2.3 in head; eye 4.4; interorbital area 2.6; snout 3.1; dorsal rays 8; anal rays 7; scales in lateral line 53; between lateral line and middle of back 14; between lateral line and origin of ventral 7; between occiput and origin of dorsal 28.

Body markedly robust, deep and heavy, the caudal peduncle especially so; head rather blunt, the snout rounded; eye just within anterior half of head and entirely above median line of body; angle of mouth reaching a vertical which passes a little anterior to orbit. Gillrakers on first arch 9, very short and blunt. Pharyngeal teeth (of cotypes) 4–5, 4 on the right side; a narrow grinding surface on each tooth, a slight hook near the tip. An examination of 10 individuals shows no material variation in the character of the teeth. Lateral line curved downward to a point above insertion of ventrals from where it is more or less straight to base of caudal. Origin of dorsal midway between center of pupil and end of last caudal vertebra; the 2 anterior rays highest, 1.25 in head; their tips falling somewhat short of those of posterior rays when fin is depressed. Ventral inserted a little anterior to dorsal, the point of insertion being midway between nostril and base of caudal; edge of fin rounded; not quite reaching anal opening when depressed. Anterior rays of anal longest, equal to those of dorsal; reaching beyond tips of posterior rays in depressed fin. Caudal emarginate, the lobes broadly rounded and about equal; somewhat longer than head. Pectoral rounded, 1.3 in head.

Color in spirits, dark above, light below; a faint, light stripe about 2 scales wide extending from upper edge of gill opening alongside of body to base of caudal, the stripe being straight and lying entirely above the lateral line; beneath this a series of narrower and very indistinct alternating light and dark

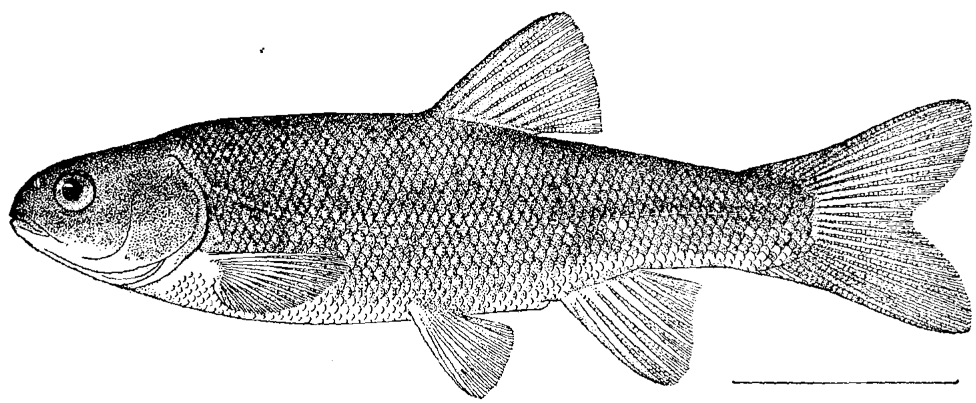

FIG. 3.—Hesperoleucus subditus, new species. Type.

stripes. In life deep olive above, whitish beneath, the transition appearing below the lateral line, a silvery pigment appearing on the lighter areas.

The number of dorsal rays is typically 8, the anal 7. Occasionally examples have 7 or 9 dorsal rays, and a few specimens have 8 anal rays. The following table will serve to illustrate the variation of fin rays:

Number of specimens examined.	Dorsal rays.			Anal rays.	
	7	8	9	7	8
205..........	9	194	2	187	18

Among the 18 examples tabulated as having 8 anal rays 13 were taken from the same pool in the Pajaro at Sargent.

The scales appear to be larger than those of *H. venustus*, and there are consequently a lesser number in the lateral series, the difference, an average one, appearing in the annexed table.

Lateral series of scales	48	49	50	51	52	53	54	55	56	57	58	59	60	61
Number of specimens, Pajaro system	1	2	14	10	14	26	28	18	16	8	1	1	....	....
Number of specimens, San Francisco Bay system	....	....	1	2	3	3	12	24	15	18	11	14	8	2

There is nothing distinctive in the shape of the scales (fig. 21–25, pl. XXIV), but on the contrary they exhibit a great variety of forms, none of which, however, is peculiar to any particular region. They are usually rather oblong, although rounded or quadrangular specimens may be found. Some are spatulate and others have the edges rather straight and nearly parallel. The nuclear area is distinctly basal in location, and the basolateral angles are pronounced. The apicolateral angles are usually weak or absent. The apical radii vary from 12 to 25, the usual number being from 15 to 21 in examples 2 or 3 years old, the radii increasing with age, as may be seen on examining the illustrations.

Number of apical radii	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Number of specimens	1	9	13	21	36	45	48	34	29	25	11	2	3	1

Lateral radii are present in nearly all cases, the scales in this regard differing markedly from those of *M. venustus*. The lateral radii number from 1 to 8, 1 to 5 or 6 being the most usual. There are no basal radii.

This species has about 36 vertebræ, in this respect not differing from related forms. Of 10 specimens from the Pajaro, 8 had 36 vertebræ, while the others had 35 and 37, respectively. In a similar series of *M. venustus* from Isabel Creek, Santa Clara County, 8 had 36 vertebræ and 2 had 37.

M. subditus is generally distributed in the Pajaro system, living in such portions of the streams as flow through the foothills and lower mountain ranges. It does not frequent the upper, turbulent parts of the creeks, nor is it often found in the low valleys where the water is shallow and the bed sandy.

MEASUREMENTS OF SPECIMENS OF HESPEROLEUCUS SUBDITUS, NEW SPECIES.

	Salinas Basin.									
	Salinas River near Gonzales.					Arroyo Seco Creek.				
Length of body ... mm.	77	74	80	75	75	89	87	85	78	70
Length head	0.27	0.25	0.27	0.27	0.26	0.26	0.25	0.27	0.26	0.28
Depth body	.25	.24	.24	.26	.26	.26	.24	.26	.26	.27
Depth caudal peduncle	.11	.11	.11	.11	.11	.10	.10	.11	.11	.11
Length caudal peduncle	.23	.23	.22	.21	.22	.22	.21	.20	.21	.20
Length snout	.09	.085	.09	.09	.09	.08	.08	.09	.08	.08
Diameter eye	.06	.06	.06	.06	.06	.06	.06	.07	.06	.07
Interorbital width	.09	.09	.09	.09	.09	.08	.09	.085	.09	.09
Depth head	.185	.18	.18	.19	.19	.18	.20	.19	.18	.20
Snout to occiput	.22	.20	.22	.21	.21	.20	.20	.22	.21	.21
Snout to dorsal	.57	.55	.59	.55	.60	.58	.56	.58	.58	.59
Snout to ventral	.52	.51	.53	.54	.54	.52	.52	.54	.55	.52
Length base of dorsal	.11	.12	.12	.135	.115	.13	.12	.12	.12	.12
Length base of anal	.10	.09	.11	.11	.09	.10	.11	.10	.10	.10
Height dorsal	.21	.19	.16	.16	.20	.16	.17	.18	.19	.18
Height anal	.20	.18	.16	.17	.175	.16	.15	.16	.17	.15
Length pectoral	.26	.23	.19	.20	.20	.19	.18	.20	.19	.18
Length ventral	.18	.16	.14	.15	.16	.15	.13	.15	.14	.14
Length caudal	.30	.25	.26	.27	.29	.24	.25	.25	.24	.24
Dorsal rays	7	8	8	8	8	8	8	8	8	8
Anal rays	7	7	7	7	7	7	8	7	7	7
Scales lateral line	53	54	51	53	53	50	54	50	53	55
Scales above lateral line	13	14	12	14	13	13	14	14	13	13
Scales below lateral line	7	8	7	7	7	7	7	7	7	7
Scales before dorsal	29	31	30	28	28	27	30	30	31	28

MEASUREMENTS OF SPECIMENS OF HESPEROLEUCUS SUBDITUS, NEW SPECIES—Continued.

	Pajaro Basin.										San Lorenzo Basin.				
	Pajaro River at Sargent.					Uvas Creek.					San Lorenzo River.				
Length of body.................mm..	79	74	70	63	60	91	84	88	76	77	65	64	62	55	57
Length head	0.24	0.25	0.26	0.26	0.26	0.25	0.24	0.26	0.25	0.26	0.27	0.26	0.28	0.26	0.27
Depth body	.26	.25	.25	.26	.28	.26	.25	.27	.27	.26	.26	.24	.27	.27	.28
Depth caudal peduncle	.10	.11	.11	.11	.12	.12	.11	.12	.12	.11	.12	.11	.11	.12	.12
Length caudal peduncle	.22	.22	.21	.22	.23	.23	.22	.22	.22	.23	.22	.23	.22	.23	.22
Length snout	.08	.09	.09	.09	.08	.08	.08	.08	.09	.085	.08	.08	.09	.08	.09
Diameter eye	.06	.05	.06	.06	.07	.05	.06	.06	.06	.06	.06	.06	.065	.065	.065
Interorbital width	.10	.085	.085	.08	.09	.09	.09	.10	.10	.10	.10	.09	.09	.09	.10
Depth head	.18	.18	.18	.20	.20	.18	.19	.19	.20	.19	.20	.22	.20	.20	.20
Snout to occiput	.20	.21	.20	.21	.22	.20	.20	.20	.20	.21	.23	.21	.22	.23	.22
Snout to dorsal	.57	.54	.57	.57	.58	.57	.57	.55	.56	.57	.58	.57	.58	.59	.58
Snout to ventral	.53	.52	.51	.52	.52	.52	.52	.53	.51	.51	.53	.53	.53	.53	.54
Length base of dorsal	.13	.12	.13	.13	.12	.13	.13	.13	.14	.14	.12	.12	.12	.12	.13
Length base of anal	.12	.10	.12	.12	.10	.11	.11	.10	.10	.11	.10	.10	.10	.10	.10
Height dorsal	.19	.20	.20	.21	.19	.19	.20	.20	.20	.18	.18	.20	.18	.19	.20
Height anal	.17	.17	.17	.19	.18	.17	.18	.18	.18	.18	.16	.16	.16	.18	.19
Length pectoral	.19	.19	.19	.21	.23	.20	.20	.20	.19	.20	.18	.20	.19	.24	.21
Length ventral	.15	.15	.16	.16	.15	.16	.16	.16	.15	.16	14	.14	.14	.15	.16
Length caudal	.28	.27	.27	.29	.27	.26	.28	.27	.28	.27	.25	.26	.25	.26	.27
Dorsal rays	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Anal rays	8	8	7	7	7	7	7	7	7	7	7	7	7	7	7
Scales lateral line	54	56	56	53	53	55	51	53	55	53	56	57	56	56	57
Scales above lateral line	15	15	14	14	13	13	14	15	15	15	14	14	15	14	16
Scales below lateral line	7	7	8	7	8	8	8	7	8	8	8	7	8	8	8
Scales before dorsal	32	30	31	31	30	29	30	29	32	32	31	32	30	30	32

Agosia carringtoni (Cope). *California dace.*

Specimens of *Agosia* taken in the Pajaro system do not appear to differ from those of the Sacramento.

Salmo irideus Gibbons. *Rainbow trout.*

The trout taken in the tributaries of the Pajaro system appear to belong to the native species, except a few specimens from the San Lorenzo River, which have larger eyes and a somewhat different color pattern. The native trout appear to agree in all details of structure and color with specimens from Coyote Creek and other streams tributary to San Francisco Bay. The young of other species have been introduced into various streams from time to time, but either none have been taken at the numerous collecting stations, or else the writer has failed to recognize them among the preserved specimens. It is possible, however, that the introduced forms of rainbow trout come to resemble the native species so closely that their identity would be difficult to detect. The dead bodies of large steelheads were occasionally seen in Uvas, Arroyo Seco, and Nacimiento Creeks. At high water they are said to enter all the streams in large numbers. They are frequently mistaken for salmon.

Small trout, beautiful in color and excellent in quality, abound in the upper courses of the creeks and rivers, and especially good fishing may be had in Nacimiento and San Antonio Creeks. The trout of the main channels of the rivers are apt to be rather poor in quality, and are usually light silvery in color. Occasionally a silvery specimen is taken among the darker colored examples of a tributary stream.

Oncorhynchus tschawytscha (Walbaum). *Chinook salmon.*

This species was reported from the San Lorenzo and Pajaro Rivers. No small salmon were taken with the seine at any collecting station.

Oncorhynchus kisutch (Walbaum). *Silver salmon.*

Silver salmon were said to have been observed in the San Lorenzo River at Santa Cruz.

Gasterosteus cataphractus (Pallas). *Stickleback.*

Sticklebacks appear in all the streams tributary to Monterey Bay. They usually have from 4 to 6 lateral plates, the sides being mostly naked and the caudal keel absent. Many fully plated examples were collected, however, these being found near the mouths of the rivers in close proximity to salt water.

An examination of the sticklebacks of this coast will scarcely bear out the conclusions of Mr. C. Tate Regan published in a recent paper.[a] He finds that a circumpolar species *G. aculeatus* extends downward along our coast to the Santa Clara River, Cal., and then gives place to *G. santa-annae*, a species inhabiting the Santa Ana River, which reaches the ocean a few miles to the southward of the Santa Clara River. The distinctive characters assigned to *G. santa-annae* are (compared with *G. aculeatus*) sides of body without bony plates (rarely with 2 or 3 anteriorly); dorsal rays 10 or 11; anal rays 6 or 7 (8); origin of first dorsal spine well behind base of pectoral and only slightly in advance of base of pelvics, 29 vertebræ.

Some time ago Rutter [b] showed that in the region between the Santa Ana River and San Francisco Bay all conditions of lateral armature from entirely naked to completely plated sides might be found. Rutter's notes show that of 111 specimens from the Santa Ana River at Riverside, 104 were naked, 4 had 1 plate, and 3 had 2 plates. Of 298 individuals from the Santa Clara River, 76 had no lateral plates, 41 had 1, 99 had 2, 67 had 3, and 15 had 4. These data seem sufficient to prevent differentiating the Santa Ana fishes on the character of lateral armature, and a perusal of Rutter's paper will demonstrate the futility of attempting to show that the sticklebacks of any locality on this coast may be distinguished by the number of plates on the sides of their bodies. The present writer [a] examined about 2,000 specimens taken in the rivers between San Francisco Bay and the Columbia, and became convinced that within that region at least but one form could be recognized. The data at hand simply show that a larger proportion of naked examples have been collected in the Santa Ana River, but judging from what is known of the lateral armature of sticklebacks in other streams it would not be very hazardous to predict that further collecting in the Santa Ana would result in securing specimens that are more fully armed. That the Santa Ana fishes are not distinguished by peculiar fin structure is shown in an examination of 20 specimens selected at random from a collection from Santa Clara River, where 3 examples have 10, 13 have 11, and 4 have 12 dorsal rays; 5 have 7, 11 have 8, and 4 have 9 anal rays. The position of the first dorsal spine and also the number of vertebræ are likewise variable. In brief, no one seems able to find any characters or set of characters that will serve to differentiate the Santa Ana sticklebacks, or in fact those from any other river basin along the west coast. Perhaps it may be said that individuals of the species generally attain a larger size and a more complete armature in the north, while they are usually smaller and more scantily armed in the south; and also that while such a geographic variation obtains a similar one seems to appear which is coordinate with habitat, i. e., heavily plated individuals are more generally found in or near salt water, while the more nearly naked ones usually occur in the rivers at some distance from the ocean.

It seems better to retain the name *G. cataphractus* for west American sticklebacks until sufficient evidence shows that it is not tenable.

Archoplites interruptus (Girard). *Sacramento perch.*

Small sunfish were collected in the Pajaro at Sargent and near the junction of the Pajaro and San Benito. This species has not been reported from Coyote Creek nor any of the smaller streams tributary to San Francisco Bay.

Hysterocarpus traski Gibbons. *Fresh-water viviparous perch.*

Frequently seen in the Pajaro and Salinas Rivers. Does not occur in the San Lorenzo.

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[a] Regan, C. Tate: The species of three-spined sticklebacks. Annals and Magazine of Natural History, ser. 8, vol. IV, p. 435.

[b] Rutter, Cloudsley: Notes on fresh-water fishes of the Pacific slope of North America. Proceedings California Academy Sciences, 2d ser., vol. VI, p. 245-254.

[c] Snyder, J. O., op cit., Bulletin Bureau Fisheries, vol. XXVII, 1907, p. 183.

Cottus asper Richardson. *Prickly bullhead.*

This species is a channel form, occurring in deep, quiet pools, and most often near the mouths of the rivers. It is easily caught with a baited hook. The following fin ray counts were made from specimens taken in the Pajaro River.

	Dorsal spines.			Dorsal rays.			Anal rays.		Pectoral rays.		
Spines or rays	7	8	9	19	20	21	16	17	15	16	17
Number of specimens	1	14	10	8	14	3	17	8	5	16	4

Cottus aleuticus Gilbert. *Aleutian bullhead.*

Cottus aleuticus appears to be associated with *C. asper*, often being taken in the same seine haul with the latter.

Cottus gulosus (Girard). *Rifflefish.*

Cottus gulosus inhabits the upper courses of the creeks, apparently preferring the clear, cool water of the ripples, where specimens may often be seen lying on the bottom near large pebbles or bowlders. They approach food with short, jerky movements, always keeping close to the bottom. They are difficult to collect, as they usually dart under the lead line of the net if it passes over the least obstruction.

	Dorsal spines.			Dorsal rays.			Anal rays.			Pectoral rays.		
Spines or rays	7	8	9	17	18	19	13	14	15	14	15	16
Uvas Creek	2	9	......	1	9	1	......	9	2	1	10	......
Llagas Creek	2	16	2	2	12	6	1	16	3	1	18	1