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A Revision of the Family Embiotocidae (The Surfperches)

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1. INTRODUCTION[*]

The viviparous surfperches (family Embiotocidae) are familiar to anglers and commercial fishermen alike, along the Pacific Coast of the United States. Until the present, 21 species have been recognized in the world. Two additional forms are herein described as new. Twenty species are found in California alone, although not all are restricted to that area.

The family, because of its surf-loving nature, is characteristic of inshore areas, although by no means restricted to this niche. Two species are generally found in tidepools, while one, Zalembius rosaceus, occurs in fairly deep waters along the continental shelf.

Because of their rather close relationships, the Embiotocidae have been a problem for the angler, the ecologist, the parasitologist, and others, to identify and even, occasionally, have proved to be difficult for the professional ichthyologist to determine. An attempt has been made in this revision, to remedy this situation by including full descriptions based on populations, rather than on individual specimens, and by including a key which, it is hoped, will prove adequate for juvenile specimens, as well as for adults.

An outline of the general history of the group and their viviparity has been included. An attempt has been made to outline the family's evolution. While it is recognized that such an attempt is not final in nature, it has been included as a point of departure for future workers. In analyzing the evolutionary trends, within the family, it was found necessary to revise the subfamilial, generic, and subgeneric limits. In every instance I have been influenced by the similarity between species rather than their difference, so it will be found that considerable "lumping" has occurred.

During the course of this work I have become indebted to many people. I wish to extend my sincere thanks and gratitude to Dr. Rolf L. Bolin, under whose direction the work was done, for his interest, advice, and sound judgment. To Dr. Carl L. Hubbs, of the Scripps Institution of Oceanography and Mr. William I. Follett, of the California Academy of Sciences, I am indebted for suggestions and loan of material. To Dr. George S. Myers and Miss Margaret Storey, of Stanford University; Dr. Reeve M. Bailey, of the University of Michigan; and to members of the California Department of Fish and Game, I am indebted for the loan or procurement of valuable material. I am especially grateful to Mr. John E. Fitch of the Department of Fish and Game for obtaining specimens of the new species Cymatogaster gracilis for me and arranging the

[*] A dissertation submitted to the Department of Biology and the Committee on Graduate Study of Stanford University in partial fulfillment of the requirements for the degree of Doctor of Philosophy, May, 1951. The original text has been modified to include additional data on the island perch, Cymatogaster gracilis. The photographs, unless otherwise credited, are from the files of the California Department of Fish and Game.

loan of the department's photgraphs of embiotocid species. Lastly, I would like to extend my special thanks to Mr. William J. Sefton of San Diego for placing at my disposal the facilities of the Sefton Foundation's research vessel "Orca," from which my first specimens of C. gracilis were taken.

2. HISTORICAL SECTION

The family Embiotocidae was first introduced to the scientific world in November, 1853, with the publication of Louis Agassiz's paper entitled "On extraordinary fishes from California, constituting a new family." That Agassiz was amazed by the discovery of this family is well demonstrated by the title which he gave the paper, as well as by its contents.

The first report of this group was sent to Agassiz by Mr. A. C. Jackson, who wrote that while fishing in San Salita (Sausalito?) Bay he had caught fish which contained living young. In a discussion of this, Agassiz admitted his scepticism by writing: "The statement seemed so extraordinary, that though an outline of the specimen observed was enclosed, I suspected some mistake, and requested Mr. Jackson to furnish me further information upon what he had actually seen, and if possible, specimens of the fish preserved in alcohol."

Jackson's reply to Agassiz's request for more information makes most interesting reading and is an excellent example of critical observation on the part of an intelligent layman.

Mr. Jackson was not the only person to observe the viviparous nature of the embiotocids. The phenomenon was noted practically simultaneously by a number of people; Mr. J. K. Lord discovered them at Vancouver Island, Dr. W. P. Gibbons and Mr. Jackson at San Francisco, and Dr. Thomas H. Webb at San Diego. It was assumed by Agassiz, in one of his later papers, that Dr. Webb was the first person to actually observe the unique viviparity of the embiotocids. At that time, Dr. Webb was a member of the Scientific Corps attached to the Mexican Boundary Line Commission and, because of the nature of his work he had occasion to travel with the seiners in San Diego Bay. It was on one of these trips that he first discovered these fascinating fishes. Agassiz received an excerpt from his diary dated May 3, 1852, from which the following partial quotation is taken: "* * * during boisterous and cold weather, Captain Ottringer caused his seine to be drawn across the harbor. Caught many tiger and shovel-nose sharks, two flounders, two specimens of a fish somewhat like our sculpin, also a number of small fish about three or four inches long, each of which contained 10 or 12 young."

There are, apparently, earlier cases of embiotocids being taken in California. Eigenmann and Ulrey point out that Brevoort, in 1856, commented in a discussion of Ditrema, that a Japanese fish called Tanako had been asserted to be viviparous by Remusat in 1827, and that this "* * * induced me to compare the Ditrema with a specimen of the California viviparous fish procured by Dr. John LeConte in that country in 1851, and with descriptions of the Embiotocidae and Holconoti, by Agassiz * * *."

Eigenmann and Ulrey likewise add that they were notified by Professor George Davidson, of the United States Coast Survey, that he had noted the viviparity of the embiotocids long before any publication of that fact appeared.

In the years immediately following the first description of the family, a quantity of literature dealing with new species was published. According to Gill: "* * * west-coast ichthyography commenced in 1854 with the announcement, by Professor Agassiz, of the discovery of the remarkable family of Embiotocids."

of the 26 papers published in 1854 which dealt with the fishes of the Pacific Coast of the United States, Gill lists nine which refer to the Embiotocidae, seven of which are wholly concerned with them. Agassiz's first description was immediately brought to the attention of the European workers through Troschel's translation which appeared in Wiegman's Archiv für Naturgeschichte, followed by his own analysis of the family's phylogenetic position. The next year there appeared in European journals further translations of the work that was being done in the United States.

After the initial years of descriptive work on new species, during which time a plethora of synonyms were being added to the literature, there followed a period in which the mode of development and reproduction was studied. These early efforts are apt to be unreliable and, it is not until the work of Ryder, and especially that of Eigenmann, appeared, that the observations in this aspect of the biology of the embiotocids, can be considered valid.

The first actual revision of the family appeared in 1894 when Eigenmann and Ulrey's "A review of the Embiotocidae" was published. In this paper 21 species (although one species was not a good one) were placed in 14 genera, most of them monotypic. The family was again revised in 1918 by Hubbs, who placed the 20 known species in 14 genera. In 1933 a new monotypic genus was deseribed (Hubbs, 1933), so that the family today stands with 21 species allocated to 15 genera. The value of a genus as a category demonstrating evolutionary relationships is often reduced to nothing by a preponderance of monotypic genera which hides the natural evolutionary lines that are actually present in such a group as the Embiotocidae. As Hubbs (1918, pp. 9, 10) has pointed out: "Most of the genera of the Embiotocidae are now regarded as monotypic. Such an arrangement of the species doubtless expresses very well their isolated position with reference to one another, but as the expression is one of difference and not of resemblance, it might be urged with justice that the more closely related of the genera should be united. As is frequently the case in similar situations, this 'lumping' of the genera, if undertaken, must be extensive, for they form several more or less uninterrupted series." This dictum has helped formulate the pattern of this revision. The lumping is done with the idea that only by this means can we gain an orderly, logical insight into the natural relationships which exist within the family.

3. VIVIPARITY

The extraordinary viviparity of the Embiotocidae was the prime factor which focused the attention of the scientific world on the group. As noted previously, it became the theme of many papers appearing here and abroad. It seems, therefore, advisable in a review of the family to include a discussion of this unique aspect in some detail.

A feature common to all males of the family is an organ on the anterior portion of the anal fin, which is, in some manner, concerned with the act of copulation. At this date of writing no satisfactory explanation of its exact function has been given. In the subfamily Embiotocinae the structure has the general appearance of an oval flask, the opening of which is directed anteroventrally. The exact form of the flask is subject to interspecific variation. In the subfamily Amphistichinae, on the other hand, there is a serrated triangular plate derived from a modified anal ray. Hubbs (1933, p. 1) states: "Anal fin of breeding male without definite horny excrescence and huge flask-like gland * * *." Actually, there is in the breeding male of the Amphistichinae, in addition to the serrated plate, a definite gland-like area of thickened epithelium forming a puffy bulb. The area extends anterior to the serrated plate and runs lateral to the rays. The tissue of this structure undoubtedly has the same function as the tissue of the flash-shaped organ found in the Embiotocinae.

Blake was the first to speculate on the manner in which copulation is achieved in the Embiotocidae. In a note published in 1863 he states: "* * * From the direction of the orifices of the penis and oviduct it is evident that anything like a perfect contact of these organs can only be maintained whilst the fishes are in a reversed position, so that the head of one fish is towards the tail of the other. In order that contact may be maintained whilst in this position, we find the anal fin of the male fish furnished with certain appendages which enable it to give a firm hold to the ventral fins of the female, so that a close contact of the ventral surfaces can be maintained."

The rationality of such inductive reasoning went unquestioned for a great number of years. As there had been no observations to the contrary, Eigenmann and Ulrey included this note in its entirety in their review of the family and apparently felt Black had adequately described the act. In 1897, however, Eigenmann received the following letter (later printed in the *American Naturalist*) which shattered Blake's speculations: “SEATTLE, WASHINGTON, FEBRUARY 13, 1897” “ *Mr. Carl Eigenmann* ” “DEAR SIR, I have just finished reading your article on the "Viviparous Fish of the Pacific Coast," in vol. xii of the Bulletins of the U. S. Fish Commission, and was very much interested. I thought some observations of mine a few years ago might interest you, so take the liberty to write to you. About six years ago I was crossing Grant Street Bridge (which runs across the shallow mud flats south of the city) in July; the tide was making and the water perfectly clear. I saw a large school of pogies, or perch, Damalicthys argyrosomus; their actions were so peculiar that I stopped and called the attention of passers-by to them.” “The identification of the fish I am sure of, but can state the year and season only approximately. The perch were swimming around very leisurely, when two would approach, swimming in the same direction, and when about their length apart would turn on their side and come in contact, still moving ahead slowly. They made apparently no effort to remain together, but after an instant would separate and resume their normal position. I did not observe whether the act was repeated by both, but in one instance I was sure that one of them immediately came in contact with another in the same manner.” “I recognized the act as one of copulation, as also did the other observers. Any further information, if it is, that I can furnish I will gladly do so, though I am not posted on the fishes, but have always been an observer of natural objects coming before me.” “I remain yours,” “P. B. RANDOLPH ”

This letter is one of three recorded observations of the actual impregnation. In 1917 Hubbs was fortunate enough to witness and be able to take notes on copulation in Cymatogaster aggregata. He writes: "The pair, now alone, then proceeded against the tide in a semi-circular course of about five feet, frequently pausing while the male, turning upon his side, applied his anal region to that of his mate. Finally reaching the shelter of a stone in about a foot of water, the pair halted and copulation ensued. With their heads in the same direction and their anal regions in contact, the pair remained quite motionless for a few seconds, seeming to balance in the water. The male then turned over to a nearly horizontal position, the female much less. For several seconds the male moved rather slowly about half an inch back and forth, paused, then resumed the vibratory movement for a few seconds, and finally darted off, without warning into deeper water." The observations indicate that the anal structure is used during copulation. Wales' (1929) observations on Damalichthys argyrosomus more or less substantiate those of Randolph.*

The following discussion of the mode of reproduction is based chiefly on the work of Hubbs. The species examined by him were mainly the smaller members of the family and the generalizations cannot be applied to the entire family.

The act of copulation which precedes the first brood of young, takes place soon after birth. Through histological examination it has been found that the males of the smaller species achieve a natal maturity, although this is not the case in Embiotoca lateralis, a larger member of the family. In the forms studied, the breeding season occurs during the summer but, fertilization of the eggs does not occur until late autumn, winter, or early spring. If the ovary of the female is examined during the lapse of time between copulation and fertilization, it is found that there is a storage of sperm.

Because of the highly specialized viviparity of the group and the concomitant deficiency of yolk, the ova of the female are very minute. The paucity of yolk has changed the cleavage from the marked meroblastic type, characteristic of teleosts, to a form of cleavage which approaches a holoblastic pattern. This type of cleavage produces pronounced changes in the development of the embryo. It is interesting to note that Cymatogaster aggregata occasionally produces a few markedly enlarged eggs filled with a great deal of yolk. This strongly suggests a rather recent ovoviviparous, if not oviparous, ancestry.

Oögenesis takes place in the ovarian sheets. Eigenmann states: "The eggs are freed from the follicle before segmentation begins. In all probability fertilization takes place just before or just after they are freed."

The small amount of yolk material demands that the embryo if it is to remain viable and grow, must do so at the expense of the mother. To

* See also Rechnitzer and Limbaugh, 1952.

accomplish this end, some type of physiological "placentation" must occur. It has been found, as a general rule, that in those teleosts which have developed vivaparity there are special temporary structures which carry out the necessary functions of nutrition, respiration, etc. The embiotocids are no exception to this rule. The early nourishment and respiration of the developing embryo is accomplished almost entirely through the medium of the ovarian fluid which bathes them. In the early development, before the mouth is open, the hyoid slit breaks through. At the same time the hindgut enlarges, developing long, hollow, vascular villi. The ovarian fluid now passes through the first gill slit, is moved by the cilia of the gut and passes out the anus. Absorption, at this time, undoubtedly takes place in the hypertrophied hindgut. The respiratory function during this stage is probably achieved through the oxygenated ovarian fluid which is helped in its circulation by the highly active spermatozoa still present in the ovary. In the later life of the embryo, after the mouth has broken through, there appears one of the most curious types of temporary structures which occurs in viviparous teleosts. A series of flattened vascular extensions of soft tissue, forming dermal flaps, develops between the ends of the rays of the vertical fins. The vertical fins become highly elevated by this process and an extensive capillary network is formed by the interradial vessels which run to the ends of the dermal flaps. These vascularized fins come in close proximity with the similar vascularized ovarian sheets. Undoubtedly a passage of gases, if not nutritive substances is effected. This supposition is further substantiated by the fact that when scales begin to form and the general body surface becomes less permeable, the vertical fins are found to reach their maximum height.

During the early stages before the breakthrough of the mouth and the activation of the gills, the embryos lie packed together in a random manner. It was noted by Girard that, in young of Hysterocarpus traski reaching the stage of parturition, the embryos all faced in the same anterior direction. of course, this is conceivable by statistical chance; however, Eigenmann emphasizes the fact that later stages can change their intraovarian positions. If this is so, it is possible that, upon reaching a stage where the gills become activated, the embryos turn and face the direction of the highest oxygen tension. This would be toward the origin of the oxygenated blood supply which is, in the embiotocids, the anterior portion of the ovary.

It seems probable that the unique viviparity found in the Embiotocidae originated independently in the family. The occasional production of yolky eggs by at least one species of the family, plus the fact the ovoviviparous or viviparous forms living today appear to be very remotely related to the embiotocids, sustains this reasoning.

It is my belief that the fishes of this family do not merit the full ordinal rank which was accorded to them by Jordan in 1923, even though their reproductive specialization is a striking one. This belief is strengthened by considering the taxonomic rank given other families which possess both ovoviviparous and viviparous members. The reproductive specialization, however, should be taxonomically recognized and allotted some rank. Such a recognition, I feel, is adequately given by the system adopted by Berg in 1940 in which he places the family Embiotocidae under the superfamily Embiotocoidae as part of the suborder Percoidei.

4. ORIGIN AND GEOGRAPHICAL DISTRIBUTION

To interpret the past on the imperfect record which exists in our museums of today is, at its best, a speculative procedure. This is not to say that such speculation is not valuable, but rather to point out that the interpretations accorded such a record should be approached with the utmost caution.

Only three specimens of fossil embiotocids are known; these all belong to one species and were taken from the Miocene at Lompoc, California. Since this species is perfectly typical of the family, suggesting that it was not newly evolved, it is reasonable to believe that the embiotocids were relatively abundant at that time; therefore, there must be a logical explanation of the scarcity of fossil material. The specimens were found in strata which were clearly laid down in fairly deep water. It may be assumed that the embiotocids have undergone no great change in their mode of life and were, then as now, surf-loving forms. It is obvious that the constant churning action of the surf is not particularly conducive to fossilization. In the reconstructed fossil species, Erequis plectrodes, it is noted that the region of the abdomen has apparently rotted away. This hints at the possibility that these specimens, buoyed up by the gases of decomposition, floated from near shore out to the deeper waters and sank, where fossilization could then occur with the minimum of tidal effect.

Frost (1934) has described a single otolith from the London Clay at Warden Point on the Isle of Sheppey. This specimen, dating from the Lower Eocene, he ascribes to the Embiotocidae, pointing out that the specimen resembles the recent species Ditrema temmincki but differs in its greater height and thickness. Embiotocid otoliths show considerable variation, and lack characters trenchantly distinguishing them from the otoliths of many other teleost families. In view of the uncertainties involved in diagnosis and the complete absence of any supplementary or confirming fossils in this part of the world the writer considers Frost's identification highly dubious.

The embiotocids probably originated in California. This conclusion is based on the facts that 1) the only unquestionable fossil remains were found in California and 2) the great majority of living species are centered there. Jordan has suggested that it is possible that the Embiotocidae had an Asiatic origin and crossed to California in comparatively recent times. Because of the subsequent discovery of the fossil Erequis plectrodes, of the excellent work of Andriashev (1939) on the origin and distribution of amphipacific forms, and of my own ideas concerning the evolution of the group, I do not feel that Jordan's suggestion is in keeping with the Law of Parsimony. It is more logical, and simpler, to assume that the Embiotocidae originated in California and crossed to Japan in one of the warmer, interglacial periods, such as the Aftonian (Günz-Mindel).

The present-day distribution of the embiotocids exhibits the family as a perfect example of an amphipacific group. The center of dispersal is found in central and southern California. From this area the species radiate north and south to limits in southern Alaska and central Baja California. They are completely absent from the Aleutian chain but reappear in Japan and Korea. Along the North American side of the

Pacific there is a negative correlation between latitude and number of species (Figure 1).

In an effort to explain this gradual reduction in the number of species, it is necessary to search for an environmental limiting factor. This limiting factor, as with so many species, appears to be temperature. It will be seen in Figure 1 that the bulk of the species are found between latitudes 33 degrees and 38 degrees north, with the remaining species being found as far north as 55 degrees. The species appear to be limited by a high temperature in the southern limit of their range, and a low temperature in the northern limit.

Grouping the North American marine species according to their temperature tolerances we find the following: *

1. *Latitudes 32 degrees N. to 38 degrees N.; temperature range 21 degrees C. to 11 degrees C.* *
2. *Latitudes 39 degrees N. to 42 degrees N.; temperature range 12 degrees C. to 10 degrees C.* *
3. *Latitudes 43 degrees N. to 49 degrees N.; temperature range 13 degrees C. to 7 degrees C.* *
4. *Latitudes 50 degrees N. to 55 degrees N.; temperature range 13 degrees C. to 4 degrees C.* *

It will be seen that of the 20 species listed in group one, 10 species have their entire range within latitudes 32 degrees and 38 degrees north, and within the temperature range for those latitudes.

The Japanese species, Ditrema temmincki and Neoditrema ransonneti, appear to be more tolerant in their temperature requirements than are their American relatives, being able to withstand August highs of 27 degrees to February lows of 5 degrees C.

The two Japanese species are therefore eurythermal, as were probably their ancestors which undoubtedly migrated to Japan under more favorable conditions than now exist. The form ancestral to the present two genera of Japanese species, and of several west coast forms, presumably extended its range northward on the North American coast and achieved a continuous distribution from America to Japan across the roof of the Pacific. Such a distribution would require warmer temperatures than presently exist in the waters surrounding the Aleutian and Kurile Islands. There is good paleontological evidence suggesting that there has

* Temperature ranges approximate, based on August high and February low.

** Found only a Guadalupe Island, but within the temperature range of this group.

* M. minimus, M. aurora, M. frenatus, M. aletes,** C. aggregata, C. gracilis, Z. rosaceus, H. argenteum, H. ellipticum, H. anale, A. argenteus, A. koelzi, A. rhodoterus, H. caryi, P. atripes, P. furcatus, R. toxotes, R. vacca, E. jacksoni, E. lateralis.

* M. frenatus, C. aggregata, H. argenteum, H. ellipticum, A. koelzi, A. rhodoterus, H. caryi, P. furcatus, R. vacca, E. lateralis.

* M. frenatus, C. aggregata, H. argenteum, H. ellipticum, A. rhodoterus, P. furcatus, R. vacca, E. lateralis.

* C. aggregata, R. vacca, E. lateralis.

been a net southward shift in isotherms, and that these waters were warmer in earlier geological ages than today.

It is conceivable that island-hopping alone could have achieved this distribution. Alternatively, if more land was then exposed in these areas than at present, the requirements for the more or less continuous distribution across the North Pacific would be fully met.

The affinities of the Cymatogaster-Hysterocarpus-Micrometrus evolutionary line with the oriental species suggest a common ancestor whose continuous distribution across the North Pacific during some interval of the Quaternary was disrupted by a period of glaciation. The southward extending icecap brought excessively cold conditions which destroyed intermediate populations of the ancestral form, and left isolated amphipacific populations which evolved into the present-day genera.

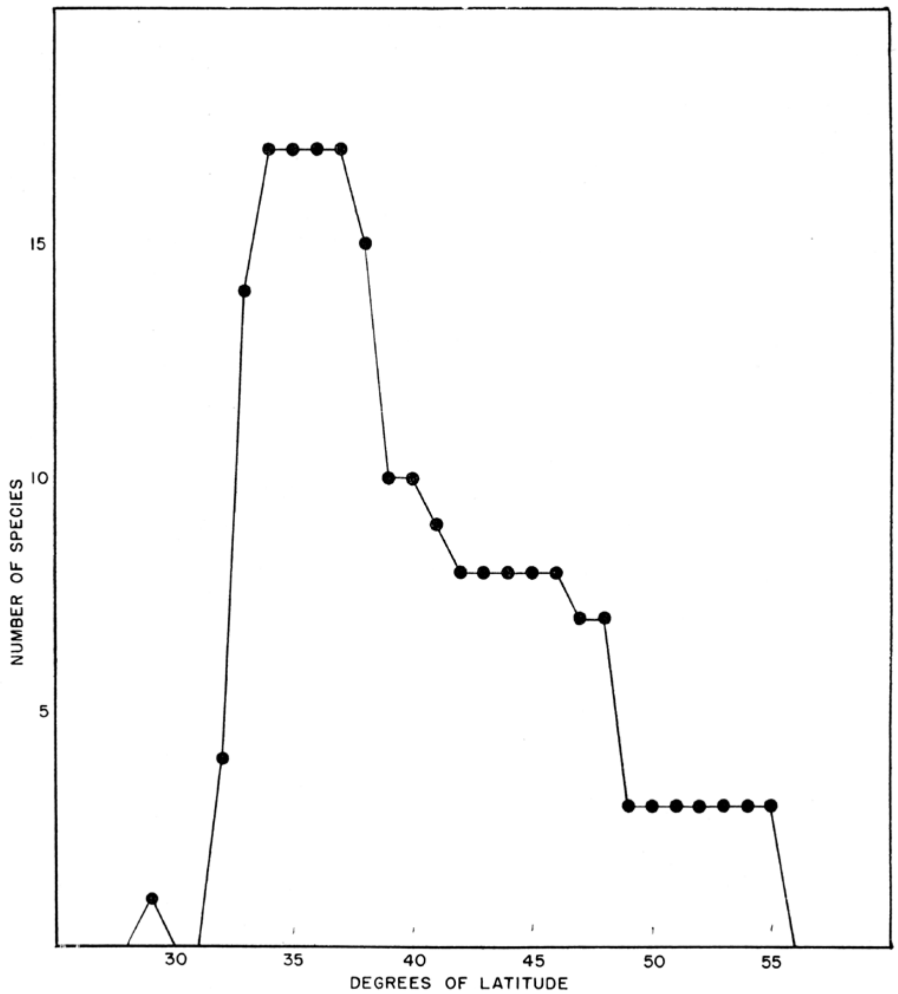

FIGURE 1. Latitudinal distribution of species

FIGURE 1. Latitudinal distribution of species

5. EVOLUTION

5.1. Extrafamily Relationships

Since the family Embiotocidae was first described several authors have attempted to elevate it to subordinal or ordinal rank. There has been general agreement that the closest living relatives of the family were to be sought among the Pomacentridae, Labridae, Gerridae, and Cichlidae.

Jordan and Evermann in 1896, probably to emphasize the group's unusual viviparity, raised the family to subordinal status within the order Acanthopterygii. The subordinal name Holconoti, which they attached to it, was the tentative family name which Agassiz had assigned in his first description of the family in 1853. According to Jordan and Sindo (1902, p. 353), "The structures connected with the viviparous habit, the united pharyngeals, the increased number of vertebrae, the double nostrils, the perfect gills, and the presence of many rays in the soft dorsal and anal, together with the unarmed bones of the head, constitute the chief characters of the Holconoti."

With the exception of the viviparous condition and the increased vertebral number, these are hardly the characters of a suborder, let alone an order, yet Jordan in 1923 (with no explanation, but apparently on the basis of the above characteristics) gave the family full ordinal stature. Most American ichthyologists have accepted Jordan's classification unquestioningly and have, in their systematic arrangements, usually placed the Holconoti between the Scleroparei and the Chromides. However, there is little morphological evidence which points to any relationship between the Embiotocidae and the Scleroparei, and not much more to indicate kinship to the Chromides. The latter problem is discussed below in the comparison of the embiotocids with the pomacentrids, the only marine family of the Chromides.

It is interesting to note that Regan (1913) ignored Jordan and Evermann completely and allocated the Embiotocidae to the series Embiotociformes, close to the Pomacentriformes and Labriformes, in the suborder Percoidea of the order Percomorphi. Berg (1940, p. 476 in 1947 English translation), as pointed out previously, has more or less followed Regan by placing the family in the superfamily Embiotocoidae (comparable to the series Embiotociformes) under the suborder Percoidei; however, he places the family between the superfamilies Cepoloidae and Pomacentroidae.

The rank of superfamily, which Berg has accorded the group, is probably the most logical solution. A balance between the specialization suggested by the viviparity on the one hand and the similarity to other percoid families indicated by osteological characters on the other, is best achieved by placing the group in a category of intermediate magnitude. The question which Berg's classification poses, however, is whether or not we can consider the Embiotocidae closely related to the Cepolidae and the Pomacentridae. The Cepolidae are not, I feel, very closely allied to the Embiotocidae and have been placed there simply because of the usual difficulties of organizing complex evolutionary patterns into a linear system. It is not the purpose of the present paper to attempt to interpret the evolutionary relationships of the Cepolidae.

In examining the Embiotocidae one becomes conscious of characters which may be classified into two groups; those which seem specialized and those which appear primitive. The single, most startling specialization of the group is, of course, their viviparity. Although this can be considered primitive as far as the family is concerned (all of the members possessing it), it is not a character through which we may gain an insight into the extra-familial relationships of the group since it probably originated within the family soon after its origin. In order to accomplish this, we must turn to the more general, primitive characters which the group has retained in common with other families.

Among primitive characters which are common to all species of the family and which occur, at least in an incipient form in other families of percoids, may be listed the fairly deep, laterally compressed body, the double nostrils, the gill membranes which are free from the isthmus, the four complete gills plus a pseudobranch, the five or six branchiostegal rays, a subocular shelf on the circumorbital ring, three anal spines, one spine and five soft rays in the ventral fin, a scaly sheath along the base of the dorsal fin, and a dorsal posterior prolongation of the abdominal cavity. The last two of these characters may require some further explanation.

The dorsal scale sheath hints at the possibility of an ancestral type which had scales on the fin, for, in all probability, the scale sheath was derived from scales which originally grew on the fin itself. The retention of scales along the base of the anal fin in some of the more primitive present-day forms seems to substantiate this idea.

The prolongation of the abdominal cavity extends into the tail region on either side of the haemal spines. It contains the posterior part of the air bladder and consequently the haemal spines extend through the middle of this structure.

On the basis of these characters it would be possible to postulate a description of a primitive embiotocid. This description should also include reference to strongly developed pharyngeal teeth, a high vertebral count, and viviparity. However, these characters are purposely omitted from the discussion so that comparison with other families on primitive, rather than specialized characters, may be facilitated.

Hill (1940, p. 54), on the basis of osteological work, placed the Embiotocidae close to the Pomacentridae. She admitted, however, that there are a number of features which the families do not hold in common. If the two families are compared on the basis of the characters outlined above, we find that in both there is a general tendency towards a fairly deep laterally compressed form, the gill membranes are free from the isthmus, a subocular shelf is present on the circumorbital ring and the ventral fins possess one spine and five soft rays. Although these characters are common to both groups the two families are trenchantly demarcated, one from the other, on characters equally as important as those above. There is, for example, merely a single nostril on each side in the pomacentrids, as compared with the two we find in the embiotocids. In addition, the gills are reduced in the Pomacentridae so that instead of four holobranchs plus a pseudobranch there are but three and a half gills, although a pseudobranch is present. There are but two anal spines instead of three and, furthermore, although scales are present on the fins there is apparently no tendency towards the formation of a dorsal scale sheath. The slight difference which exists between the number of branchiostegal rays in the two groups is discounted and unfortunately the condition of the abdominal cavity is unknown. It can thus be seen that, although many characters are held in common, there is a considerable deviation on many important points. This denies, rather than supports the tenents of those ichthyologists who would place the embiotocids very close to the pomacentrids.

Turning to the Girellidae, a family which has never been suggested as a possible relative of the surfperches, we find that these fishes agree in general with the embiotocids in all respects, except for those specializations which have developed in the latter family after its origin. It is true that there are certain slight differences which, however, demonstrate tendencies toward similarities in the two groups. The branchiostegal ray count is slightly higher in the girellids ranging from five to seven instead of being five or six. The scales found along the base of the dorsal fin, although not organized into a definite dorsal scale sheath in the girellids, show a marked tendency towards the formation of one. Furthermore, the posterior prolongation of the abdominal cavity, while not as pronounced as in the embiotocids, is present in an incipient form as a small but clearly evident diverticulum.

On the basis of the above, I wish to postulate the Girellidae as the closest living relatives of the Embiotocidae and to suggest that they are a family which, probably, had a rather recent common ancestry with them.

5.2. Interfamily Relationships

The primitive embiotocid apparently gave rise to two well-differentiated subfamilies, the Embiotocinae and the Amphistichinae. The subfamilies are sharply defined by the following characteristics:

Amphistichinae

Prefrontals with a tendency towards joining medially to form a bony anterior wall to the orbit; cleithrum with a specialized expanded process on the middle of its medio-posterior margin; male with a serrated plate in the anal fin, and an unspecialized anal gland.

Embiotocinae

Prefrontals with no tendency to join medially; cleithrum without a specialized process; male without serrated plate in anal fin, but with a specialized flask-shaped anal gland.

The subfamily Amphistichinae soon split into two genera. The older genus Amphistichus retained the primitive scaling on the base of the anal fin whereas, this feature was lost by the more highly specialized Hyperprosopon. The division of the genus Amphistichus from Hyperprosopon is further accentuated by the fact that the tendency for reduction of the dorsal sheath, which is found throughout the subfamily, is carried to its extreme in Hyperprosopon where it becomes markedly shortened. Furthermore, there is an elongation of the lower jaw in the latter genus, so that a hypognathous condition arises with the mouth becoming superior and oblique in comparison to the terminal, fairly straight one found in Amphistichus. In Hyperprosopon, the lower lip has lost the primitive frenum and it is retained in only one species of Amphistichus, although a tendency for this character is found in another member of the genus. The feature of a short caudal peduncle, also found in primitive members of the Embiotocinae, is retained by the entire subfamily.

A genetic change apparently occurred within the genus Hyperprosopon affecting the body depth, thereby giving rise to the narrower-bodied subgenus Hypocritichthys, with its single species, derived from the deeper-bodied main stock of the subgenus Hyperprosopon. The subgenus Hypocritichthys, along with its loss of body depth, suffered a reduction in the size of eye, as well as a decrease in the number of dorsal and anal rays. As can be seen, all of the changes which occurred to give rise to the single species H. anale, were reductive in nature. The subgenus Hyperprosopon is composed of two, very closely allied, species, H. argenteum and H. ellipticum. The latter was probably derived from H. argenteum by minor genetic changes resulting in small proportional differences and a loss of the ability to synthesize pigment on the pelvic fins.

The more primitive line forming the genus Amphistichus apparently gave rise to two rather closely related stocks. One led to A. argenteus, the other to a branch of the family tree which gave rise to two, extremely close species, A. koelzi and A. rhodoterus. A. argenteus retained the primitive frenum of the lower lip. This character was almost completely lost by the branch leading towards A. koelzi and A. rhodoterus, although a tendency towards the formation of a frenum apparently is still retained by A. koelzi. The genetic control of this feature is apparently unstable, as evidenced by the variability of the character amongst the Embiotocinae. A. argenteus underwent a modification which changed its body shape from the primitive type that was deep and equally curved dorso-ventrally (as retained by A. koelzi and A. rhodoterus) to one in which the ventral surface was noticeably flattened and, therefore, not quite as deep. The species A. koelzi and A. rhodoterus probably separated from each other rather recently on the basis of minor genetic changes of the type affecting body proportions and color pattern.

The most primitive member of both the subfamily Embiotocinae and of the family, as David (1943) has correctly assumed, is probably Embiotoca jacksoni. From the main branch leading to the genus Embiotoca, there arose, very early in the family's history, a rather specialized sub-branch of the Embiotocinae. The male members of this branch are all differentiated by the presence of a lunar-shaped depression in the body wall, dorsal to the anterior anal rays, or at least show a definite tendency in this direction. The scaling of the anal fin, apparent in the primitive Embiotoca jacksoni, has been lost. This line was rather fertile, giving rise to five genera.

One of the first offshoots to diverge from this specialized branch arose rather early and migrated to Japanese waters during a warm interglacial period. The divergence must have taken place before the mutation for the reduction in number and increase in size of scales (which characterize the remaining members of this line) occurred, since both of the present-day Japanese species have numerous small scales. From the stock which reached Japanese waters there arose two species, Ditrema temmincki, retaining many of the primitive characters of the stem stock and Neoditrema ransonneti, which acquired certain specialized features. Probably the most important single specialization which occurred was a change in body size and, concommitantly, a change in body proportions. In this line there also occurred a loss of the primitive frenum, a decrease in the number of dorsal spines, and a loss of teeth in the female of the species. D. temmincki, was rather conservative and beyond an elevation of the anal fin in the male, probably retained its original genic complement with little change. Some authors have pointed out the resemblance between Embiotoca and Ditrema. This similarity is probably not an indication of particularly close relationship, but of conservatism on the part of both species. Their parallel history is indicated on the chart of relationships where Embiotoca is shown as the most primitive genus of the Embiotocinae and Ditrema as the most conservative member of an early offshoot from that line.

After the branch leading to Ditrema and Neoditrema broke off from the main ancestral stock, a line arose on the eastern side of the Pacific, composed of individuals which possessed large scales and were moderate in size. Three fairly close lines diverged from this branch giving rise to the genera Cymatogaster, Hysterocarpus, and Micrometrus, which probably originated close to one another in geological time. The stock from which these three genera were derived must have possessed a great deal of physiological plasticity. This is shown by the present-day freshwater habitat of Hysterocarpus traski and the large geographical range and comparative euryhalinity of Cymatogaster aggregata.

The first divergence from this branch led to the genus Cymatogaster. This line lost the frenum, which was typical of the ancestral stock leading to Hysterocarpus and Micrometrus. It retained the primitive fairly long dorsal fin and short caudal peduncle which characterized the stem line of the entire family. A rather interesting sexual dimorphism arose in Cymatogaster affecting color, and serving to further differentiate this genus from the main stock. The genus is composed of two, closely allied species, C. aggregata and C. gracilis. It appears that C. gracilis was derived from the ancestral stock of C. aggregata, a far ranging species which today is found from southern Alaska to Baja California. C. gracilis, an insular form, arose by geographical isolation, being cut off from the mainland stock at the time that the Channel Islands were isolated from California. This isolation produced a form which was narrower in body than its mainland relative. There were, because of this, accompanying minor changes in the body proportions between the two.

The second divergence from the main branch led to the monotypic genus Hysterocarpus. As mentioned above, this branch retained the frenum. The ancestors of H. traski must have possessed an enormous physiological tolerance. Mutations arose, which, fostered by selection, enable them to withstand the tremendous shock of migration into fresh water. In addition to the change in the osmoregulatory system, there occurred in H. traski a marked increase in the number of dorsal spines, correlated with a reduction in the number of soft dorsal rays. The dorsal fin remained moderately long and the caudal peduncle fairly short, Hysterocarpus, like Cymatogaster, remaining primitive in these respects.

The third offshoot, leading to the genus Micrometrus, produced a specialized form in which the dorsal and anal fins were shortened, so that a rather long caudal peduncle was formed. The genus bifurcated rather early into two lines forming the subgenera Micrometrus and

Brachyistius. The tendency for sexual dimorphism, present in Cymatogaster, is also manifested in the subgenus Micrometrus, the males possessing more rays in the anal fin than the females. The subgenus Brachyistius is further differentiated from Micrometrus by a change in the mouth from a terminal to a superior position. A large, pigmented triangle is present on the body wall, in the region of the axilla, in the subgenus Micrometrus; Brachyistius, however, displays only a tendency towards this character. The lunar-shaped depression, found in all of the male members of this side branch, reaches its ultimate expression in the subgenus Micrometrus, where it becomes very large, while the subgenus Brachyistius, again merely retains the primitive tendency for the development of the depression.

The subgenus Brachyistius contains two closely related species, Micrometrus frenatus and M. aletes. Here again the type of speciation which was found in the genus Cymatogaster has been at work. When Guadalupe Island was isolated from the mainland in fairly recent geological times, individuals from the mainland ancestral stock were isolated with it. Through the joint action of geographical isolation and selection M. aletes arose, differing from the mainland form in having slightly larger eyes and a greater tendency toward pigmentation of the body in the region of the axilla than is possessed by M. frenatus. Minor changes in proportions likewise accompanied this isolation.

The subgenus Micrometrus is composed of two, fairly closely related species, M. aurora and M. minimus. M. aurora appears to retain more of the primitive features of this subgeneric line than does M. minimus. The relatively narrow body is probably a feature which was possessed by the ancestral stock of this entire main line leading from the ancestors of Ditrema and Neoditrema. This is evidenced by the relatively slender body retained by Cymatogaster and Hysterocarpus. M. aurora is narrow-bodied, whereas M. minimus diverged in this respect and became rather deep-bodied, at the same time suffering a reduction in the number of its dorsal rays.

Returning to the main branch of the Embiotocinae, we find four genera not affected by the mutation which produced the lunar-shaped depression near the anal origin.

Apparently, quite soon after the line leading to the genus Micrometrus diverged from the more conservative embiotocine stock, there arose the monotypic genus Hypsurus. This genus stands fairly well isolated from the other members of the Embiotocinae. It is differentiated primarily by a great elongation of the abdominal region, with a correlated shortening of the base of the anal fin. This modification has changed the body shape from elliptical (found in all other members of the family) to one which is actually oblong. The single species, Hypsurus caryi, retains the primitive frenum, but diverges from the ancestral stock leading to Embiotoca and Rhacochilus by having lost the squamation along the base of the anal fin, and having the high soft dorsal fin reduced.

Another branch arose from the main stem leading to Embiotoca at a slightly later date. This branch gave rise to the genera Rhacochilus and Phanerodon. Rhacochilus retained the high soft dorsal fin, which was reduced in the genus Phanerodon. In all probability the streamlined Phanerodon was derived from the bulkier ancestral stock of Rhacochilus.

The frenum is retained by the genus Phanerodon and the most primitive member of the genus Rhacochilus, R. vacca; it is lost, however, by R. toxotes. Besides retaining the primitive high soft dorsal, Rhacochilus developed a particular form of color pattern consisting of a single dusky bar which appears at some period during development. Rhacochilus toxotes, in addition to losing the frenum, has developed large, thick, incised lips. It is seen that the presence or absence of the frenum is a variable character, appearing here as a specific, and in other instances as a generic difference. It may be argued that the great development of the pharyngeal teeth, found in R. vacca, warrants the placement of this species in a separate genus. I feel that this type of thinking tends to over-emphasize the differences between species instead of stressing their likeness. The entire branch has lost the primitive scales along the base of the anal fin and demonstrates a tendency towards a greater development of peduncular length than is found in the more primitive line leading to Embiotoca.

There are two, very closely allied, species within the genus Phanerodon, P. furcatus and P. atripes, differentiated on rather small genetic differences. The former species is probably more like the original stock than is P. atripes which has developed a more sharply conic snout than P. furcatus. In addition it has evolved an ability to synthesize black pigment on the pelvics. Minor differences in proportions and color, accompanying the other changes, also separate the two species.

The main line of the Embiotocinae apparently led more or less directly to the genus Embiotoca, containing two closely related species, E. jacksoni and E. lateralis. The genus retained the primitive features of a frenum and a high soft dorsal fin, plus a short caudal peduncle. E. jacksoni, the most primitive member of the entire family, retained, in addition, the ancestral trait of scales along the base of the anal fin. E. lateralis lost the scales at the base of the anal fin and underwent a change in its color pattern from a vertical barring, found in E. jacksoni, to a horizontal striping. The number of dorsal and anal rays differ between the two species, the greater number being found in E. lateralis.

The monotypic genus Zalembius has been purposely left to last. At this stage it is impossible to place Zalembius, with its single species Z. rosaceus, on the diagram with anything approaching accuracy. Its general characteristics such as the large scales, the tendency towards a lengthened caudal peduncle, and the shortened dorsal base, hint at its possible position somewhere on the line leading to Micrometrus. However, the complete absence of any tendency towards the formation of a lunar-shaped depression in the body wall, dorsal to the anterior anal rays, seems to preclude its placement on that line. The other features, mentioned above, appear to exclude it from any other evolutionary line of the subfamily Embiotocinae, whose characters it possesses. Zalembius, for the time is incertae sedis and is tentatively placed on the Micrometrus line with the full realization that further investigation may show its closer affinity to other species.

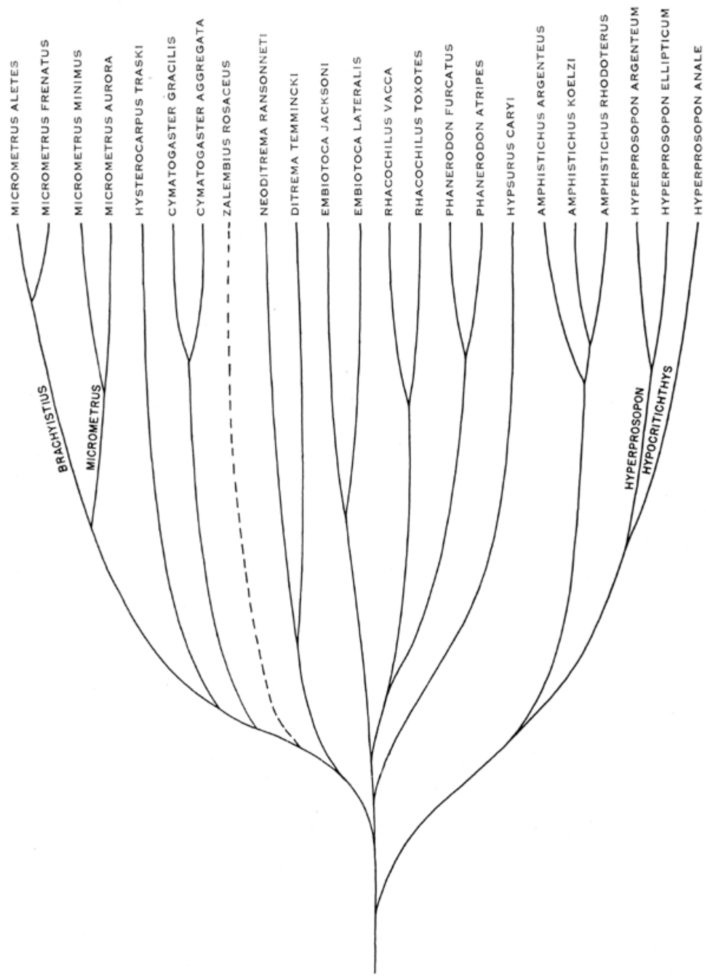

FIGURE 2. Suggested evolution of Embiotocidae

FIGURE 2. Suggested evolution of Embiotocidae

6. METHODS

The specific descriptions which follow have been based on 50 specimens, when such material was available, so that a particular description depicts the population rather than an individual specimen. An attempt has been made to include some specimens from the entire geographical range of the species, although in certain instances this aim has not been achieved. The descriptions follow a rigid pattern, with paragraphs organized alike so that a comparison of species is facilitated. An attempt has been made to keep the terminology uniform throughout.

The measurements and counts have all been taken in a uniform manner. All of the measurements were made in a straight line with needlepoint dividers, and were recorded to tenths of millimeters. The per milleage of standard length and other proportions were calculated mathematically with a slide rule. The mean is given for all measurements, and the extremes are enclosed within parentheses which follow. Counts are treated in a similar manner but the mode, instead of the mean, is given.

The upper lip is always the most anterior point of the head (except for the tip of the lower jaw in a few hypognathous species) and it was always used in the measurements of length of the body, head, snout, and in locating the position of all fin origins. It will be called tip of snout hereafter. The standard length was measured from the tip of the snout to the end of the hypural. The latter point is readily located with sufficient accuracy by bending the caudal fin from side to side and noticing where the wrinkling occurs at its base. The length of the head was measured from the tip of snout to the most distant point of the opercular membrane; the length of snout as the shortest distant between the same point and the anterior edge of the orbit. The maxillary was measured from the tip of the snout to the most distant point on its margin, and the length of eye was measured along its greatest horizontal axis. The interorbital width was taken at its narrowest point.

In an attempt to define the general shape and proportions of the body more accurately than is possible by means of the two usual measurements of greatest depth and depth of caudal peduncle, five different measurements of depth were taken, four of them on lines, which, although somewhat oblique, were taken between definite points fixed by skeletal structures (fin origins or endings) instead of along a variable perpendicular. The measurements were: depth of body measured between first dorsal and pelvic origins; first dorsal spine to first anal spine; first anal spine to last dorsal ray; caudal depth, measured between the ends of the dorsal and anal fins; and the caudal peduncle, measured in the usual way at its narrowest point. Any of these measurements, as well as others, involving the origin of a fin were taken from the anterior edge of the base of the first spine or ray and, any involving the end of a fin, from the posterior edge of the base of the last ray. Thus, the length of the soft dorsal was measured from the base of the first to the base of the last ray, both rays being included (the dorsal sheath may cover the base of the first ray but its position may be determined if the specimen is held up to the light). As a further example, the distance from the last anal ray to the hypural (known as peduncular length) was measured from the posterior edge of the base of the last anal ray to the lateral line in the wrinkle at the base of the caudal. The length of the dorsal sheath was measured from the dorsal origin to the posterior edge of the last scale of the sheath.

Measurements of the length of spines and rays in the median fins were taken from the base to the tip of the longest elements, except in the case of the spinous dorsal where, due to the opacity of the anterior part of the scale sheath, the basal reference point was taken as the anterior edge of the spine on the level of the upper margin of the sheath. The pectoral and pelvic rays were measured from the base of the first spine to the tip of the longest ray in each case.

The last ray of the dorsal or anal fin was counted as 1½ if it was split to the base; if it was close to, but not visibly joined on the surface to the penultimate ray, it was counted as distinct. The vestigial spine on the pectoral fin was included in the ray count. The principal caudal rays were counted. The lateral-line count was made from the first scale to the end of the hypural, with those additional scales posterior to the hypural appended to the main count by a plus sign. The scales from the first dorsal spine to the lateral line were counted posteriorly along a diagonal line from the anterior base of the spine to the lateral line. The scales on the ventral portion of the body, due to the variability of the region near the first anal spine, were counted in a similar manner from the anterior lateral edge of the anus to the lateral line. A special scale count was taken from below the dorsal sheath, at the junction of the spinous with the soft dorsal fins, posteriorly to the lateral line. Occasionally a small scale will be found just at the base of the dorsal sheath; if present this is counted as a half.

7. SUPERFAMILY EMBIOTOCICAE*

Holconoti Jordan and Evermann, 1898, p. 1493; Jordan and Sindo, 1902, p. 353; Jordan, 1905b, p. 372; Hubbs, 1921, p. 182; Jordan, 1923; Fowler, 1949, p. 63.

Ditremiformes Regan, 1913, p. 131.

Embiotocoidae Berg, 1940, pp. 312, 476.

Viviparous fishes, the young retained until birth within the body in a sac-like enlargement of the oviduct, analogous to the uterus. Cleavage approaching a holoblastic type. Vertebrae 32 to 42. Air bladder large, simple, extending into a posterior prolongation of the abdominal cavity, surrounding the anterior haemal spines of the caudal vertebrae.

8. FAMILY EMBIOTOCIDAE

Embiotocoidae L. Agassiz, 1853, p. 383 (p. 6 in reprint); Girard, 1854a, pp. 81, 82; 1854b, p. 134; 1854d, p. 151; Troschel, 1854a, pp. 152, 153; 1854b, p. 167; Girard, 1857a, p. 541; A. Agassiz, 1861, p. 125; Gill, 1862, p. 274.

Holconoti L. Agassiz, 1853, p. 383 (p. 6 in reprint); 1854, in title; Troschel, 1854a, pp. 152, 153; 1855a, p. 30; 1855b, p. 331; 1855c, p. 353 (in original misnumbered as 343); A. Agassiz, 1861, pp. 125, 133.

Labroidae Gibbons, 1854e, p. 122; Troschel, 1855b, p. 332.

Ambiotocidae Richardson, 1856, p. 268.

Menidae Bleeker, 1858.

Holconotoidei Bleeker, 1859.

Scombridae Günther, 1860, p. 392.

Embiotocidae Günther, 1862, pp. 244, 246; Cope, 1872, p. 343; Jordan and Gilbert, 1882b, p. 585; 1882a, p. 49; Jordan, 1885, p. 884 (p. 96 in reprint); Eigenmann, 1893, pp. 124, 155; 1894b, pp. 401–403, 405; 1894a, pp. 381, 382; Eigenmann and Ulrey, 1894, p. 382; Starks, 1896, p. 551; Jordan and Evermann, 1898, p. 1493;

* In accordance with Stenzel (1950, p. 94) and the Report of the Committee on Fish Classification (1950, p. 326).

Jordan and Sindo, 1902, pp. 353, 357; Boulenger, 1904, pp. 654, 670; Bridge, 1904, pp. 418, 419; Jordan, 1905a, pp. 125, 127; 1905b, p. 373; Hubbs, 1918, p. 9; 1921, pp. 182, 198; Jordan and Evermann, 1922, p. 469; Wales, 1928, p. 59; Bonnot, 1929, p. 229; Walford, 1931, pp. 23, 100; Barnhart, 1936, p. 72; Blanco, 1938, pp. 379, 380, 382; Berg, 1940, pp. 312, 476; Herz, 1941, p. 75; Clemens and Wilby, 1946, pp. 27, 147; Roedel, 1948, pp. 22, 76; Fowler, 1949, p. 63.

Ditremata Fitzinger, 1873, p. 30.

Ditremidae Eigenmann, 1890a, p. 926; Regan, 1913, p. 131.

Holconotidae Eigenmann, 1890b, p. 64.

Body ovate or oblong, laterally compressed, covered with cycloid scales; cheeks, operculum, and interoperculum scaly; lateral line not extending onto caudal. No teeth on vomer or palatines; lower pharyngeals united without a suture, the pharyngeal teeth conical or paved. Upper jaw protractile; opercular bones entire; branchiostegals 5 or 6; gill membranes free from isthmus or very slightly connected to each other; gills 4, a slit behind the fourth, pseudobranch present. Nostrils double on each side. Dorsal fin single, with a dorsal sheath of scales along its base; this sheath varying in length and separated by a furrow from the scales of the body. Three anal spines (a few geographically isolated specimens with four spines). Ventral fin I, 5. A subocular shelf present on the circumorbital ring. No pyloric caeca.

KEY TO THE FISHES OF THE FAMILY EMBIOTOCIDAE

The clear-cut characters which differentiate species in many families of fishes are not markedly evident in the Embiotocidae. This is apparent when one reads the descriptions of the species of the family which follow. Because of this difficulty many of the key characters have been based on structures influenced by varying relative growth rates. To overcome the overlap of extremes which thereby occurs, graphs have been introduced into the dichotomous key in an attempt to separate these fishes. The variability of the forms is further acknowledged by listing the same species under both branches of certain dichotomies so that wherever a question may arise in the mind of the investigator as to the proper path to take, he may achieve the correct identification by following either one.

1. Dorsal spines XV or more; base of soft dorsal fin 2.6 to 4.2 in base of entire dorsal fin; the single fresh-water representative of the family; rivers and lakes of California ---------- *Hysterocarpus traski*
   Dorsal spines XII or less; base of soft dorsal fin 1.2 to 2.1 in base of entire dorsal fin; all marine ---------- 2

2. The sum of the dorsal and anal rays equalling 44 or less (Specimens with $44\frac{1}{2}$ rays may be keyed by way of either 3 or 13) ---------- 3
   The sum of the dorsal and anal rays equalling 45 or more ---------- 13

3. Lower lip definitely without a frenum (Fig. 3) ---------- 4

FIGURE 3

FIGURE 4

   Lower lip with a frenum (Fig. 4) ---------- 7

4. Length of maxillary 2.4 to 2.8 in head; scale sheath shorter than the base of soft dorsal fin; 23 to 27 pectoral rays; an inky blotch on the spinous dorsal (Fig. 5); San Francisco to Pt. Conception ---------- *Hyperprosopon anale*

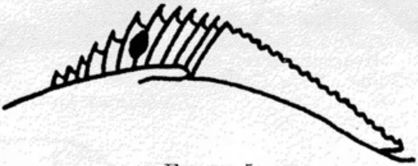

FIGURE 5

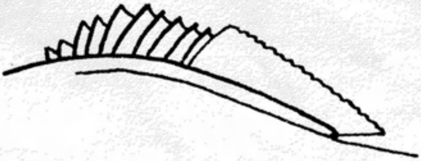

FIGURE 6

Length of maxillary 3.0 to 4.3 in head; scale sheath longer than the base of soft dorsal fin; 19 to 21 pectoral rays; without a distinctive blotch on the spinous dorsal (Fig. 6) 5

5. Lateral line with 45 or fewer scales; length of dorsal base 1.8 to 2.2 in standard length; distance from last dorsal ray to hypural 4.7 to 6.8 in standard length 6

Lateral line with 65, or more, scales; length of dorsal base 2.2 to 2.4 in standard length; distance from last dorsal ray to hypural 3.7 to 4.4 in standard length; Japan and surrounding seas .... *Neoditrema ransonneti*

6. Least depth of caudal peduncle 7.90 (7.2-8.6) in standard length; distance from upper end of pectoral base to first dorsal spine 3.74 (3.3-3.9) in standard length (Fig. 7); Port Wrangell, Alaska, to Todos Santos Bay, Baja California *Cymatogaster aggregata*

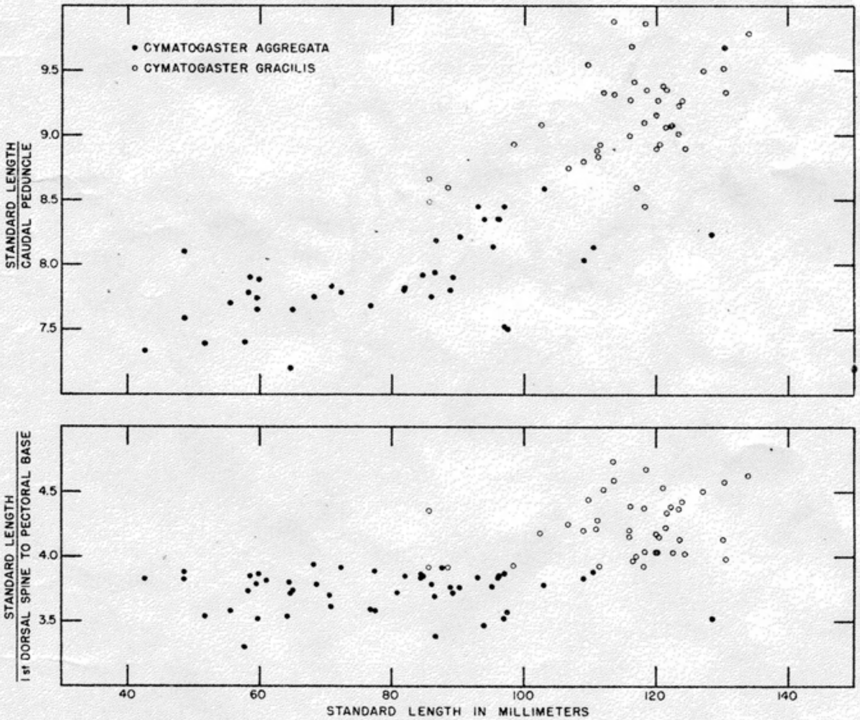

FIGURE 7

Least depth of caudal peduncle 9.15 (8.4-9.9) in standard length; distance from upper end of pectoral base to first dorsal spine 4.24 (3.9-4.7) in standard length (Fig. 7); Santa Rosa, Santa Cruz, and Santa Catalina Islands *Cymatogaster gracilis* sp. nov.

7. Anal fin with a definite row of small scales extending along its base to the last ray, the posterior elements prominent (Fig. 8); a series of enlarged scales between the pectoral and pelvic fins; color olivaceous green or reddish brown; Bodega Lagoon, California, to Abreojos Point, Baja California *Embiotoca jacksoni*

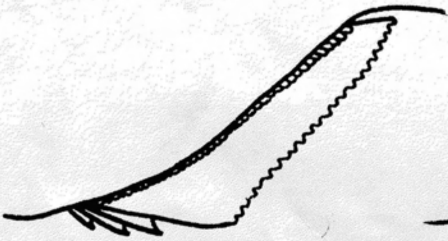

FIGURE 8

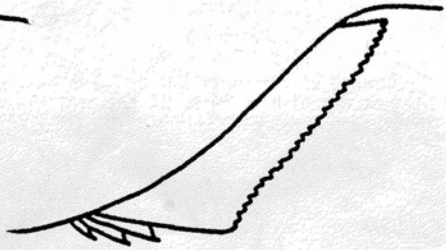

FIGURE 9

Anal fin without a definite row of small scales along the posterior half of its base (Fig. 9); no series of enlarged scales between pectoral and pelvic fins-- 8

8. Lateral line with 60 to 71 scales; abdomen extremely elongated and straight (except in very young); 8 or 9 scales from the first dorsal spine to lateral line; Cape Mendocino, California, to Todos Santos Island, Baja California *Hypsurus caryi*

Lateral line with 56, or fewer, scales; abdomen normal, not elongated; 5 to 7 scales from the first dorsal spine to lateral line---------------------------- 9

9. Color silvery white overlain with rose; two large, distinctive chocolate spots on the body, the one ventral to the junction of the spinous with the soft dorsal, the other at the end of the dorsal fin; normally taken from fairly deep water; Drakes Bay, California, to San Diego, California (Fig. 10) *Zalembius rosaceus*

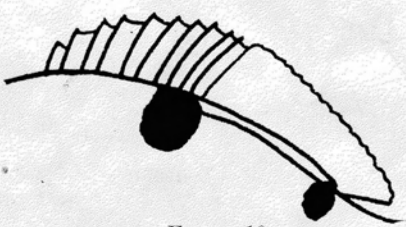

FIGURE 10

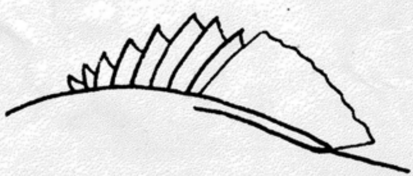

FIGURE 11

Color rarely silvery white; no large chocolate spots on the body near base of dorsal fin (Fig. 11)-- 10

10. Mouth terminal; jaws equal; body with a large, conspicuous black triangle in the axilla; males with a large, deep, lunar-shaped depression at the base of anal fin-- 11

Mouth superior, oblique; upper jaw slightly shorter than lower; the heavy pigmentation of the axilla, which is so conspicuous in *M. minimus* and *M. aurora*, is represented, at most, by a small, semicircle of black; males occasionally with a very small, inconspicuous depression at base of anal fin------- 12

11. Body depth, from first dorsal spine to pelvic, 2.20 (2.0-2.4) in standard length; distance from upper end of pectoral base to first dorsal spine 1.28 (1.1-1.4) in base of dorsal fin; dorsal fin IX (VIII-XI), 14 (12-16); Bodega Lagoon, California, to just south of Rio San Isidro, Baja California *Micrometrus minimus*

Body depth, from first dorsal spine to pelvic, 2.67 (2.4-2.8) in standard length; distance from upper end of pectoral base to first dorsal spine 1.63 (1.4-1.8) in base of dorsal fin; dorsal fin VIII (VII-IX), 17 (16-19); Tomales Bay, California, to just south of Rio San Isidro, Baja California *Micrometrus aurora*

12. Axilla with a small amount of peppery black pigmentation, or lacking this entirely; eye fairly small (Fig. 12); Vancouver Island, British Columbia, to Turtle Bay, Baja California *Micrometrus frenatus*

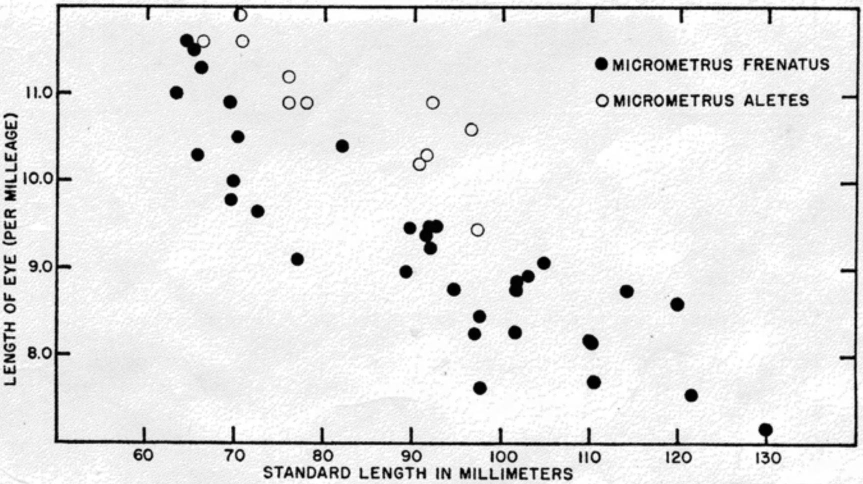

FIGURE 12

Axilla with a semicircle of black pigmentation; eye rather large (Fig. 12); Guadalupe Island, Baja California *Micrometrus aletes* sp. nov.

13. Anal fin with a definite row of small scales extending along its base to the last ray (see Fig. 8) 14
Anal fin without a row of small scales along the posterior half of its base (see Fig. 9) 18

14. Color olivaceous or reddish brown; maxillary short, 3.0 to 4.5 in head; snout bluntly conic, its profile on a straight line with the dorsal contour of the head; dorsal rays 20 (19-22); pectoral rays 22 (20-22); dorsal sheath 1.0 to 1.1 in dorsal base; a row of enlarged scales between pectoral and pelvic fin; Bodega Lagoon, California, to Abreojos Point, Baja California *Embiotoca jacksoni*

Color silvery, overlain with rosy or brassy tones, usually with a brassy pattern; maxillary fairly large, 2.2 to 3.0 in head; snout abrupt, giving an aquiline profile to anterior contour of head; dorsal rays 24 to 28; pectoral rays 25 to 29; dorsal sheath 1.3 to 1.9 in dorsal base; scales of body wall normal 15

15. Posterior groove of lower lip interrupted by a broad frenum (see Fig. 4) 16

Posterior groove of lower lip not interrupted by a broad frenum (see Fig. 3) 17

16. Lower jaw somewhat included; snout fairly large, 1.27 (1.15-1.42) in depth of caudal peduncle; caudal peduncle fairly narrow (Fig. 13); body walls usually with a series of brassy-olive vertical bars alternating with a vertical series of spots of the same color (aberrant individuals have been reported lacking the bars, or both bars and stripes); Bodega Bay, California, to just south of Arroyo Descanso, Baja California *Amphistichus argenteus*

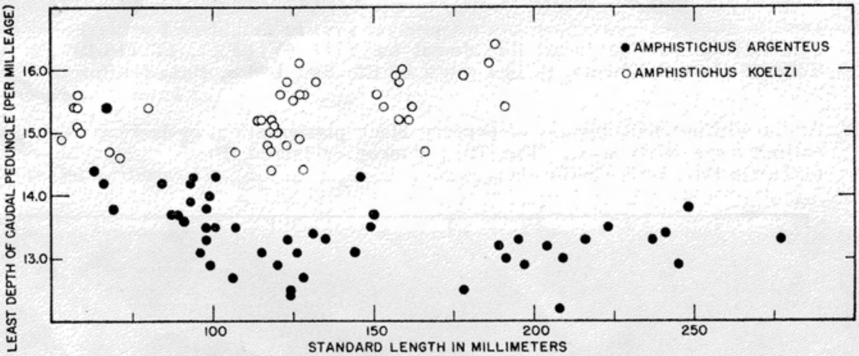

FIGURE 13

Lower jaw slightly projecting; snout smaller, 1.75 (1.49-1.92) in depth of caudal peduncle; caudal peduncle rather deep (Fig. 13); body walls with a series of bronze speckles which may roughly approximate narrow vertical bars; Trinidad, California, to Santa Tomas, Baja California---*Amphistichus koelzi*

17. Length of maxillary 1.39 (1.1-1.6) in depth of caudal peduncle, 1.34 (1.1-1.6) in distance from last dorsal ray to hypural, and 5.14 (4.1-6.0) in base of dorsal (Fig. 14); 18 (17-20) scales from anterior end of anus to lateral line; Trinidad, California, to Santa Tomas, Baja California------*Amphistichus koelzi*

Length of maxillary 1.17 (1.1-1.2) in depth of caudal peduncle, 1.20 (1.0-1.3) in distance from last dorsal ray to hypural, and 4.66 (4.3-4.9) in base of dorsal (Fig. 14); 22 (20-22) scales from anterior end of anus to lateral line; Cape Flattery, Washington to Monterey, California----*Amphistichus rhodoterus*

18. Lower lip without a frenum, its posterior groove continuous across chin (see Fig. 3)------ 19

Lower lip with a frenum (Fig. 4)------ 25

19. Lower lip thick, lobed or incised behind; Bodega Harbor, Sonoma County, to San Diego------*Rhacochilus toxotes*

Lower lip thin or moderate, entire behind------ 20

20. Lateral line with fewer than 46 scales------ 21

Lateral line with more than 55 scales------ 22

21. Least depth of caudal peduncle 7.90 (7.2-8.6) in standard length; distance from upper end of pectoral base to first dorsal spine 3.74 (3.3-3.9) in standard length (Fig. 7); Port Wrangell, Alaska, to Todos Santos Bay, Baja California *Cymatogaster aggregata*

Least depth of caudal peduncle 9.15 (8.4-9.9) in standard length; distance from upper end of pectoral base to first dorsal spine 4.24 (3.9-4.7) in standard length (Fig. 7); Santa Rosa, Santa Cruz, and Santa Catalina Islands *Cymatogaster gracilis* sp. nov.

22. Dorsal rays 19 to 22; length of dorsal base 2.2 to 2.4 in standard length; peduncular length (last anal ray to hypural) 1.3 to 1.7 in head; length of scale sheath 2.3 to 2.8 in standard length; Japan and surrounding seas *Neoditrema ransonneti*

Dorsal rays 22 to 28; length of dorsal base 1.8 to 2.2 in standard length; peduncular length (last anal ray to hypural) 1.9 to 2.6 in head; length of scale sheath 3.0 to 5.6 in standard length------ 23

23. Distance from first anal spine to last dorsal ray rather short, 2.7 to 3.2 in standard length; interorbital rather narrow, its width 3.4 to 4.1 in head; anal base short, its length 3.6 to 4.5 in standard length; dorsal fin VII-IX, 22-25; anal fin III, 23-26; San Francisco to Pt. Conception--*Hyperprosopon anale*

Distance from first anal spine to last dorsal ray rather long, 2.1 to 2.5 in standard length; interorbital rather broad, its width 2.7 to 3.4 in head; anal base rather long, its length 2.6 to 3.2 in standard length; dorsal fin VIII-X, 25-28; anal fin III, 29-37------ 24

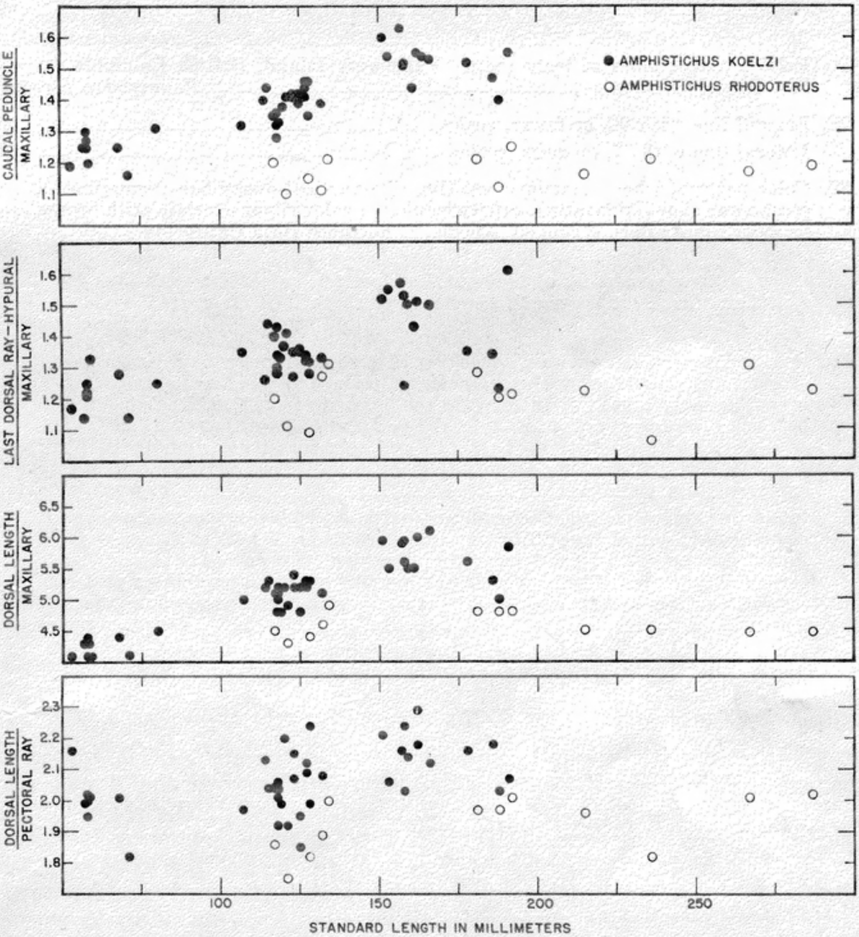

FIGURE 14

24. Pelvic fins with black tips; Vancouver Island, British Columbia, to Baja California -- *Hyperprosopon argenteum*

Pelvic fins plain; Clallam County, Washington, to Southern California *Hyperprosopon ellipticum*

25. Length of anal 4.8 to 6.8 in standard length; distance from first anal ray to last dorsal ray 1.6 to 2.5 in distance from first dorsal ray to first anal ray; abdomen extremely elongated and straight (except in very young); Cape Mendocino, California, to Todos Santos Island, Baja California ------ *Hypsurus caryi*

Length of anal 2.9 to 4.6 in standard length; distance from first anal ray to last dorsal ray less than 1.5 in distance from first dorsal ray to first anal ray; abdomen normal, not elongated -- 26

26. Four or five rows of large scales between lower edge of scale sheath at junction of spinous and soft dorsal fins and lateral line (one small scale may be present above the five larger ones) -- 27

Six or more scales between lower edge of scale sheath at junction of spinous and soft dorsal fins and lateral line -- 28

27. Pelvics tipped with black; sides of body with reddish streaks; Monterey to San Diego, California ---------- *Phanerodon atripes*
Pelvics plain; sides of body plain; Vancouver Island, British Columbia, to San Diego, California ---------- *Phanerodon furcatus*

28. Lateral line with 66, or fewer, scales ---------- 29
Lateral line with 67, or more, scales ---------- 30

29. Color pattern, when obvious, consisting of a vertical dusky bar (sometimes a second one showing faintly), otherwise plain; color silver overlain with brown or sooty tones; Port Wrangell, Alaska, to northern Baja California *Rhacochilus vacca*
Color pattern consisting of horizontal stripes; color reddish with blue horizontal streaks; Port Wrangell, Alaska, to northern Baja California *Embiotoca lateralis*

30. Color pattern, when obvious, consisting of a vertical dusky bar (sometimes a second one showing faintly), otherwise plain; color silver overlain with brown or sooty tones; dorsal rays 21 to 25; anal rays 27 to 30; 8 or 9 scales between first dorsal spine and lateral line; 6 or 7 scales between lower edge of scale sheath at junction of spinous and soft dorsal fins and lateral line; posterior rays of anal fin normal in both sexes; Port Wrangel, Alaska to northern Baja California ---------- *Rhacochilus vacca*
No obvious color pattern; color silvery with steel blue on dorsum or overall coppery red; dorsal rays 19 to 22; anal rays 24 to 28; 10 to 12 scales from first dorsal spine to lateral line; 8 or 9 scales between lower edge of scale sheath at junction of spinous and soft dorsal fins and lateral line; posterior rays of anal fin greatly elongated in male; Japan and surrounding seas and Korea ---------- *Ditrema temmincki*

SUBFAMILY AMPHISTICHINAE HUBBS

Amphistichinae Hubbs, 1918, pp. 9, 12; 1933, p. 1; Barnhart, 1936, p. 75.

Cleithrum with a small, expanded process on its medial, posterior margin. This process located about midway between the dorsal and ventral margins of the bone and directed inwardly. The shape of the process varies interspecifically. Prefrontal bones tending to abut medially and form a bony, anterior wall to the orbit. This character, however, shows marked intraspecific variation. The tendency for apposition is, nevertheless, obvious in all species. Anal fin of male with a serrated triangular plate derived from a modified ray (about the twelfth), and with the following ray somewhat strengthened. As Hubbs has pointed out, the homologous rays of the female are also somewhat modified in this direction. Anal gland of the male appearing as a bulbous area of thickened epithelium. This area extends anterior to the serrated plate and runs lateral to the rays.

Genus *Hyperprosopon* Gibbons

Hyperprosopon Gibbons, 1854a (genotype by monotypy, *Hyperprosopon argenteus* Gibbons).

Ditrema Günther, 1862, p. 245 (ex parte).

Amphistichus Jordan and Gilbert, 1882b, pp. 586, 590, 592, 936 (ex parte).

Holconotus Jordan, 1885, p. 884 (p. 96 in reprint) (ex parte).

Body variable in shape; caudal peduncle short, its length 1.9 to 2.6 in head, somewhat narrow, its least depth 2.0 to 2.9 in head.

Head relatively small, its length 2.8 to 3.7 in standard length; mouth superior, oblique; upper jaw shorter than lower; maxillary rather long, its length 2.4 to 3.1 in head; snout short, 3.2 to 4.4 in head, on a straight line with upper anterior profile of head; posterior nostril usually an ellipse, almost perpendicular to axis of body; eye rounded; frenum absent, posterior groove of lower lip continuous across chin.

Lateral line farthest from the dorsal contour of body at its origin.

Origin of dorsal fin opposite origin of the pelvic; base of dorsal fin moderately long, its length 1.8 to 2.2 in standard length; dorsal sheath reduced, its length 1.5 to 2.7 in base of dorsal; soft dorsal rather long, 1.2 to 1.4 in dorsal base; spinous dorsal abruptly graduated anteriorly, the remaining elements gradually decreasing in length and the profile of fin usually continuous with that of the soft dorsal; longest spine always higher than soft dorsal fin; first dorsal ray usually longest, either branched or simple, with remaining rays branched, in adults. Anal length variable; margin of fin straight in young, sigmoid in adults, its least depth in general region of modified ray; first anal ray branched or simple, the remaining ones branched; anal base, posterior to modified ray, without a row of small scales on fin. Pectoral frayed ventrally; first ray unbranched with remainder branched except for lower third which is composed of simple rays. Origin of pelvic fin opposite first dorsal spine.

῾Υπερ

FIGURE

above, and,

πρόσωπον

FIGURE

face; alluding to the upward production of the face and snout.

10.1.1. Subgenus Hyperprosopon Gibbons

Hyperprosopon Gibbons, 1854a (genotype by monotypy, Hyperprosopon argenteus Gibbons); 1854e, p. 124; A. Agassiz, 1861, pp. 132, 133; Jordan and Gilbert, 1882b, p. 591; Eigenmann and Ulrey, 1894, pp. 383, 386; Jordan and Evermann, 1896, p. 403; 1898, pp. 1494, 1501; Jordan and Sindo, 1902, p. 354; Hubbs, 1918, p. 12; Jordan and Evermann, 1922, p. 471; Jordan, Evermann and Clark, 1930, p. 410.

Cymatogaster Gibbons, 1854e, p. 123 (ex parte); Troschel, 1855b, p. 335.

Ennichthys Girard, 1855, p. 322 (ex parte); Troschel, 1855c, p. 351; Girard, 1858, p. 196.

Hyperprosodon Troschel, 1855b, p. 338 (lapsus calami pro Hyperprosopon Gibbons).

Bramopsis L. Agassiz in A. Agassiz, 1861, p. 132 (listed in synonymy as Bramopsis mento MSS Agassiz).

Tocichthys Hubbs, 1918, p. 12 (type Hyperprosopon agassizii Gill = Hyperprosopon ellipticus (Gibbons) by original designation); Jordan, Evermann and Clark, 1930, p. 410.

Eunichthys Jordan, Evermann and Clark, 1930, p. 410 (listed in synonymy, lapsus calami pro Ennichthys).

Body moderately long (less than 250 mm in standard length), fairly deep, its depth 1.9 to 2.5 in standard length; distance from first anal spine to last dorsal ray rather long, 2.1 to 2.5 in standard length; dorsal contour of body gently curved, about same as ventral.

Interorbital moderately broad, its width 2.7 to 3.4 in head.

Anal base rather long, its length 2.6 to 3.2 in standard length; distance from first anal spine to hypural 1.9 to 2.2 in standard length.

D. VIII–X, 25–28; A. III, 29–35 (Hubbs, 1918, p. 12 found one Hyperprosopon argenteum with 37 anal rays); scales from first dorsal spine to lateral line 8 to 10; scales from anterior end of anus to lateral line 18 to 21.

10.1.1.1. Hyperprosopon (Hyperprosopon) argenteum Gibbons, Walleye Perch

Hyperprosopon argenteus Gibbons, 1854d, p. 105; 1854e, p. 125; Gill, 1862, pp. 275, 276; Cooper, 1868, p. 489; Jordan and Gilbert, 1882b, p. 936; Eigenmann and Eigenmann, 1892, p. 353; Eigenmann and Ulrey, 1894, pp. 386, 387; Eigenmann, 1894b, p. 404; Jordan and Evermann, 1896, p. 403; 1898, p. 1501; Starks and Morris, 1907, p. 200; Hubbs, 1918, p. 12; Jordan and Evermann, 1922, p. 471; Fowler, 1923a, pp. 285, 292, 300; 1923b, p. 78; Ulrey and Greeley, 1928, p. 16; Wales, 1928, p. 63, fig. 9; Bonnot, 1929, p. 230; Jordan, Evermann and Clark, 1930, p. 410.

Hyperprosopon argenteum punctatum Gibbons, 1854d, p. 106.

Hyperprosopon arcuatus Gibbons, 1854e, p. 125; Gill, 1862, pp. 275, 276; Cooper, 1868, p. 489; Jordan, 1905b, p. 375.

Holconotus megalops Girard, 1854d, p. 152.

Ennichthys megalops Girard, 1855, p. 323; Troschel, 1855c, p. 351; Girard, 1857b, p. 26; 1858, p. 197, pls. xxvi (fig. 10), xxxvii.

Hyperprosodon argenteus Troschel, 1855b, p. 338 (lapsus calami pro Hyperprosopon argenteus Gibbons).

Hyperprosodon arcuatus Troschel, 1855b, p. 339 (lapsus calami pro Hyperprosopon arcuatus Gibbons).

Hyperprosopon argenteum A. Agassiz, 1861, p. 132; Eigenmann, 1893, pp. 130, 156; Hubbs, 1928, p. 12; Clark, 1930, p. 140; Walford, 1931, pp. 24, 101, fig. 77; Hubbs, 1933, p. 2; Barnhart, 1936, pp. 75, 78, fig. 231; Schultz, 1936, p. 190; Schultz and DeLacy, 1936, p. 137; Herz, 1941, p. 75; Clemens and Wilby, 1946, pp. 28, 153, fig. 91; Hewatt, 1946, p. 205; Roedel, 1948, pp. 22, 86, fig. 58; Rechnitzer and Limbaugh, 1952, pp. 41–42.

Bramopsis mento A. Agassiz, 1861, p. 133 (listed in synonymy as Bramopsis mento Agassiz MSS).

Ditrema arcuatum Günther, 1862, p. 249.

Ditrema megalops Günther, 1862, p. 249.

Hyperprosopon arcuatum Jordan and Gilbert, 1881a, p. 28.

Holconotus argenteus Smith, 1880; Jordan and Gilbert, 1881e, p. 456; Jordan and Jouy, 1882, p. 10; Jordan and Gilbert, 1882a, p. 50; Jordan, 1885, p. 884 (p. 96 in reprint); 1887, p. 278.

Amphistichus arcuatus Jordan and Gilbert, 1882b, p. 591.

Hyperprosopon argenteus Starks, 1926, p. 256 (lapsus calami pro Hyperprosopon argenteus Gibbons).

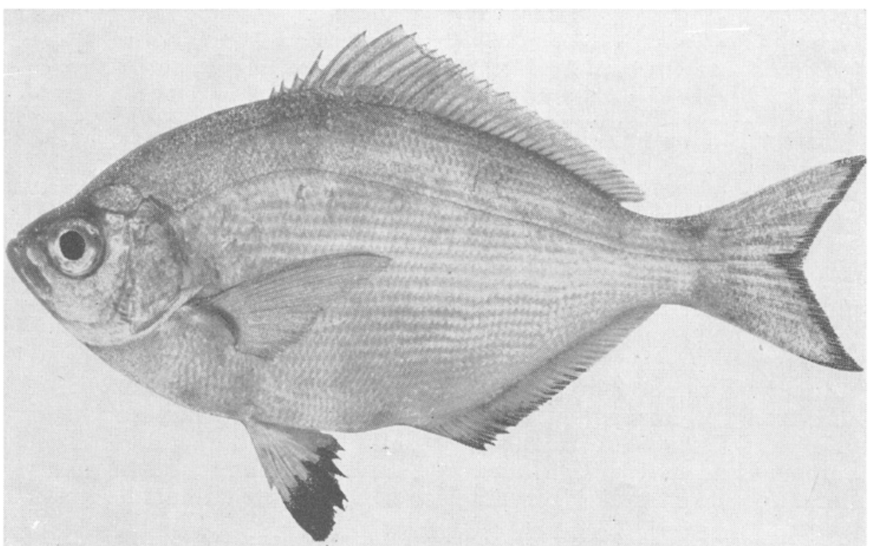

FIGURE 15. *Hyperprosopon (Hyperprosopon) argenteum.* Walleye perch.

FIGURE 15. Hyperprosopon (Hyperprosopon) argenteum. Walleye perch

Body deep, its depth 2.20 (2.0–2.5) in standard length; peduncular length 2.36 (2.0–2.6) in head; least depth of caudal peduncle 2.58 (2.3–2.9) in head.

Head 3.16 (2.8–3.4) in standard length; mouth fairly large, the maxillary usually reaching a vertical from anterior edge of orbit, its length 2.59 (2.4–2.9) in head; dorsal contour of the head gently curved; snout straight, 3.70 (3.2–4.3) in head; eye large, its length 2.80 (2.5–3.2) in head; interorbital 3.20 (2.9–3.4) in head.

Lateral line farthest from the dorsal contour of the body at its origin, generally nearest at posterior end of dorsal fin, depressed slightly at caudal peduncle.

Length of dorsal base 1.97 (1.8–2.1) in standard length; dorsal sheath 2.41 (2.1–2.7) in dorsal base; ventral origin of dorsal sheath under ultimate or penultimate dorsal spine; soft dorsal 1.38 (1.2–1.4) in dorsal base; longest dorsal spine 3.81 (2.8–5.1) in dorsal base, slightly higher than general contour of soft dorsal fin; sixth spine (occasionally fifth or seventh) longest; last dorsal spine 1.11 (0.9–1.5) in first dorsal ray; longest dorsal ray 3.66 (3.1–4.3) in dorsal base. Origin of anal fin under fourth to sixth dorsal ray; anal base 1.44 (1.3–1.5) in dorsal base; third anal spine longest, its length 6.95 (5.1–10.0) in anal base; first or second anal ray usually longest, its length 4.45 (3.6–5.8) in anal base. Base of upper pectoral ray on a vertical somewhere between origin of lateral line and second lateral-line scale; distance from upper end of pectoral base to first dorsal spine 1.57 (1.4–1.6) in dorsal base; fin moderately long, usually triangular in shape, occasionally falcate in outline, third or fourth ray longest, 1.10 (0.9–1.3) in head; base of fin 3.40 (2.8–3.9) in longest ray. Pelvic fin moderately long, first or second ray longest, its length 1.54 (1.2–1.9) in head; pelvic spine 1.71 (1.5–2.0) in longest ray.

Measurements in per mille of standard length based on 50 specimens from 55.0 mm to 203.9 mm (average 113.1 mm) in standard length; length of head 317 (288–349); length of maxillary 122 (110–132); length of eye 114 (90–131); length of snout 86 (72–98); width of interorbital space 99 (87–114); distance from first dorsal to pelvic 455 (396–499); distance from first dorsal spine to first anal spine 485 (430–527); distance from first anal spine to last dorsal ray 428 (393–463); caudal depth 145 (125–165); least depth of caudal peduncle 123 (107–134); distance from tip of snout to first dorsal 438 (420–454); distance from first dorsal spine to hypural 650 (625–677); distance from last dorsal ray to hypural 152 (134–176); length of dorsal base 509 (475–538); length of dorsal sheath 211 (178–246); length of soft dorsal base 369 (338–394); longest dorsal spine 135 (104–172); longest dorsal ray 139 (119–160); length of ultimate dorsal spine 97 (72–118); length of first dorsal ray 106 (85–124); distance from tip of snout to anal 623 (582–679); distance from first anal spine to hypural 483 (449–516); distance from last anal ray to hypural 132 (119–156); length of anal base 352 (327–378); length of longest anal spine 51 (34–67); length of longest anal ray 80 (61–94); distance from tip of snout to upper end of pectoral base 314 (285–341); distance from first dorsal to upper end of pectoral base 323 (295–355); width of pectoral base 85 (75–94); length of longest pectoral ray 289 (246–312); distance from tip of snout to pelvic 425 (415–469); length of longest pelvic ray 206 (164–241); length of pelvic spine 121 (92–141).

Fin and scale formulae: D. IX (VIII–X), 27 (25–28); A. III, 32 (30–35); P. 27 (25–28); L1 69 (68–73) + 5 (5–7); scales from first dorsal spine to lateral line 9 (8–10); scales from dorsal sheath to lateral line 9 (8½–10).

Color stable; pattern, on body proper, occasionally obliterated in adults. Ground color silvery, dorsum dark blue. In young, and usually in adults, a series of narrow, vertical bars of pale golden pink, on body walls. Readily distinguished from Hyperprosopon ellipticum by the heavy black pigmentation of the pelvics. No pigmentation on body, in axilla.

I have examined specimens of this species from the following localities in California: Humboldt Bay, Lat. 40° 48' 45" N., Long. 124° 10' 25" W.; Elkhorn Slough, Lat. 36° 48' 45" N., Long. 121° 47' 15" W.; Del Monte Beach, Monterey Bay, Monterey County; Santa Barbara, Lat. 34° 40' 54" N., Long. 119° 24' 16" W.; Santa Cruz Island, Lat. 33° 57' 46" N., Long. 119° 45' 12" W.; Newport Harbor, Orange County.

The recorded range of this species is from Vancouver Island, British Columbia south into Baja California.

One of the more important commercial species. Usually taken along sandy beaches, in the surf.

The name, argenteum, silvery, in allusion to the sheen of the body.

10.1.1.2. Hyperprosopon (Hyperprosopon) ellipticum (Gibbons), Silver Perch

Cymatogaster ellipticus Gibbons, 1854e, p. 124; Troschel, 1855b, p. 336; Hubbs, 1933, p. 4.

Hyperprosopon arcuatum A. Agassiz, 1861, p. 133.

Ditrema agassizii Günther, 1862, p. 250.

Hyperprosopon agassizii Gill, 1862, p. 276; Eigenmann and Eigenmann, 1892, p. 353; Jordan and Evermann, 1896, p. 404; 1898, p. 1502; Jordan, 1905b, p. 375; Starks and Morris, 1907, p. 201; Hubbs, 1918, p. 12; Jordan and Evermann, 1922, p. 471; Fowler, 1923a, p. 292; Hubbs, 1928, p. 13; Ulrey and Greeley, 1928, p. 16; Clark, 1930, p. 140; Hubbs, 1933, p. 2; Barnhart, 1936, p. 75.

Hyperprosopon punctatum Cooper, 1868, p. 486.

Holconotus agassizi Jordan and Gilbert, 1881e, p. 456.

Holconotus agassizii Jordan and Jouy, 1882, p. 10; Jordan and Gilbert, 1882a, p. 50; Jordan, 1885, p. 884 (p. 96 in reprint); 1887, p. 278.

Amphistichus agassizi Jordan and Gilbert, 1882b, p. 592.

Hyperprosopon agassizi Eigenmann and Ulrey, 1894, pp. 386, 387.

Amphysticus agassizi Jordan and Evermann, 1898, p. 1502 (listed in synonymy).

Tocichthys agassizii Hubbs, 1928, p. 13; Jordan, Evermann and Clark, 1930, p. 410.

Tocichthys ellipticus Hubbs, 1933, p. 2; Barnhart, 1936, pp. 75, 78; Schultz, 1936, p. 190; Schultz and DeLacy, 1936, p. 136; Roedel, 1948, pp. 22, 86.

Ditrema jacksoni fide Schultz and DeLacy, 1936, p. 136 (in synonymy).

Embiotoca jacksoni fide Schultz and DeLacy, 1936, p. 136 (in synonymy).

Body deep, its depth 2.18 (1.9–2.2) in standard length; peduncular length 2.17 (1.9–2.3) in head; least depth of caudal peduncle 2.24 (2.0–2.4) in head.

Head 3.40 (3.1–3.7) in standard length; mouth moderately large, the maxillary usually reaching a vertical from anterior edge of orbit, its length 2.86 (2.6–3.1) in head; dorsal contour of the head straight to a point slightly beyond the eye, then arching gently to dorsal fin; snout

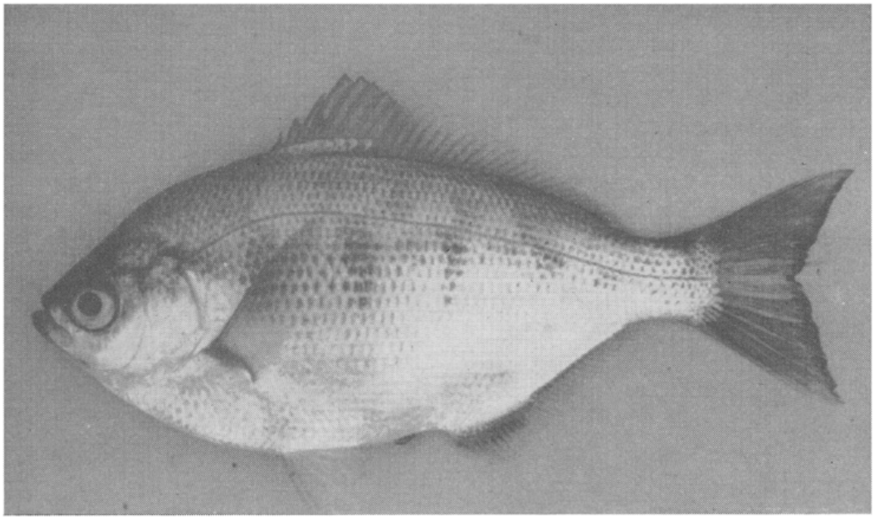

FIGURE 16. *Hyperprosopon (Hyperprosopon) ellipticum.* Silver perch. Photograph by W. I. Follett.

FIGURE 16. Hyperprosopon (Hyperprosopon) ellipticum. Silver perch. Photograph by W. I. Follett

straight, 3.95 (3.5–4.4) in head; eye fairly large, its length 3.29 (2.8–3.7) in head; interorbital 2.94 (2.7–3.3) in head.

Lateral line farthest from the dorsal contour of the body at its origin, generally nearest at a point equidistant from hypural and posterior end of dorsal base, depressed slightly beyond this point.

Length of dorsal base 1.91 (1.8–2.0) in standard length; dorsal sheath 2.02 (1.8–2.2) in dorsal base; ventral origin of dorsal sheath generally under third or fourth spine in advance of soft dorsal; soft dorsal 1.40 (1.3–1.4) in dorsal base; longest dorsal spine 4.02 (3.6–4.9) in dorsal base, slightly higher than general contour of soft dorsal fin; sixth spine (occasionally fourth, fifth or seventh) longest; last dorsal spine 1.12 (0.9–1.3). in first dorsal ray; longest dorsal ray 4.10 (3.7–4.8) in dorsal base. Origin of anal fin variable, under sixth to eleventh dorsal ray; anal base 1.55 (1.4–1.7) in dorsal base; third anal spine longest, its length 6.01 (4.5–7.5) in anal base; first ray usually longest, its length 3.88 (3.2–4.7) in anal base. Base of upper pectoral ray under second to fourth scale of lateral line; distance from upper end of pectoral base to first dorsal spine 1.60 (1.5–1.7) in dorsal base; third or fourth pectoral ray longest, its length 0.98 (0.9–1.1) in head; base of fin 3.54 (2.9–4.0) in longest ray. Pelvic fin moderately long, first ray usually longest, its length 1.49 (1.2–1.8) in head; pelvic spine 1.48 (1.3–1.6) in longest ray.

Measurements in per mille of standard length based on 34 specimens from 74.5 mm to 154.5 mm (average 113.9 mm) in standard length; length of head 294 (270–314) ; length of maxillary 103 (91–114) ; length of eye 90 (77–107) ; length of snout 75 (65–87) ; width of interorbital space 100 (92–113) ; distance from first dorsal to pelvic 469 (449–506) ; distance from first dorsal spine to first anal spine 505 (482–550) ; distance from first anal spine to last dorsal ray 428 (392–452) ; caudal depth 160 (149–180) ; least depth of caudal peduncle 132 (117–148) ; distance from tip of snout to first dorsal 422 (398–443) ; distance from first dorsal spine to hypural 670 (642–700) ; distance from last dorsal ray to hypural 158

(145–175) ; length of dorsal base 525 (492–555) ; length of dorsal sheath 260 (226–292) ; length of soft dorsal base 374 (342–396) ; longest dorsal spine 130 (112–143) ; longest dorsal ray 128 (111–139) ; length of ultimate dorsal spine 83 (63–102) ; length of first dorsal ray 92 (77–105) ; distance from tip of snout to anal 640 (600–719) ; distance from first anal spine to hypural 471 (443–509) ; distance from last anal ray to hypural 136 (119–150) ; length of anal base 337 (311–376) ; length of longest anal spine 57 (43–69) ; length of longest anal ray 87 (75–98) ; distance from tip of snout to upper end of pectoral base 296 (266–324) ; distance from first dorsal to upper end of pectoral base 328 (314–347) ; width of pectoral base 85 (75–95) ; length of longest pectoral ray 301 (279–328) ; distance from tip of snout to pelvic 444 (407–485) ; length of longest pelvic ray 199 (174–224) ; length of pelvic spine 135 (117–154).

Fin and scale formulae: D. IX (VIII–X), 26 (25–28) ; A. III, 31 (29–34) ; P. 27 (26–28) ; Ll 62 (59–67) + 5 (4–6) ; scales from first dorsal spine to lateral line 8 (8–9) ; scales from dorsal sheath to lateral line 7 (6½–8).

Color stable; pattern, on body proper, occasionally obliterated in adults. Ground color silvery, dorsum dark green. In young, and usually in adults, a series of narrow, vertical bars of pale golden pink on body walls. Fins all plain, except for occasional small splash of black on anterior portion of anal fin. Readily distinguished from Hyperprosopon argenteum by the lack of heavy black pigmentation 'on pelvics. No pigmentation on body, in axilla.

I have examined specimens of this species from the following localities in California: Duncan's Landing, Sonoma County; mouth of Salmon Creek, Sonoma County; Dillon's Beach, Marin County; Muir Beach, Lat. 37° 51' 30" N., Long. 122° 34' 35" W.; Miramar Pier, Halfmoon Bay, San Mateo County; one mile north of Waddell Creek, Santa Cruz County; Swanton, Santa Cruz County; Del Monte Beach, Monterey Bay, Monterey County; Pismo Beach, San Luis Obispo County; Willows Anchorage, Santa Cruz Island, Lat. 33° 57' 48" N., Long. 119° 44' 56" W.

The recorded range of this species is from Clallam County, Washington to Southern California.

No commercial value. Usually taken along sandy beaches, in the surf.

The name ellipticum refers to the elliptical outline of the body.

10.1.2. Subgenus Hypocritichthys Gill

Hypocritichthys Gill, 1862, p. 275 (type by original designation, Hyperprosopon analis) ; Jordan and Gilbert, 1882b, p. 591; Jordan and Evermann, 1896, p. 403; 1898, pp. 1494, 1500; Jordan and Sindo, 1902, pp. 354, 355; Jordan and Evermann, 1922, p. 471; Jordan, Evermann and Clark, 1930, p. 410.

Body small (less than 150 mm in standard length), rather narrow, its depth 2.3 to 2.9 in standard length; distance from first anal spine to last dorsal ray rather short, 2.7 to 3.2 in standard length; dorsal contour of the body straight from snout to dorsal fin, then gently curved; ventral contour gently curved.

Interorbital rather narrow, its width 3.4 to 4.1 in head.

Anal base short, its length 3.6 to 4.5 in standard length; distance from first anal spine to hypural 2.3 to 2.8 in standard length.

D. VII–IX, 22–25 ; A. III, 23–26 ; scales from first dorsal spine to lateral line 6 (5–7) ; scales from anterior end of anus to lateral line 15 to 17.

10.1.2.1. Hyperprosopon (Hypocritichthys) anale A. Agassiz, Spotfin Perch

Hyperprosopon analis A. Agassiz, 1861, p. 133 (name only) ; Eigenmann and Eigenmann, 1892, p. 353; Eigenmann and Ulrey, 1894, pp. 386, 387.

Hypocritichthys analis Gill, 1862, p. 275; Cooper, 1868, p. 489; Jordan and Evermann, 1896, p. 403; 1898, p. 1500; 1900, Fig. 582; Jordan, 1905b, p. 375, Fig. 311; Gilbert, 1915, p. 328; Hubbs, 1918, p. 12; Jordan and Evermann, 1922, p. 471; Ulrey and Greeley, 1928, p. 16; Jordan, Evermann and Clark, 1930, p. 410; Hubbs, 1933, p. 2; Barnhart, 1936, p. 75; Roedel, 1948, p. 22.

Ditrema anale Günther, 1862, p. 250.

Holconotus analis Jordan and Gilbert, 1881e, p. 456; Jordan and Jouy, 1882, p. 10; Jordan and Gilbert, 1882a, p. 51; Jordan, 1885, p. 884 (p. 96 in reprint) ; 1887, p. 278.

Amphistichus analis Jordan and Gilbert, 1882b, p. 591.

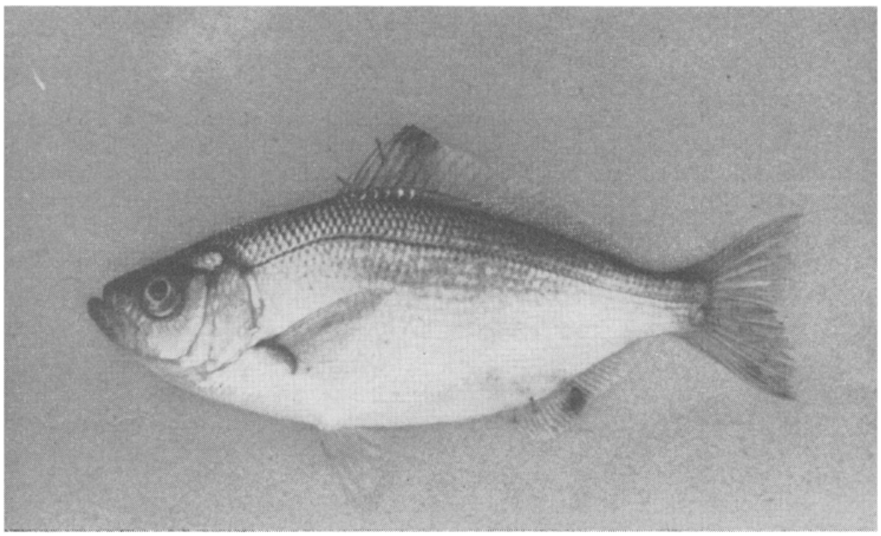

FIGURE 17. *Hyperprosopon (Hypocritichthys) anale.* Spotfin perch. Photograph by W. I. Follett.

FIGURE 17. Hyperprosopon (Hypocritichthys) anale. Spotfin perch. Photograph by W. I. Follett

Body narrow, its depth 2.58 (2.3–2.9) in standard length; peduncular length 2.23 (2.0–2.5) in head; least depth of caudal peduncle 2.74 (2.5–2.9) in head.

Head 3.22 (2.8–3.4) in standard length; mouth fairly large, the maxillary usually not reaching a vertical from anterior edge of orbit, its length 2.74 (2.4–2.8) in head; dorsal contour of head straight; snout 3.49 (3.2–3.8) in head; eye rather small, its length 3.79 (3.2–4.2) in head; interorbital 3.69 (3.4–4.1) in head.

Lateral line farthest from the dorsal contour of the body at its origin, generally nearest at posterior end of dorsal fin, depressed slightly at caudal peduncle.

Length of dorsal base 2.05 (1.9–2.2) in standard length; dorsal sheath 1.72 (1.5–2.0) in dorsal base; ventral origin of dorsal sheath generally under third or fourth spine in advance of soft dorsal; soft dorsal 1.37 (1.2–1.4) in dorsal base; longest dorsal spine 3.47 (3.0–3.9) in dorsal base, slightly higher than general contour of soft dorsal fin; fourth spine (occasionally third or fifth) longest; last dorsal spine 0.99 (0.8–1.2) in first dorsal ray; first ray usually longest, its length 3.95 (3.1–4.6) in dorsal base. Origin of anal fin under ninth to eleventh dorsal ray; anal base 1.99 (1.7–2.2) in dorsal base; third anal spine longest, its length 4.11 (3.4–5.4) in anal base; first or second anal ray usually longest, its length 3.22 (2.7–4.3) in anal base. Base of upper pectoral ray on a vertical somewhere between origin of lateral line and second lateral line scale; distance from upper end of pectoral base to first dorsal spine 1.70 (1.5–1.8) in dorsal base; fin rather short, third or fourth ray longest, its length 1.34 (1.1–1.4) in head; base of fin 3.14 (2.6–3.6) in longest ray. Pelvic fin moderately long, second ray usually longest, its length 1.63 (1.4–1.8) in head; pelvic spine 1.69 (1.5–1.9) in longest ray.

Measurements in per mille of standard length based on 50 specimens from 50.0 mm to 136.5 mm (average 98.5 mm) in standard length; length of head 311 (294–350); length of maxillary 120 (114–138); length of eye 83 (70–106); length of snout 90 (80–100); width of interorbital space 85 (74–96) ; distance from first dorsal to pelvic 387 (345–429) ; distance from first dorsal spine to first anal spine 455 (415–498) ; distance from first anal spine to last dorsal ray 328 (312–360) ; caudal depth 148 (137–164) ; least depth of caudal peduncle 114 (105–128) ; distance from tip of snout to first dorsal 419 (394–455) ; distance from first dorsal spine to hypural 639 (589–669) ; distance from last dorsal ray to hypural 162 (143–191) ; length of dorsal base 487 (449–510) ; length of dorsal sheath 284 (244–330) ; length of soft dorsal base 357 (318–388) ; longest dorsal spine 141 (124–159) ; longest dorsal ray 124 (107–141) ; length of ultimate dorsal spine 96 (77–116) ; length of first dorsal ray 96 (86–111) ; distance from tip of snout to anal 695 (648–725) ; distance from first anal spine to hypural 382 (354–420) ; distance from last anal ray to hypural 140 (112–153) ; length of anal base 246 (220–277) ; length of longest anal spine 60 (47–73) ; length of longest anal ray 77 (62–89) ; distance from tip of snout to upper end of pectoral base 306 (283–340) ; distance from first dorsal to upper end of pectoral base 287 (254–312) ; width of pectoral base 75 (66–81) ; length of longest pectoral ray 235 (210–268) ; distance from tip of snout to pelvic 437 (411–470) ; length of longest pelvic ray 193 (176–233) ; length of pelvic spine 114 (99–130).

Fin and scale formulae: D. VIII (VII–IX), 23 (22–25) ; A. III, 25 (23–26) ; P. 25 (23–27) ; Ll 62 (57–66) + 5 (4–6) ; scales from first dorsal spine to lateral line 6 (5–7) ; scales from dorsal sheath to lateral line 5 (5–5½).

Color and pattern stable. Ground color silvery, dorsum dark. A characteristic black spot on the spinous dorsal. Anal fin usually with a small splash of black anteriorly, other fins plain. No pigmentation on body, in axilla.

I have examined specimens of this species from the following localities in California: Halfmoon Bay, San Mateo County; Monterey Bay, Lat. 36° 50' N., Long. 121° 48' 30" W. and Lat. 36° 37' 20" N., Long. 121° 54' 08" W.; San Simeon, San Luis Obispo County; Avila, San Luis Obispo County.

The recorded range of this species is from San Francisco to Pt. Conception.

No commercial value. Occasionally taken with hook and line by sports fishermen.

The name *anale* presumably refers to the inky blotch found on the anal fin.

10.2. Genus Amphistichus Agassiz

Amphistichus L. Agassiz, 1854, p. 367 (p. 29 in reprint) (genotype by monotypy, Amphistichus argenteus Agassiz); Girard, 1854d, p. 153; 1855, p. 323; Troschel, 1855a, p. 33; 1855c, p. 352; Girard, 1858, p. 201; A. Agassiz, 1861, p. 130; Gill, 1862, p. 275; Jordan and Gilbert, 1882b, pp. 586, 590, 592, 936; Jordan, 1885, p. 884 (p. 96 in reprint); Eigenmann and Ulrey, 1894, pp. 383, 388; Jordan and Evermann, 1896, p. 404; 1898, pp. 1495, 1503; Jordan, Evermann and Clark, 1930, p. 410; Hubbs, 1933, p. 3.

Holconotus L. Agassiz, 1854, p. 367 (p. 29 in reprint) (genotype by monotypy, Holconotus rhodoterus Agassiz); Girard, 1854b, p. 135; Troschel, 1855a, p. 34; A. Agassiz, 1861, pp. 131, 133; Gill, 1862, p. 275; Blake, 1867, p. 371; Jordan and Gilbert, 1882b, p. 590; Eigenmann and Ulrey, 1894, pp. 383, 388; Jordan and Evermann, 1896, p. 404; 1898, pp. 1494, 1502; Jordan and Evermann, 1922, p. 472; Jordan, Evermann and Clark, 1930, p. 410; Hubbs, 1933, pp. 1, 3.

Cymatogaster Gibbons, 1854c (ex parte); 1854e, p. 123; Troschel, 1855b, p. 335.

Mytilophagus Gibbons, 1854e, p. 125 (genotype by monotypy, Mytilophagus fasciatus Gibbons = Amphistichus argenteus Agassiz); Troschel, 1855b, p. 340.

Ennichthys Girard, 1855, p. 322 (ex parte); Troschel, 1855c, p. 351; Girard, 1858, p. 196.

Ditrema Günther, 1862, p. 245 (ex parte).

Amphisticus Blake, 1867, p. 371 (lapsus calami pro Amphistichus Agassiz).

Crossochir Hubbs, 1933, pp. 1, 3, 4 (genotype by original designation, Crossochir koelzi).

Embiotoca Hubbs, 1933, p. 4 (lapsus calami pro Amphistichus).

Body variable in shape; caudal peduncle short, its length 1.9 to 2.7 in head, fairly deep, its least depth 1.8 to 2.6 in head.

Head relatively small, 2.7 to 3.5 in standard length; mouth terminal or very slightly superior, slightly to moderately oblique; upper jaw slightly shorter than lower; maxillary rather long, its length 2.2 to 3.0 in head; snout abrupt, giving an aquiline profile to anterior contour of head.

Lateral line farthest from the dorsal contour of the body at its origin, generally nearest on the caudal peduncle.

Origin of dorsal slightly in advance of origin of pelvic; base of dorsal fin moderately long, its length 1.6 to 2.0 in standard length; dorsal sheath moderate, its length 1.3 to 1.9 in dorsal base; first dorsal ray usually longest, either branched or simple, with remaining rays branched, in adults. Anal length variable, margin of fin fairly straight in juveniles, sigmoid in adults (this most marked in males), its least depth in general region of modified ray; anterior one or two rays simple, with the remaining elements branched; anal base, posterior to modified ray, with a definite row of small scales on fin. Pectoral frayed ventrally; first ray unbranched with remainder branched except for lower two to five rays which are simple. Origin of pelvic slightly posterior to first dorsal spine.

Αμφι

FIGURE

—double,

στοιχος

FIGURE

series—for the biserial teenth which are usually found in the adults.

10.2.1. Amphistichus argenteus Agassiz, Barred Perch

Amphistichus argenteus L. Agassiz, 1854, p. 367 (p. 29 in reprint); Girard, 1854b, p. 135; 1854c, p. 141; 1854d, p. 153; 1855, p. 323; Troschel, 1855a, p. 34; 1855c, p. 352; Girard, 1858, p. 201, pl. xxxix; 1859a, p. 51; 1859b, p. 88; A. Agassiz, 1861, p. 131; Gill, 1862, p. 275; Cooper, 1868; Smith, 1880; Jordan and Gilbert, 1881a, p. 28; 1881e, p. 456; Jordan and Jouy, 1882, p. 10; Jordan and Gilbert, 1882b, p. 593; 1882a, p. 50; Jordan, 1885, p. 884 (p. 96 in reprint); Smith, 1885; Jordan, 1887, p. 278; Eigenmann, 1893, p. 130; 1894b, p. 404; Eigenmann and Ulrey, 1894, p. 389; Jordan and Evermann, 1896, p. 404; 1898, p. 1503; Gilbert, 1899, p. 25; Jordan, 1905b, p. 375; Starks and Morris, 1907, p. 201; Starks, 1911, p. 209; Hubbs, 1918,

p. 12; Jordan and Evermann, 1922, p. 472; Fowler, 1923a, pp. 292, 300; Hubbs, 1928, p. 13; Ulrey and Greeley, 1928, p. 15; Wales, 1928, p. 63, fig. 8; Bonnot, 1929, p. 230; Clark, 1930, p. 140; Jordan, Evermann and Clark, 1930, p. 411; Walford, 1931, pp. 24, 102, fig. 78; Hubbs, 1933, p. 3; Barnhart, 1936, pp. 76, 78, fig. 232; Follett, 1936, p. 117, fig.; 1942, pp. 49, 50, fig.; Hewatt, 1946, p. 205; Roedel, 1948, pp. 23, 87, fig. 59.

Mytilophagus fasciatus Gibbons, 1854e, p. 125; Troschel, 1855b, p. 340.

Amphistichus similis Girard, 1854b, p. 135; 1855, p. 323; Troschel, 1855, c, p. 353 (misprinted in original as page 343); Girard, 1858, p. 203, pl. xxxvi (figs. 5–9); 1859b, p. 88.

Ditrema argenteum Günther, 1862, p. 251; Lord, 1886; Anon., 1869, pp. 95, 96.

Amphistichus arenatus Ryder, 1885, p. 140.

Amphisticus argenteus Eigenmann and Eigenmann, 1892, p. 354.

Amphisticus argenticus Starks, 1926, p. 256.

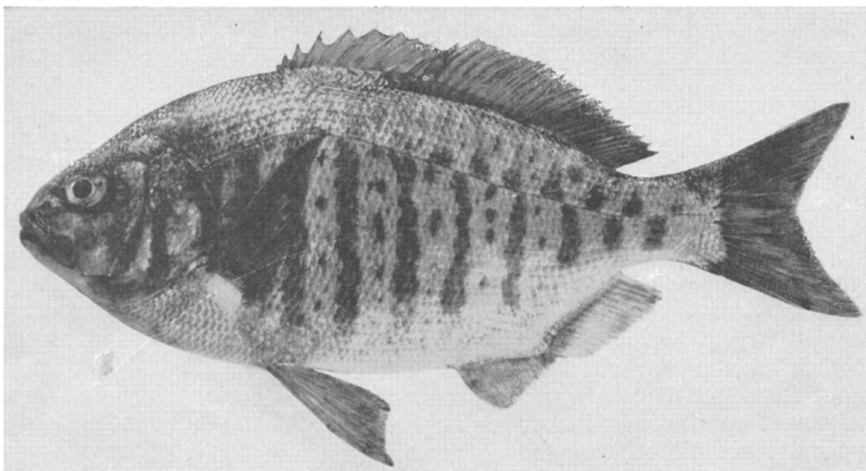

FIGURE 18. *Amphistichus argenteus*. Barred perch.

FIGURE 18. Amphistichus argenteus. Barred perch

Body rather large (to more than 275 mm in standard length), fairly deep, its depth 2.29 (2.1–2.4) in standard length; dorsal contour much more curved than the fairly straight ventral outline; peduncular length 2.23 (1.9–2.7) in head; least depth of caudal peduncle 2.44 (2.1–2.6) in head.

Head 3.06 (2.7–3.2) in standard length; mouth rather large, slightly oblique; lower jaw usually somewhat included; maxillary usually reaching a vertical taken from the anterior edge of the pupil of eye, its length 2.62 (2.2–2.8) in head; dorsal contour of head abrupt at snout, then gently curving to dorsal origin; snout 3.11 (2.7–3.3) in head; posterior nostril a slit (in young) to an ellipse (in adult), perpendicular to horizontal axis of body; eye rounded, its length 3.97 (2.8–5.3) in head; interorbital width 3.39 (2.9–3.9) in head. Posterior groove of lower lip interrupted by a broad frenum.

Length of dorsal base 1.91 (1.7–2.0) in standard length; dorsal sheath 1.48 (1.3–1.7) in dorsal base; ventral origin of dorsal sheath generally under second to fourth spine in advance of soft dorsal; soft dorsal 1.59 (1.4–1.6) in dorsal base; spinous dorsal evenly graduated to longest spine, posterior elements very gradually decreasing in length; fifth or sixth (occasionally seventh or eighth) dorsal spine longest, its length 4.63 (3.6–6.2) in dorsal base; longest spine generally shorter than general contour of soft dorsal; last dorsal spine 1.20 (1.0–1.3) in first dorsal ray; first ray longest, 3.83 (3.3–4.9) in dorsal base. Origin of anal fin under fifth to seventh dorsal ray; anal base 1.88 (1.7–2.1) in dorsal base; third (or fourth, when present) anal spine longest, its length 4.25 (3.0–5.3) in anal base; first or second anal ray longest, its length 3.00 (2.3–3.9) in anal base. Base of upper pectoral ray under first or second scale of lateral line; distance from upper end of pectoral base to first dorsal spine 1.64 (1.5–1.8) in dorsal base; fin moderately long, triangular in shape, third or fourth ray longest, 1.14 (1.0–1.3) in head; base of fin 3.44 (3.0–3.9) in longest ray. Pelvic fin moderately long, first or second ray longest, its length 1.57 (1.3–1.7) in head; pelvic spine 1.87 (1.6–2.1) in longest ray.

Measurements in per mille of standard length based on 50 specimens from 63.0 mm to 277.5 mm (average 139.7 mm) in standard length: length of head 327 (302–362); length of maxillary 125 (111–138); length of eye 84 (62–110); length of snout 106 (92–120); width of interorbital space 97 (83–107); distance from first dorsal to pelvic 436 (403–471); distance from first dorsal spine to first anal spine 497 (461–530); distance from first anal spine to last dorsal ray 373 (347–408); caudal depth 162 (149–173); least depth of caudal peduncle 134 (122–154); distance from tip of snout to first dorsal 468 (435–495); distance from first dorsal spine to hypural 665 (636–700); distance from last dorsal ray to hypural 150 (132–172); length of dorsal base 523 (494–559); length of dorsal sheath 354 (298–390); length of soft dorsal base 331 (308–366); longest dorsal spine 114 (87–139); longest dorsal ray 137 (112–162); length of ultimate dorsal spine 85 (67–108); length of first dorsal ray 102 (78–130); distance from tip of snout to anal 647 (608–705); distance from first anal spine to hypural 420 (395–447); distance from last anal ray to hypural 147 (127–163); length of anal base 276 (260–310); length of longest anal spine 66 (52–94); length of longest anal ray 93 (73–110); distance from tip of snout to upper and of pectoral base 318 (283–354); distance from first dorsal to upper end of pectoral base 318 (291–349); width of pectoral base 83 (75–92); length of longest pectoral ray 287 (253–328); distance from tip of snout to pelvic 429 (411–466); length of longest pelvic ray 209 (182–243); length of pelvic spine 112 (87–124).

Fin and scale formulae: D. X (IX–XI), 24 (23–27); A. III (occasionally IV in specimens from Santa Cruz Island, California), 26 (25–28); P. 26 (25–28); L1 62 (59–67) + 5 (5–7); scales from first dorsal spine to lateral line 9 (8–10); scales from dorsal sheath to lateral line 7 (7–8); scales from anterior end of anus to lateral line 19 (17–21).

Color stable; pattern variable. Ground color silvery overlain lightly with brassy tones. Dorsum usually bluish or grayish. Body walls usually with a series of brassy-olive vertical bars alternating with a vertical series of spots of the same color. Fins plain or slightly dusky at ends. Follett (1936 and 1942) has reported two abberant color phases of this form. In one the life color was "* * * uniform olive above and silvery below, without bars or spots." and the other was a form "* * * in which the entire back and sides are brassy-olive, interrupted only by a few irregular vertical streaks of silver upon the sides."

I have examined specimens of this species from the following localities: Bodega Bay, Lat. 38° 18' 48" N., Long. 123° 02' 05" W.; Muir Beach, Marin County, California; Miramar Pier, San Mateo County, California; 1 mile north of Waddell Creek, Santa Cruz County, California; Monterey Bay, Lat. 36° 50' N., Long. 121° 48' 30" W. and Lat. 36° 33' 40" N., Long. 121° 56' 25" W.; Santa Cruz Island, Lat. 33° 57' 48" N., Long. 119° 44' 56" W.; Beach Club, La Jolla, San Diego County, California; Mouth of Rio San Miguel, Baja California; 1.5 miles South of Arroyo Descanso, between Tijuana and Ensenada, Baja California.

The first and last of these localities represent the known limits of the range of this species.*

Taken in the surf along sandy beaches in considerable numbers by sports fishermen. Occasionally taken by commercial fishermen to form a small part of the "perch" catch of California.

The name argenteus -silvery, alludes to the ground color.

10.2.2. Amphistichus koelzi (Hubbs), Calico Perch

Holconotus rhodoterus Yarrow and Henshaw, 1878, p. 205; Bean, 1880, p. 88; Jordan and Gilbert, 1881e, p. 456; Jordan and Jouy, 1882, p. 10; Jordan and Gilbert, 1882a, p. 50; Eigenmann, 1893, pp. 130, 156; Eigenmann and Eigenmann, 1892, p. 354; Gilbert, 1895, p. 466; Hubbs, 1918, p. 12; Ulrey and Greeley, 1928, p. 16.

Amphistichus rhodoterus Eigenmann and Eigenmann, 1890, p. 9.

Crossochir koelzi Hubbs, 1933, pp. 1–8, pl. 1; Barnhart, 1936, pp. 76, 79, fig. 239; Hewatt, 1946, p. 205; Roedel, 1948, pp. 23, 87.

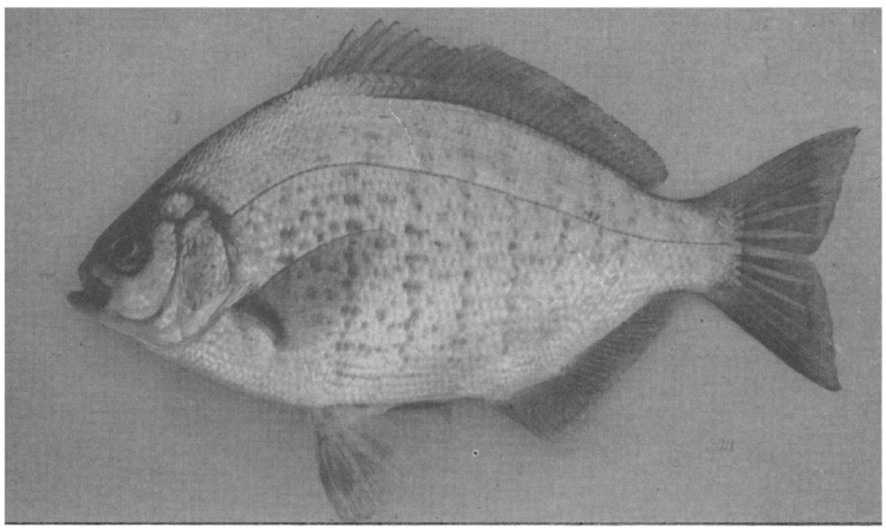

FIGURE 19. *Amphistichus koelzi.* Calico perch. Photograph by W. I. Follett.

FIGURE 19. Amphistichus koelzi. Calico perch. Photograph by W. I. Follett

Body moderately large (to more than 190 mm in standard length), deep, its depth 2.01 (1.7–2.4) in standard length; dorsal contour of body more sharply arched than the gently curved ventral surface; peduncular length 2.16 (1.9–2.4) in head; least depth of caudal peduncle 2.00 (1.8–2.3) in head.

Head 3.26 (2.9–3.5) in standard length; mouth fairly large, moderately oblique; lower jaw slightly projecting; maxillary extending

* Taken by Department of Fish and Game at Playa Maria Bay, Lat. 28° 51.9' N., Long. 114° 24.8' W., September, 1952.

slightly beyond a vertical taken from the anterior edge of the orbit, its length 2.80 (2.6–3.0) in head ; dorsal contour of head abrupt at snout, then gently curving to dorsal origin, occasionally very slightly concave over the nape ; snout 3.50 (3.2–4.0) in head ; posterior nostril a slit (in young) to an ellipse (in adult), perpendicular to horizontal axis of body ; eye rounded, its length 3.55 (2.9–4.1) in head ; interorbital width 3.20 (2.8–3.7) in head. Posterior groove of lower lip usually not interrupted by a frenum, however, this character is not trenchantly differentiated since a narrow frenum is apparent in some specimens.

Length of dorsal base 1.79 (1.6–1.9) in standard length ; dorsal sheath 1.68 (1.5–1.8) in dorsal base ; ventral origin of dorsal sheath generally under second to fourth spine in advance of soft dorsal ; soft dorsal 1.49 (1.3–1.5) in dorsal base ; spinous dorsal evenly graduated to longest spine, posterior elements very gradually decreasing in length ; fifth or sixth spine longest, its length 4.24 (3.4–5.6) in dorsal base ; longest spine about same height as general contour of soft dorsal ; last dorsal spine 1.28 (1.1–1.5) in first dorsal ray ; first ray usually longest, 3.46 (3.0–3.9) in dorsal base. Origin of anal fin under fifth to seventh dorsal ray ; anal base 1.73 (1.6–1.9) in dorsal base ; third anal spine longest, its length 5.15 (3.7–6.2) in anal base ; first or second anal ray longest, its length 3.42 (2.6–4.2) in anal base. Base of upper pectoral ray on a vertical somewhere between origin of lateral line and second lateral-line scale ; distance from upper end of pectoral base to first dorsal spine 1.58 (1.4–1.7) in dorsal base ; fin moderately long, triangular in shape, third or fourth ray longest, 1.13 (1.0–1.3) in head ; base of fin 3.26 (2.7–3.5) in longest ray. Pelvic fin fairly long, first or second ray longest, its length 1.34 (1.1–1.7) in head ; pelvic spine 1.80 (1.6–2.0) in longest ray.

Measurements in per mille of standard length based on 43 specimens from 53.6 mm to 191.0 mm (average 123.0 mm) in standard length : length of head 307 (285–341) ; length of maxillary 110 (95–125) ; length of eye 87 (70–112) ; length of snout 87 (77–101) ; width of interorbital space 95 (81–107) ; distance from first dorsal to pelvic 497 (412–566) ; distance from first dorsal spine to first anal spine 552 (466–604) ; distance from first anal spine to last dorsal ray 432 (401–468) ; caudal depth 177 (162–191) ; least depth of caudal peduncle 153 (144–164) ; distance from tip of snout to first dorsal 460 (445–482) ; distance from first dorsal spine to hypural 696 (647–733) ; distance from last dorsal ray to hypural 148 (130–161) ; length of dorsal base 560 (512–598) ; length of dorsal sheath 333 (295–370) ; length of soft dorsal base 376 (328–420) ; longest dorsal spine 133 (93–161) ; longest dorsal ray 162 (141–188) ; length of ultimate dorsal spine 95 (78–107) ; length of first dorsal ray 121 (105–137) ; distance from tip of snout to anal 634 (615–665) ; distance from first anal spine to hypural 461 (417–490) ; distance from last anal ray to hypural 142 (133–154) ; length of anal base 324 (295–350) ; length of longest anal spine 64 (50–87) ; length of longest anal ray 96 (76–119) ; distance from tip of snout to upper end of pectoral base 303 (280–348) ; distance from first dorsal to upper end of pectoral base 355 (298–394) ; width of pectoral base 83 (74–89) ; length of longest pectoral ray 272 (242–299) ; distance from tip of snout to pelvic 432 (412–473) ; length of longest pelvic ray 230 (194–272) ; length of pelvic spine 128 (112–140).

Fin and scale formulae : D. X (IX–XI), 26 (24–28) ; A. III, 29 (26–32) ; P. 27 (25–29) ; L1 66 (61–68) + 5 (4–6) ; scales from first dorsal spine to lateral line 9 (8–10) ; scales from dorsal sheath to lateral line 8 (7–8) ; scales from anterior end of anus to lateral line 18 (17–20).

Color stable ; pattern slightly variable. Ground color silvery overlain lightly with brassy tones. Dorsum bluish or olivaceous. Cheeks, opercle, and ventral surfaces from symphysis of mandible to pelvics tinged with red. Body walls with a series of bronze speckles which may roughly approximate narrow vertical bars. Fins, except pectorals, reddish ; pectorals plain. Reddish tinge occasionally absent.

I have examined specimens of this species from the following localities : Little Head, Trinidad, Lat. 41° 03' 27" N., Long. 124° 08' 36" W. ; 1 mile North of Waddell Creek, Santa Cruz County, California ; Del Monte Beach, Monterey Bay, Lat. 36° 33' 40" N., Long. 121° 56' 25" W. ; Carmel Beach, Lat. 36° 33' 00" N., Long. 121° 55' 45" W. ; San Simeon, San Luis Obispo County, California ; San Luis Obispo Bay, San Luis Obispo County, California ; Santa Cruz Island, California ; Cabrillo Beach, San Pedro, Los Angeles County, California ; Santa Tomas, Baja California.

The previously recorded range of this species is from Drakes Bay to San Diego, California. The range is hereby extended about 200 miles northward and 20 miles southward.

Fairly common in the surf along sandy beaches.

Koelzi—named in honor of Dr. Walter Koelz.

10.2.3. Amphistichus rhodoterus (L. Agassiz), Redtail Perch

Holconotus rhodoterus L. Agassiz, 1854, p. 368 (p. 30 in reprint) ; A. Agassiz, 1861, p. 131 ; Cooper, 1868, p. 489 ; Bean, 1881, p. 88 ; Jordan and Gilbert, 1881e, p. 456 ; Jordan, 1885, p. 884 (p. 96 in reprint) ; 1887, p. 278 ; Eigenmann, 1893, pp. 130, 156 ; Eigenmann and Eigenmann, 1892, p. 354 ; Eigenmann and Ulrey, 1894, p. 388 ; Jordan and Evermann, 1896, p. 404 ; 1898, p. 1502 ; Jordan, 1905b, p. 375 ; Starks and Morris, 1907, p. 201 ; Jordan and Evermann, 1922, p. 472 ; Hubbs, 1928, p. 13 ; Jordan, Evermann and Clark, 1930, p. 410 ; Walford, 1931, p. 24 ; Hubbs, 1933, pp. 1, 2, 4 ; Barnhart, 1936, p. 75 ; Schultz, 1936, p. 190 ; Schultz and DeLacy, 1936, p. 137 ; Clemens and Wilby, 1946, pp. 28, 154, fig. 92 ; Roedel, 1948, pp. 22, 87.

Cymatogaster larkinsii Gibbons, 1854e, p. 123 ; Troschel, 1855b, p. 335 ; Hubbs, 1933, p. 4.

Cymatogaster pulchellus Gibbons, 1854e, p. 123 ; Troschel, 1855b, p. 335 ; Hubbs, 1933, p. 4.

Amphistichus heermanni Girard, 1854b, p. 135.

Ennichthys heermanni Girard, 1855, pp. 319, 323 ; Troschel, 1855c, pp. 342, 351 ; Girard, 1858, pp. 165, 199, pls. xxvi (fig. 9), xxxviii ; 1859b, p. 88 ; Hubbs, 1933, p. 4.

Holconotus rhodopterus Troschel, 1855a, p. 34 (lapsus calami pro Holconotus rhodoterus Agassiz).

Holconotus pulchellus A. Agassiz, 1861, p. 132 ; Cooper 1868, p. 489.

Ditrema rhodoterum Günther, 1862, p. 250.

Amphistichus rhodoterus Jordan and Gilbert, 1882b, p. 592.

Ennichthys heermani Jordan and Gilbert, 1882b, p. 592 (in synonymy, lapsus calami pro Ennichthys heermanni Girard).

Embiotoca heermanni Hubbs, 1933, p. 4 (lapsus calami pro Amphistichus heermanni Girard).

Amphistichus argenteus fide Schultz and DeLacy, 1936, p. 137 (in synonymy).

Body rather large (to more than 275 mm in standard length), deep, its depth 2.07 (1.9–2.2) in standard length ; dorsal contour of body more sharply arched than the gently curved ventral surface ; peduncular length 2.16 (2.0–2.4) in head ; least depth of caudal peduncle 2.26 (2.1–2.3) in head.

Head 3.18 (3.0–3.3) in standard length ; mouth fairly large, moderately oblique ; lower jaw slightly projecting ; maxillary usually extending to a vertical taken from the anterior edge of the orbit, its length 2.65 (2.5–2.7) in head ; dorsal contour of head abrupt at snout, then gently curving to dorsal origin, occasionally very slightly concave over the nape ; snout 3.36 (2.9–3.5) in head ; posterior nostril usually slit-like, perpendicular to horizontal axis of body ; eye very slightly longer than wide, its length 4.40 (3.9–5.0) in head ; interorbital width 3.20 (2.9–3.5) in head. Posterior groove of lower lip not interrupted by a frenum.

Length of dorsal base 1.81 (1.7–1.8) in standard length ; dorsal sheath 1.72 (1.5–1.9) in dorsal base ; ventral origin of dorsal sheath under third to fifth spine in advance of soft dorsal ; soft dorsal 1.42 (1.4–1.5) in dorsal base ; spinous dorsal sharply graduated to longest spine, posterior elements decreasing in length ; dorsal spines quite long in adults and higher than the general contour of the soft dorsal at all ages ; fourth or fifth spine longest, its length 3.21 (2.7–3.7) in dorsal base ; last dorsal spine 1.02 (0.9–1.1) in first dorsal ray ; first ray usually longest, 3.92 (3.4–4.2) in dorsal base. Origin of anal fin under seventh to tenth dorsal ray ; anal base 1.91 (1.7–2.1) in dorsal base ; third anal spine longest, its length 3.90 (2.4–4.8) in anal base ; first or second anal ray usually longest, its length 2.66 (2.1–3.3) in anal base. Base of upper pectoral ray on a vertical somewhere between origin of lateral line and second lateral-line scale ; distance from upper end of pectoral base to first dorsal spine 1.60 (1.5–1.7) in dorsal base ; fin moderately long, triangular in shape, third or fourth ray longest, 1.09 (1.0–1.1) in head ; base of fin 3.39 (3.1–3.6) in longest ray. Pelvic fin fairly long, first or second ray longest, its length 1.45 (1.2–1.5) in head ; pelvic spine 1.72 (1.5–1.8) in longest ray.

Measurements in per mille of standard length based on 12 specimens from 117.0 to 287.0 mm (average 183.0 mm) in standard length : length of head 315 (300–326) ; length of maxillary 119 (112–128) ; length of eye 72 (60–82) ; length of snout 94 (85–106) ; width of interorbital space 99 (86–107) ; distance from first dorsal to pelvic 484 (446–514) ; distance from first dorsal spine to first anal spine 545 (522–585) ; distance from first anal spine to last dorsal ray 405 (377–438) ; caudal depth 169 (157–179) ; least depth of caudal peduncle 140 (131–149) ; distance from tip of snout to first dorsal 458 (445–479) ; distance from first dorsal spine to hypural 687 (662–709) ; distance from last dorsal ray to hypural 143 (131–151) ; length of dorsal base 554 (535–576) ; length of dorsal sheath 322 (286–358) ; length of soft dorsal base 389 (375–406) ; longest dorsal spine 174 (147–202) ; longest dorsal ray 142 (128–161) ; length of ultimate dorsal spine 99 (79–133) ; length of first dorsal ray 105 (95–135) ; distance from tip of snout to anal 666 (630–701) ; distance from first anal spine to hypural 429 (405–463) ; distance from last anal ray to hypural 140 (133–151) ; length of anal base 291 (265–318) ; length of longest anal spine 79 (58–121) ; length of longest anal ray 111 (94–136) ; distance from tip of snout to upper end of pectoral base 309 (292–328) ; distance from first dorsal to upper end of pectoral base 346 (318–374) ; width of pectoral base 85 (76–91) ; length of longest pectoral ray 288 (266–316) ; distance from tip of snout to pelvic 450 (436–475) ; length of longest pelvic ray 219 (196–263) ; length of pelvic spine 128 (107–148).

Fin and scale formulae : D. IX (IX–X), 27 (25–28) ; A. III, 29 (28–31) ; P. 27 (27–28) ; L1 63 (60–67) + 5 (4–6) ; scales from first dorsal spine to lateral line 10 (9–11) ; scales from dorsal sheath to lateral line 8 (7½–9) ; scales from anterior end of anus to lateral line 22 (20–22).

Color and pattern stable. Ground color silvery overlain lightly with brassy tinge. Dorsum usually olivaceous. Body walls with a series of about 9 to 11 vertical reddish brown or bronze bars. Caudal, pelvic and anal fins usually tinged with red. Pectoral fins plain.

I have examined specimens of this species from the following localities : mouth of Columbia River, Washington ; mouth of Salmon Creek, Sonoma County, California ; Point Reyes, Marin County, California ; Muir Beach, Lat. 35° 51' 30" N., Long. 122° 34' 35" W. ; San Francisco, San Francisco County, California.

The recorded range of this species is from Cape Flattery, Washington to Monterey Bay, California.

Common in the surf along sandy beaches.

ροδοτερος

FIGURE

-rosy, referring to the rosy tinge often seen in this form.

11. SUBFAMILY EMBIOTOCINAE GILL

Embiotocinae Gill, 1862, pp. 274, 275 ; Jordan and Gilbert, 1882b, p. 586 ; Eigenmann and Ulrey, 1894, p. 383 ; Jordan and Evermann, 1898, p. 1494 ; Hubbs, 1918, pp. 9, 10 ; Barnhart, 1936, p. 74.

Hysterocarpinae Gill, 1862, p. 275 ; Jordan and Gilbert, 1882b, p. 586 ; Eigenmann and Ulrey, 1894, pp. 384, 399 ; Jordan and Evermann, 1898, p. 1494.

Micrometrinae Hubbs, 1918, pp. 9, 13 ; Barnhart, 1936, p. 76.

Cleithrum entire, without a small expanded process on its posterior margin. Prefrontal bones showing no tendency to abut medially. Anal rays of males not modified into any specialized structure ; the rays, however, having a tendency to be crowded anteriorly. Anal glands of males appearing as a fleshly and enlarged structure on the anterior portion of the fin. Modified posteriorly into a flask-shaped organ whose opening is directed anteriorly. The exact shape of this structure varies inter-specifically.

11.1. Genus *Hypsurus* A. Agassiz

Embiotoca L. Agassiz, 1853, p. 389 (p. 11 in reprint) (ex parte).

Holconotus California Academy of Natural Science, 1854 (MSS) (genotype by monotypy, Holconotus gibbonsii California Academy of Natural Science).

Hypsurus A. Agassiz, 1861, p. 133 (type by original designation, Embiotoca caryi L. Agassiz) ; Gill, 1862, p. 274 ; Jordan and Gilbert, 1882b, pp. 586, 593 ; Jordan, 1885, p. 884 (p. 96 in reprint) ; Eigenmann and Ulrey, 1894, pp. 383, 384 ; Jordan and Evermann, 1896, 404 ; 1898, pp. 1495, 1508 ; 1922, p. 473 ; Jordan, Evermann and Clark, 1930, p. 412.

Ditrema Günther, 1862, p. 245 (ex parte).

Body moderately long (to more than 190 mm in standard length), approximately oblong in shape ; dorsal contour of body gently curved, belly extremely elongate and straight (between pelvics and origin of anal fin) except in very young ; caudal peduncle fairly short, its length 1.7 to 2.6 in head, rather narrow, its depth about equal throughout, 2.5 to 3.2 in head.

Head relatively small, more than 2.7 in standard length ; mouth fairly straight ; lower jaw usually slightly included ; maxillary occasionally reaching a vertical from anterior edge of orbit ; snout bluntly conic, on a straight line with anterior dorsal contour of head; posterior nostril usually slit-like, slightly oblique to the axis of the body; eye rounded; frenum present.

Lateral line farthest from the dorsal contour of body at its origin, generally nearest on the caudal peduncle.

Base of dorsal fin fairly long, 1.6 to 2.0 in standard length; dorsal sheath extending almost its entire length, its ventral origin usually under the first dorsal ray or ultimate dorsal spine; spinous dorsal low, graduated to about the fifth spine, then fairly even. Anal base extremely short, 4.8 to 6.8 in standard length; no lunar-shaped depression in the body surface. Lowermost pectoral rays frayed.

Scales from dorsal sheath to lateral line 6 to 7; scales from anterior end of anus to lateral line 14 to 17.

Υφι

FIGURE

-high,

ουρα

FIGURE

-tail, referring to the arching of the caudal which is often found in the adult.

11.1.1. Hypsurus caryi (L. Agassiz), Rainbow Perch

Embiotoca caryi L. Agassiz, 1853, p. 389 (p. 11 in reprint); Troschel, 1854a, pp. 153, 155, 160, 161; L. Agassiz, 1854, p. 366 (p. 28 in reprint); Troschel, 1855a, p. 32; A. Agassiz, 1861, pp. 126, 133.

Holconotus gibbonsii California Academy of Natural Science, 1854 (MSS); Gibbons, 1854e, p. 122.

Ditrema caryi Günther, 1862, p. 247.

Hypsurus caryi A. Agassiz, 1861, p. 133; Cooper, 1868, p. 489; Smith, 1880; Jordan and Gilbert, 1881e, p. 456; 1882b, p. 593; 1882a, p. 50; Jordan and Jouy, 1882, p. 11; Jordan, 1885, p. 884 (p. 96 in reprint); 1887, p. 278; Eigenmann, 1893, pp. 130, 156; Eigenmann and Eigenmann, 1892, p. 354; Eigenmann, 1894b, p. 404; Eigenmann and Ulrey, 1894, p. 384; Jordan and Evermann, 1896, p. 404; 1898, p. 1508; 1900, fig. 585; Jordan, 1905b, p. 375, fig. 308; Starks and Morris, 1907, p. 202; Hubbs, 1918, p. 11; 1921, pp. 184, 192; Jordan and Evermann, 1922, p. 473, fig.; Ulrey and Greeley, 1928, p. 16; Wales, 1928, p. 60, fig. 3; Bonnot, 1929, p. 230; Clark, 1930, p. 140; Jordan, Evermann and Clark, 1930, p. 412; Walford, 1931, pp. 23, 104, fig. 80; Barnhart, 1936, pp. 74, 79, fig. 237; Roedel, 1948, pp. 22, 78, fig. 50.

Hypsurus careyi Fowler, 1923a, pp. 292, 300 (lapsus calami pro Hypsurus caryi).

Hypsurus traski Starks, 1926, p. 256 (lapsus calami pro Hypsurus caryi).

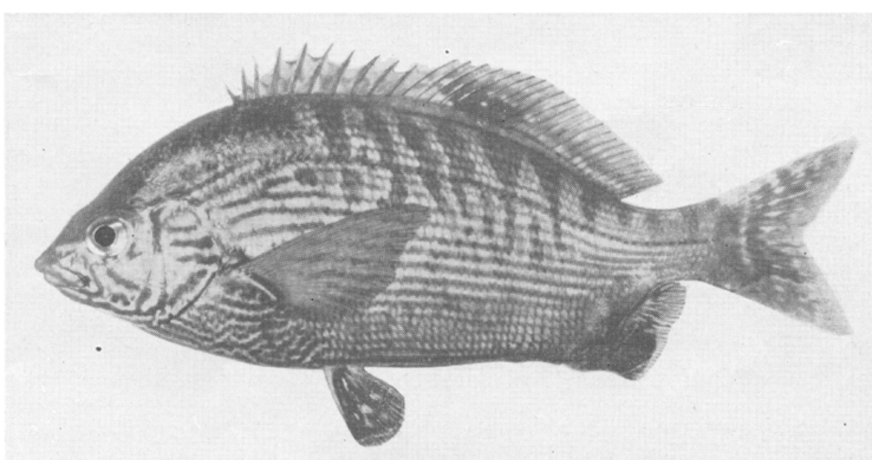

FIGURE 20. *Hypsurus caryi.* Rainbow perch.

FIGURE 20. Hypsurus caryi. Rainbow perch

Body fairly deep, its depth 2.39 (2.1–2.6) in standard length; peduncular length 2.20 (1.8–2.6) in head; least depth of caudal peduncle 2.41 (2.1–2.7) in head.

Head 3.00 (2.7–3.3) in standard length; maxillary fairly long, its length 3.38 (3.0–4.1) in head; dorsal contour of head, rather abrupt, straight to region above end of opercle, then gently curving to origin of dorsal fin; length of snout 2.96 (2.6–3.3) in head; length of eye 3.93 (2.9–4.7) in head; interorbital 3.08 (2.8–3.3) in head.

Origin of dorsal fin anterior to the origin of the pelvic; dorsal base 1.83 (1.6–2.0) in standard length; dorsal sheath 1.14 (1.0–1.2) in dorsal base; soft dorsal 1.63 (1.4–1.8) in dorsal base; fifth, occasionally fourth or sixth, dorsal spine longest, 5.60 (3.7–8.2) in dorsal base, always lower than general contour of soft dorsal fin; last dorsal spine 1.28 (1.0–1.6) in first dorsal ray; longest dorsal ray 3.94 (2.5–5.4) in dorsal base; anterior two or three rays simple, the remainder branched in adults. Origin of anal fin usually under eleventh to fifteenth soft dorsal ray, well posterior to middle of body, excluding head and tail; anal base 3.08 (2.4–3.7) in dorsal base; third anal spine always longest, 3.84 (3.1–5.0) in anal base; longest ray 2.16 (1.8–2.5) in anal base; anterior anal rays simple, the remaining ones branched; anal gland of males appearing as a fleshy organ on the anterior portion of the fin, its tubular opening usually directed downwards. Base of upper pectoral ray under third to sixth scale of lateral line; distance from upper end of pectoral base to first dorsal spine 2.01 (1.7–2.3) in dorsal base; fin moderately long, third or fourth (occasionally second) ray longest, 1.19 (1.0–1.3) in head; base of fin 3.42 (3.1–3.7) in longest ray; first ray simple, remainder branched, except for ventral one. Origin of pelvic fin posterior to first dorsal spine; second or third ray longest, 1.97 (1.7–2.3) in head; pelvic spine 1.55 (1.3–1.8) in longest ray.

Measurements in per mille of standard length based on 29 specimens from 55.0 mm to 196.1 mm (average 129.1 mm) in standard length: length of head 333 (297–364); length of maxillary 99 (89–112); length of eye 87 (67–125); length of snout 112 (99–126); width of interorbital space 108 (96–117); distance from first dorsal to pelvic 419 (380–460); distance from first dorsal spine to first anal spine 564 (496–616); distance from first anal spine to last dorsal ray 276 (236–323); caudal depth 151 (138–167); least depth of caudal peduncle 120 (104–135); distance from tip of snout to first dorsal 407 (367–449); distance from first dorsal spine to hypural 706 (664–746); distance from last dorsal ray to hypural 164 (141–187); length of dorsal base 546 (489–595); length of dorsal sheath 477 (421–512); length of soft dorsal base 334 (306–378); longest dorsal spine 102 (66–132); longest dorsal ray 143 (107–189); length of ultimate dorsal spine 81 (56–122); length of first dorsal ray 102 (67–140); distance from tip of snout to anal 743 (676–809); distance from first anal spine to hypural 328 (272–382); distance from last anal ray to hypural 152 (125–184); length of anal base 179 (147–207); length of longest anal spine 46 (33–63); length of longest anal ray 84 (67–109); distance from tip of snout to upper end of pectoral base 336 (304–363); distance from first dorsal to upper end of pectoral base 272 (233–295); width of pectoral base 82 (74–87); length of longest pectoral ray 280 (256–307); distance from tip of snout to pelvic 456 (432–487); length of longest pelvic ray 170 (141–203); length of pelvic spine 110 (90–138).

Fin and scale formulae: D. X (IX–XI), 22 (21–24); A. III, 22 (21–23); P. 22 (21–23); L1 66 (63–71) (one specimen with 60) + 7 (6–8); scales from first dorsal spine to lateral line 9 (8–9).

Color and pattern stable. Entire body marked by horizontal stripes of red, orange and blue. Head with streaks of orange and sky blue. Fins usually tinged with orange; soft dorsal with a series of small creamy spots and a black blotch anteriorly; a similar black blotch on the anterior portion of anal fin. A very beautiful and strikingly colored fish.

I have examined specimens of this species from the following localities: Sausalito, Marin County, California; Elkhorn Slough, Monterey County, California; Pacific Grove, Lat. 36° 37' 20" N., Long. 121° 54' 08" W.; kelp beds off Gaviota, Santa Barbara County, California; Santa Barbara, Santa Barbara County, California; off La Jolla, San Diego County, California; Todos Santos Island, Baja California, Lat. 31° 47' 50" N., Long. 116° 47' 29" W.

The previously recorded range of this species is from Cape Mendocino, California to San Diego, California. The range is hereby extended southwards about 50 miles.

The name, caryi, was given in honor of Mr. Thomas G. Cary, who discovered and sent the first specimen to his brother-in-law, Dr. Louis Agassiz.

11.2. Genus Phanerodon Girard

Phanerodon Girard, 1854d, p. 153 (genotype by monotypy, Phanerodon furcatus Girard); 1855, p. 321; Troschel, 1855c, p. 348; Girard, 1858, p. 183; A. Agassiz, 1861, pp. 123, 128; Gill, 1862, p. 274; Jordan and Gilbert, 1881e, p. 456; Eigenmann and Ulrey, 1894, pp. 384, 393; Jordan and Evermann, 1896, p. 404; 1898, pp. 1495, 1506; Jordan and Sindo, 1902, p. 354; Jordan and Evermann, 1922, p. 472; Jordan, Evermann and Clark, 1930, p. 411; Barnhart, 1936, p. 78.

Ditrema Günther, 1862, pp. 244, 245 (ex parte); Jordan and Gilbert, 1882b, p. 586 (ex parte).

Embiotica Smith, 1880 (lapsus calami pro Embiotoca).

Embiotoca Eigenmann and Ulrey, 1894, p. 394 (listed in synonymy).

Body moderately long (to more than 200 mm in standard length); dorsal contour of body gently curved, about the same as ventral; caudal peduncle rather long, tapering, its length 1.2 to 1.7 in head, rather narrow, its depth 2.3 to 3.0 in head.

Head relatively small, more than 2.9 in standard length; mouth terminal; jaws equal; maxillary short, 3.5 to 4.4 in head, not reaching a vertical from anterior edge of orbit; eye rounded; frenum present.

Base of dorsal fin fairly long, 1.9 to 2.2 in standard length; dorsal sheath extending almost its entire length, its ventral origin under penultimate dorsal spine to first dorsal ray. Lowermost pectoral rays not frayed.

Scales from dorsal sheath to lateral line 4 to 5; scales from anterior end of anus to lateral line 14 to 17.

Φανερός

FIGURE

-evident,

οδονς

FIGURE

-tooth, for the supposedly enlarged teeth of this genus.

11.2.1. Phanerodon atripes (Jordan and Gilbert), Sharpnose Perch

Ditrema atripes Jordan and Gilbert, 1881d, pp. 320, 321; 1881e, p. 456; 1882b, p. 595; 1882a, p. 50; Jordan and Jouy, 1882, p. 11; Jordan, 1885, p. 885 (p. 97 in reprint); 1887, p. 277; Eigenmann and Eigenmann, 1889c, p. 132 (p. 10 in reprint).

Ditrema orthonotus Eigenmann and Eigenmann, 1889b, p. 4.

Phanerodon atripes Eigenmann, 1893, pp. 130, 157; Eigenmann and Ulrey, 1894, pp. 393, 395; Jordan and Evermann, 1896, p. 404; 1898, p. 1507; Jordan, 1905b, p. 375; Starks and Morris, 1907, p. 202; Hubbs, 1918, p. 11; Higgins and Sette, 1921, p. 270; Jordan and Evermann, 1922, p. 472; Fowler, 1923a, p. 300; Ulrey and Greeley, 1928, p. 17; Jordan, Evermann and Clark, 1930, p. 411; Barnhart, 1936, pp. 74, 78, 79; Roedel, 1948, pp. 22, 83.

Phanerodon orthonotus Eigenmann, 1893, pp. 130, 157.

Body fairly deep, its depth 2.52 (2.3–2.6) in standard length; peduncular length 1.58 (1.4–1.7) in head; least depth of caudal peduncle 2.86 (2.6–3.0) in head.

Head 3.26 (3.1–3.3) in standard length; maxillary fairly short, its length 3.70 (3.5–4.1) in head; anterior profile of head rather sharply pointed, dorsal contour fairly straight to origin of dorsal fin; snout sharply conic, straight, 3.25 (2.8–3.4) in head; length of eye 4.26 (3.7–4.6) in head; interorbital 3.02 (2.8–3.4) in head.

Lateral line farthest from the dorsal contour of the body at its origin, generally nearest on the caudal peduncle.

Origin of dorsal fin anterior to origin of the pelvic; dorsal base 2.04 (1.9–2.1) in standard length; dorsal sheath 1.33 (1.2–1.3) in dorsal base; soft dorsal 1.68 (1.6–1.7) in dorsal base; spinous dorsal evenly graduated to longest spine (fifth to ninth) then fairly even in profile; longest dorsal spine 4.58 (4.3–4.8) in dorsal base, about same height as soft dorsal rays; last dorsal spine 1.13 (1.0–1.1) in first dorsal ray; longest dorsal ray 3.66 (3.3–3.9) in dorsal base; anterior two or three rays simple, the remainder branched in adults. Origin of anal fin usually under fourth to sixth dorsal ray; anal base 1.84 (1.7–1.9) in dorsal base; third anal ray always longest, 4.88 (4.5–5.4) in anal base; longest ray 3.40 (3.1–3.7) in anal base; anterior anal rays simple, the remaining elements branched; anal gland of male appearing as a fleshy organ on the anterior portion of the fin, its orifice opening obliquely downwards. Base of upper pectoral ray under fourth or fifth scale of the lateral line; distance from upper end of pectoral base to first dorsal spine 1.94 (1.8–2.1) in dorsal base; fin moderately long, third or fourth (occasionally fifth) ray longest, 1.11 (1.0–1.1) in head; base of fin 3.64 (3.4–3.9) in longest ray; first ray simple, remainder branched except for lower two or three. Origin of pelvic fin posterior to first dorsal spine; first or second ray longest, 1.72 (1.6–1.8) in head; pelvic spine 1.38 (1.3–1.4) in longest ray.

Measurements in per mille of standard length based on 6 specimens from 125.0 mm to 196.9 mm (average 171.0 mm) in standard length: length of head 306 (300–314); length of maxillary 83 (76–92); length of eye 72 (66–84); length of snout 94 (86–107); width of interorbital space 101 (88–110); distance from first dorsal to pelvic 396 (372–426); distance from first dorsal spine to first anal spine 444 (424–464); distance from first anal spine to last dorsal ray 357 (333–375); caudal depth 159 (145–171); least depth of caudal peduncle 107 (99–116); distance from tip of snout to first dorsal 395 (375–418); distance from first dorsal spine to hypural 691 (662–736); distance from last dorsal ray to hypural 206 (183–223); length of dorsal base 490 (462–510); length of dorsal sheath 369 (348–396); length of soft dorsal base 293 (267–312); longest dorsal spine 107 (102–112); longest dorsal ray 134 (128–146); length of ultimate dorsal spine 100 (94–112); length of first dorsal ray 113 (108–120); distance from tip of snout to anal 610 (587–655); distance from first anal spine to hypural 460 (440–480); distance from last anal ray to hypural 194 (182–207); length of anal base 267 (250–287); length of longest anal spine 55 (45–60); length of longest anal ray 78 (72–83); distance from tip of snout to upper end of pectoral base 305 (295–314); distance from first dorsal to upper end of pectoral base 254 (229–277); width of pectoral base 76 (70–80); length of longest pectoral ray 276 (268–280); distance from tip of snout to pelvic 434 (419–453); length of longest pelvic ray 177 (172–184); length of pelvic spine 129 (122–134).

Fin and scale formulae : D. X (X–XI), 23 (22–24); A. III, 29 (27–30); P. 21 (20–22); L1 66 (63–68) + 5 (5–6); scales from first dorsal spine to lateral line 6 (6–7).

Color generally stable, pattern stable. Ground color silvery, overlain dorsally with sooty tones. Body walls usually with reddish streaks. Anal fin often with black anteriorly; pelvics black; remaining fins plain or slightly dusky. Occasionally a rosy hue overall.

I have examined specimens of this species from the following localities in California : Monterey Bay, Monterey County; off Gaviota (from seismic blasting), Santa Barbara County.

The recorded range of this species is from Monterey, California to San Diego, California.

Taken in comparatively deep water.

The name is derived from *ater* -black and *pes* -foot, in allusion to the black fringed pelvics.

11.2.2. Phanerodon furcatus Girard, White Perch

Phanerodon furcatus Girard, 1854d, p. 153; 1855, p. 322; Troschel, 1855c, p. 349; Girard, 1858, p. 184, pl. xxxiv (figs. 1–5); A. Agassiz, 1861, p. 128; Cooper, 1868, p. 489; Eigenmann, 1894b, p. 404; Eigenmann and Ulrey, 1894, p. 394; Jordan and Evermann, 1896, p. 404; 1898, p. 1506; 1900, fig. 583; Jordan, 1905b, p. 375; Starks and Morris, 1907, p. 202; Starks, 1911, p. 209; Hubbs, 1918, p. 11; Jordan and Evermann, 1922, p. 472, fig.; Fowler, 1923a, pp. 292, 300; Hubbs, 1928, p. 13; Ulrey and Greeley, 1928, p. 17; Wales, 1928, p. 61, fig. 4; Bonnot, 1929, p. 230; Clark, 1930, p. 140; Jordan, Evermann and Clark, 1930, p. 411; Walford, 1931, pp. 24, 106, fig. 82; Barnhart, 1936, pp. 74, 78, 79, fig. 235; Schultz, 1936, p. 190; Schultz and DeLacy, 1936, p. 137; Herz, 1941, p. 75, fig. 64; Clemens and Wilby, 1946, pp. 28, 152, fig. 90; Roedel, 1948, pp. 22, 83, fig. 55.

Phanerodon forcatus Girard, 1855, p. 322 (in synonymy, lapsus calami pro Phanerodon furcatus).

Ditrema furcatum Günther, 1862, p. 247; Jordan and Gilbert, 1881d, pp. 320, 321; 1881a, p. 28; 1881e, p. 456; 1882b, p. 596; 1882a, p. 50; Jordan and Jouy, 1882, p. 11; Jordan, 1885, p. 885 (p. 97 in reprint); Smith, 1885; Jordan, 1887, p. 277.

Embiotica furcata Smith, 1880 (lapsus calami pro Embiotoca furcata).

Phanerodon furcatum Eigenmann, 1893, pp. 130, 157; Eigenmann and Ulrey, 1894, p. 393.

Embiotoca furcata Eigenmann and Ulrey, 1894, p. 393 (in synonymy).

Body fairly deep, its depth 2.50 (2.3–2.7) in standard length; peduncular length 1.53 (1.2–1.7) in head; least depth of caudal peduncle 2.50 (2.3–2.8) in head.

Head 3.31 (2.9–3.6) in standard length; maxillary fairly short, its length 3.95 (3.5–4.4) in head; dorsal contour of head gently curved to origin of dorsal fin, occasionally very slightly sigmoid; snout bluntly conic, rounded slightly, on a curve with the dorsal contour of the head,

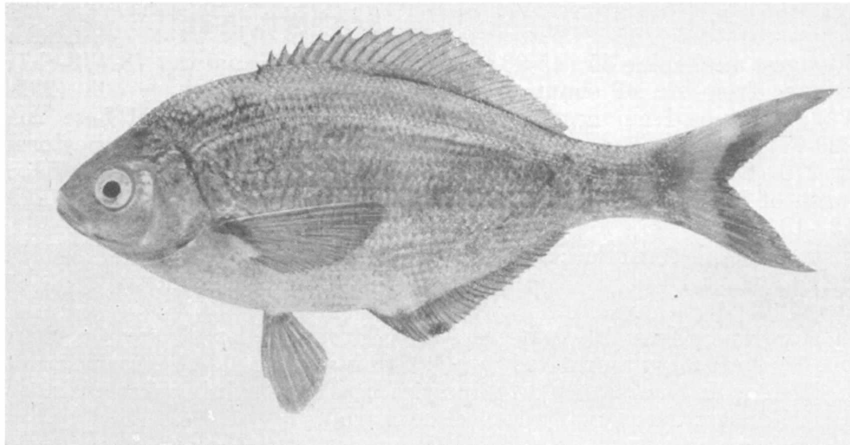

FIGURE 21. *Phanerodon furcatus.* White perch.

FIGURE 21. Phanerodon furcatus. White perch

its length 3.36 (3.0–3.6) in head; length of eye 3.81 (2.9–4.5) in head; interorbital 2.96 (2.6–3.2) in head.

Lateral line farthest from the dorsal contour of the body at its origin, generally nearest at the end of the dorsal fin.

Origin of dorsal fin about opposite origin of pelvics; dorsal base 2.05 (1.9–2.2) in standard length; dorsal sheath 1.26 (1.1–1.3) in dorsal base; soft dorsal 1.58 (1.4–1.7) in dorsal base; spinous dorsal progressively increasing in length to about the last spine; longest dorsal spine 4.45 (3.0–5.4) in dorsal base, somewhat shorter than the contour of the soft dorsal rays; last dorsal spine 1.23 (1.0–1.3) in first dorsal ray; longest dorsal ray 3.14 (2.6–3.7) in dorsal base; anterior one to three rays simple, the remaining elements branched in adults. Origin of anal fin usually under third or fourth dorsal ray; anal base 1.55 (1.3–1.7) in dorsal base; third anal ray always longest, 6.02 (4.3–8.1) in anal base; longest ray 3.44 (2.7–4.3) in anal base; anterior anal rays simple, the remaining elements branched; anal gland of males appearing as a fleshy organ on the anterior portion of the fin, its opening directed obliquely downwards. Base of upper pectoral ray under third to fifth scale of the lateral line; distance from upper end of pectoral base to first dorsal spine 1.81 (1.4–2.0) in dorsal base; fin moderately long, third or fourth ray longest, 1.15 (1.0–1.2) in head; base of fin 3.65 (3.3–4.0) in longest ray; first ray simple, remainder branched except for ventral two or three. Origin of pelvic about opposite origin of dorsal fin; first or second ray longest, 1.72 (1.5–1.9) in head; pelvic spine 1.52 (1.3–1.6) in longest ray.

Measurements in per mille of standard length based on 50 specimens from 64.9 mm to 204.5 mm (average 130.1 mm) in standard length : length of head 302 (278–336); length of maxillary 76 (66–92); length of eye 80 (62–110); length of snout 90 (79–107); width of interorbital space 102 (87–113); distance from first dorsal to pelvic 400 (369–430); distance from first dorsal spine to first anal spine 440 (411–464); distance from first anal spine to last dorsal ray 406 (370–436); caudal depth 172 (158–192); least depth of caudal peduncle 120 (110–135); distance from tip of snout to first dorsal 408 (366–448); distance from first dorsal spine to hypural 686 (645–725); distance from last dorsal ray to hypural 205 (176–225); length of dorsal base 488 (450–521); length of dorsal sheath 389 (349–437); length of soft dorsal base 309 (268–342); longest dorsal spine 110 (93–152); longest dorsal ray 156 (133–174); length of ultimate dorsal spine 103 (88–130); length of first dorsal ray 128 (111–147); distance from tip of snout to anal 559 (519–610); distance from first anal spine to hypural 509 (458–543); distance from last anal ray to hypural 197 (176–223); length of anal base 315 (282–345); length of longest anal spine 53 (40–68); length of longest anal ray 92 (79–116); distance from tip of snout to upper end of pectoral base 305 (274–340); distance from first dorsal to upper end of pectoral base 270 (242–323); width of pectoral base 72 (66–79); length of longest pectoral ray 263 (227–288); distance from tip of snout to pelvic 410 (386–435); length of longest pelvic ray 176 (157–190); length of pelvic spine 116 (97–135).

Fin and scale formulae : D. X (IX–XI), 23 (20–26); A. III, 31 (29–34); P. 20 (20–21); L1 61 (56–67) + 6 (5–7); scales from first dorsal spine to lateral line 5 (4–5).

Color stable; pattern generally stable. Ground color silvery, dorsum usually olivaceous. Body walls plain, occasionally with a yellowish tinge. A line of black along base of soft dorsal fin. Occasionally entire body with a rosy hue. Fins usually with a yellowish cast, plain, except for edging of black on caudal and an occasional black spot on anterior portion of anal fin.

I have examined specimens of this species from the following localities in California : Humboldt Bay, Lat. 40° 49' 08" N., Long. 124° 10' 44" W.; Bodega Lagoon Inlet, Lat. 38° 18' 18" N., Long. 123° 03' 25" W.; Pacific Gas and Electric Pumping Station A, San Francisco, San Francisco County; Capitola, Santa Cruz County; Monterey Bay, Lat. 36° 50' N., Long. 121° 48' 30" W. and Lat. 36° 46' N., Long. 121° 50' W.; San Simeon, San Luis Obispo County; Avila, San Luis Obispo County; off Gaviota, Santa Barbara County; Santa Barbara, Lat. 34° 40' 54" N., Long. 119° 24' 16" W.; Newport Bay, Orange County; off La Jolla, San Diego County; San Diego, San Diego County.

The recorded range of this species is from Vancouver Island, British Columbia, to San Diego, California.

It is the most important commercial species in the state. Frequently taken incidentally by trawl fishermen and purse seiners.

The name, furcatus -forked, from the supposedly marked forking of the adult caudal fin.

11.3. Genus Rhacochilus Agassiz

Rhacochilus L. Agassiz, 1854, p. 367 (p. 29 in reprint) (genotype by monotypy, Rhacochilus toxotes); Troschel, 1855a, p. 33; Girard, 1858, p. 188; A. Agassiz, 1861, p. 130; Gill, 1862, p. 275; Jordan and Gilbert, 1882b, p. 586; Jordan, 1885, p. 885 (p. 97 in reprint); Eigenmann and Ulrey, 1894, pp. 383, 389; Jordan and Evermann, 1896, p. 404; 1898, pp. 1495, 1507; 1922, p. 473; Jordan, Evermann and Clark, 1930, p. 411.

Pachylabrus Gibbons, 1854c (genotype by monotypy, Pachylabrus variegatus); 1854e, p. 126; Troschel, 1855b, p. 341.

Rhacocheilus Girard, 1855, p. 320 (lapsus calami pro Rhacochilus).

Damalichthys Girard, 1855, p. 321 (genotype by monotypy, Damalichthys vacca); Troschel, 1855c, p. 348; Girard, 1858, p. 181; A. Agassiz, 1861, pp. 123, 127; Gill, 1862, p. 274; Jordan and Gilbert, 1882b, pp. 586, 597; 1882a, p. 50; Jordan, 1885, p. 885 (p. 97 in reprint); Eigenmann and Ulrey, 1894, pp. 383, 385; Jordan and

Evermann, 1896, p. 404; 1898, pp. 1495, 1509; 1922, p. 473; Jordan, Evermann and Clark, 1930, p. 412.

Embiotoca Girard, 1856, p. 136 (genotype by monotypy, Embiotoca argyrosoma).

Ditrema Günther, 1862, pp. 246, 247 (ex parte).

Damolichthys Blake, 1867, p. 371 (lapsus calami pro Damalichthys).

Damalicthys Randolph, 1898, p. 305 (lapsus calami pro Damalichthys).

Rhocochilus Starks and Morris, 1907, p. 202; Starks, 1926, p. 256 (lapsus calami pro Rhacochilus).

Body large (more than 275 mm. in standard length), rather deep, its depth 2.1 to 2.6 in standard length; dorsal profile straight anteriorly, curving gently behind nape; caudal peduncle fairly long, its length 1.4 to 2.0 in head.

Head fairly large, 2.5 to 3.1 in standard length; mouth slightly oblique; maxillary usually reaching anterior edge of orbit; snout fairly long, bluntly conic.

Origin of dorsal slightly in advance of origin of pelvic; base of dorsal fin fairly long, its length 1.9 to 2.3 in standard length; dorsal sheath rather long, its length 1.1 to 1.4 in dorsal base; spinous dorsal evenly graduated to about ninth or tenth spine, posterior elements of about equal length; anterior soft dorsal rays about 1.5 to 2.0 times the height of the spinous dorsal (in adults). Anterior anal rays simple, the posterior elements branched; no lunar-shaped depression in body wall, dorsal to anal base; anal gland appearing as a fleshy organ on the anterior portion of fin, its tubular opening directed obliquely downwards. Lowermost pectoral rays not frayed.

One or two distinct vertical dusky bars on body, present at some time during life history. The anterior bar usually running from the juncture of the spinous with the soft dorsal fin, the posterior bar from the end of the dorsal fin. These bars are quite obvious in the juvenile stage, usually becoming obliterated in the adult, however, this feature retains its prominence in those adults which are maintained as aquarium fishes.

Rhacochilus, from the Greek

Ρακος

FIGURE

ragged and

χειλος

FIGURE

lip, referring to the thick, incised lip of R. toxotes.

11.4. Rhacochilus toxotes Agassiz, Rubberlip Perch

Rhacochilus toxotes L. Agassiz, 1854, p. 367 (p. 29 in reprint); Girard, 1854d, pp. 151, 152; 1854a, p. 81; Troschel, 1855a, p. 33; Girard, 1858, p. 188, pl. xl; A. Agassiz, 1861, p. 130; Cooper, 1868, p. 489; Jordan and Gilbert, 1881e, p. 456; 1882b, p. 596; 1882a, p. 49; Jordan and Jouy, 1882, p. 11; Jordan, 1885, p. 885 (p. 97 in reprint); 1887, pp. 276, 277; Eigenmann and Eigenmann, 1889d, p. 11; Eigenmann, 1890a; 1893, pp. 130, 157; Eigenmann and Ulrey, 1894, p. 390, fig. 2; Jordan and Evermann, 1896, p. 404; 1898, p. 1507; 1900, fig. 584; Jordan, 1905b, p. 375, fig. 310; Hubbs, 1918, p. 10; Higgins and Sette, 1921, p. 270; Jordan and Evermann, 1922, p. 473, fig.; Fowler, 1923a, pp. 285, 292, 300; Ulrey and Greeley, 1928, p. 17; Wales, 1928, p. 60, fig. 1; Clark, 1930, p. 140; Jordan, Evermann and Clark, 1930, p. 411; Walford, 1931, pp. 24, 108, fig. 84; Barnhart, 1936, pp. 74, 79, fig. 236; Herz, 1941, p. 75, fig. 65; Roedel, 1948, pp. 22, 81, fig. 53.

Pachylabrus variegatus Gibbons, 1854c; 1854e, p. 126; Troschel, 1855b, p. 341.

Rhacocheilus toxotes Girard, 1856, p. 136; 1857a, p. 541.

Ditrema toxotes Günther, 1862, p. 247.

Rhocochilus toxotes Starks and Morris, 1907, p. 202; Starks, 1926, p. 256.

Body depth changing with age, the young being more slender than the adult, 2.42 (2.1–2.6) in standard length; peduncular length 1.65 (1.4–2.0) in head; least depth of caudal peduncle 2.68 (2.3–3.1) in head.

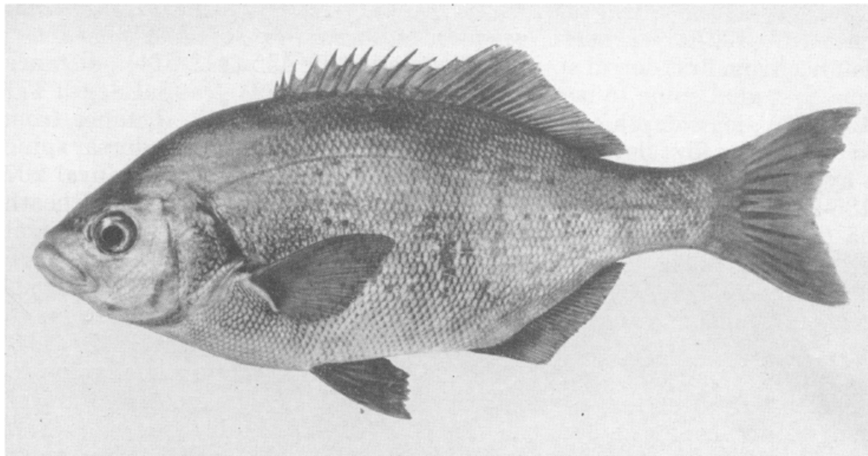

FIGURE 22. *Rhacochilus toxotes.* Rubberlip perch.

FIGURE 22. Rhacochilus toxotes. Rubberlip perch

Head 2.88 (2.5–3.1) in standard length; mouth fairly large, length of maxillary 2.78 (2.5–3.2) in head; snout on a fairly straight line with dorsal contour of head, its length 2.75 (2.5–2.9) in head; posterior nostril oval to round in shape, oblique to horizontal axis of body; eye very slightly longer than high, its length 4.12 (3.3–4.7) in head; interorbital 3.26 (2.7–3.6) in head; lower lip not interrupted by a frenum; lips extremely thick and incised.

Lateral line farthest from the dorsal contour of the body at its origin, generally nearest at a point equidistant from hypural and posterior end of dorsal base, depressed slightly beyond this point.

Length of dorsal base 2.17 (2.0–2.3) in standard length; dorsal sheath 1.30 (1.2–1.3) in dorsal base; ventral origin of dorsal sheath generally under ultimate dorsal spine to second dorsal ray; soft dorsal 1.69 (1.5–1.9) in dorsal base; seventh (occasionally fifth, sixth or eighth) dorsal spine longest, its length 5.35 (4.5–6.6) in dorsal base; tip of longest spine generally a great deal lower than general contour of soft dorsal, except in young; last dorsal spine 1.40 (1.1–2.1) in first dorsal ray; second or third ray longest, its length 3.00 (2.7–3.7) in dorsal base; first two rays simple, the remainder branched in adults. Origin of anal fin under fifth to seventh dorsal ray, in adults; anal base 1.83 (1.6–2.2) in dorsal base; third anal spine longest, its length 5.51 (4.4–7.4) in anal base; position of longest ray variable, in anterior portion of fin, its length 2.84 (2.3–3.1) in anal base. Base of upper pectoral ray on a vertical somewhere between first and fourth lateral-line scale; distance from upper end of pectoral base to first dorsal spine 1.66 (1.6–1.7) in dorsal base; fourth pectoral ray longest, its length 1.38 (1.3–1.4) in head; base of fin 3.23 (2.8–3.5) in longest ray. Origin of pelvic fin slightly posterior to origin of dorsal (except in young where it is generally opposite); first, or second, ray longest, its length 1.97 (1.7–2.1) in head; pelvic spine 1.53 (1.4–1.5) in longest ray.

Measurements in per mille of standard length based on 11 specimens from 78.5 mm to 308.0 mm (average 184.7 mm) in standard length; length of head 347 (314–387); length of maxillary 125 (107–136); length of eye 86 (68–106); length of snout 126 (114–142); width of interorbital space 107 (102–124); distance from first dorsal to pelvic 413 (380–456); distance from first dorsal spine to first anal spine 455 (412–514); distance from first anal spine to last dorsal ray 368 (352–379); caudal depth 171 (153–183); least depth of caudal peduncle 130 (120–135); distance from tip of snout to first dorsal 439 (421–464); distance from first dorsal spine to hypural 659 (625–695); distance from last dorsal ray to hypural 207 (185–224); length of dorsal base 461 (433–488); length of dorsal sheath 355 (332–382); length of soft dorsal base 272 (230–287); longest dorsal spine 87 (72–100); longest dorsal ray 154 (128–174); length of ultimate dorsal spine 79 (60–90); length of first dorsal ray 109 (78–127); distance from tip of snout to anal 606 (571–655); distance from first anal spine to hypural 457 (411–495); distance from last anal ray to hypural 211 (191–227); length of anal base 253 (191–227); length of longest anal spine 47 (35–62); length of longest anal ray 90 (76–120); distance from tip of snout to upper end of pectoral base 346 (314–382); distance from first dorsal to upper end of pectoral base 276 (254–303); width of pectoral base 78 (70–85); length of longest pectoral ray 250 (235–269); distance from tip of snout to pelvic 443 (412–481); length of longest pelvic ray 176 (158–189); length of pelvic spine 115 (102–125).

Fin and scale formulae: D.X (X–XI), 23 (22–24); A. III, 29 (27–30); P. 23 (21–24); L1 72 (69–76) + 7 (6–9); scales from first dorsal spine to lateral line 12 (11–12); scales from dorsal sheath to lateral line 9 (8–11); scales from anterior end of anus to lateral line 22 (22–24).

Color variable, pattern often obliterated (see generic description). Ground color silvery, dorsum overlain with blue or purple, occasionally blackish. Some individuals coppery overall. Pectoral fins yellowish, pelvics usually black, all other fins dusky or fringed with black. The large, heavy, incised lips usually white or pink.

I have examined specimens of this species from the following localities in California: Pacific Gas and Electric Pumping Station A, San Francisco, San Francisco County; Pacific Grove, Lat. 36° 37' 20" N., Long. 121° 54' 08" W.; off Gaviota, Santa Barbara County; San Pedro, Los Angeles County; off Torrey Pines (between La Jolla and Del Mar), San Diego County.

The recorded range of this species is from Bodega Harbor, Sonoma County, to San Diego, California.

This species taken commonly by anglers in rocky areas and is said to be the finest food fish of the family. Forms, along with Phanerodon furcatus, the major bulk of California's "perch" catch.

The name toxotes is from the Greek, meaning an archer.

11.4.1. Rhacochilus vacca (Girard), Pile Perch

Damalichthys vacca Girard, 1855, p. 321; Troschel, 1855c, p. 348; Girard, 1858, p. 182, pl. xxxiii; A. Agassiz, 1861, p. 127; Cooper, 1868, p. 489; Lockington, 1880b, p. 30; Jordan and Gilbert, 1881e, p. 456; Clark, 1930, p. 140; Walford, 1931, pp. 24, 107, fig. 83; Schultz, 1936, p. 190; Schultz and DeLacy, 1936, p. 137; Clemens and Wilby, 1946, pp. 27, 151, fig. 89; Roedel, 1948, pp. 22, 82, fig. 54.

Embiotoca argyrosoma Girard, 1856, p. 136; 1857b, p. 25; 1858, pp. 165, 180; A. Agassiz, 1861, pp. 123, 124, 127; Gill, 1862, p. 274; Cooper, 1868, p. 489; Jordan and Gilbert, 1881e, p. 456.

Ditrema vacca Günther, 1862, p. 246.

Phanerodon argyrosoma Gill, 1862, p. 274 (note).

Ditrema argyrosoma Jordan and Gilbert, 1881d, p. 321.

Damalichthys argyrosomus Jordan and Gilbert, 1881e, p. 456; 1882b, p. 597; 1882a, p. 49; Jordan and Jouy, 1882, p. 11; Bean, 1884, p. 360; Jordan, 1885, p. 885 (p. 97 in reprint); Jordan, 1887, pp. 276, 277; Eigenmann and Eigenmann, 1890, p. 9; Eigenmann, 1893, pp. 130, 157; Eigenmann and Ulrey, 1894, p. 385, fig. 1; Jordan and Starks, 1895, p. 797; Gilbert, 1895, p. 476; Jordan and Evermann, 1896, p. 404; 1898, p. 1509; 1900, fig. 586; Jordan, 1905b, p. 375, fig. 309; Evermann and Goldsborough, 1907, p. 279, fig. 28; Starks and Morris, 1907, p. 203; Starks, 1911, p. 209; Hubbs, 1918, p. 11; Higgins and Sette, 1921, p. 270; Jordan and Evermann, 1922, p. 473, fig.; Fowler, 1923a, pp. 283, 285, 292, 300; 1923b, p. 78; Hubbs, 1928, p. 13; Ulrey and Greeley, 1928, p. 16; Wales, 1928, p. 61, fig. 5; 1929, pp. 57, 58; Jordan, Evermann and Clark, 1930, p. 412; Barnhart, 1936, pp. 74, 79, fig. 238.

Embiotoca argyrosomus Eigenmann and Ulrey, 1894, p. 385 (in synonymy).

Damalicthys argyrosomus Randolph, 1898, p. 305.

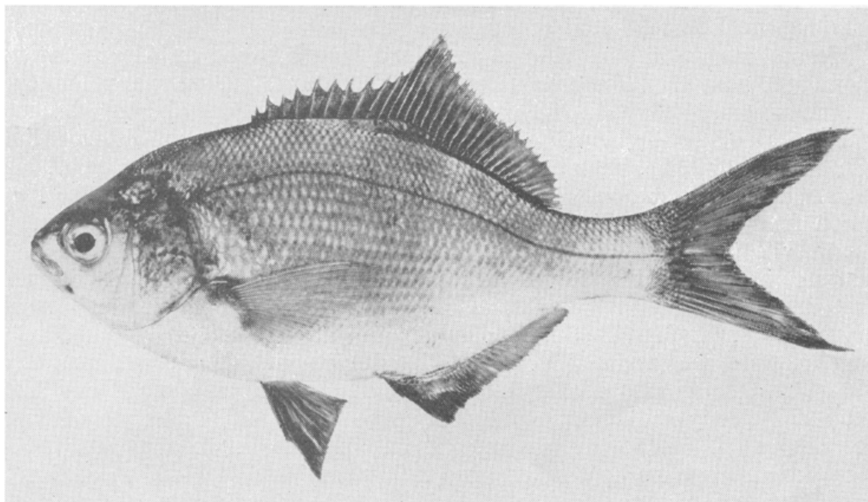

FIGURE 23. *Rhacochilus vacca.* Pile perch.

FIGURE 23. Rhacochilus vacca. Pile perch

Body depth changing somewhat with age, the young being more slender than the adult, 2.32 (2.1–2.5) in standard length; peduncular length 1.66 (1.4–1.9) in head; least depth of caudal peduncle 2.52 (2.1–2.8) in head.

Head 3.03 (2.7–3.2) in standard length; mouth moderate in size, length of maxillary 3.90 (3.0–4.7) in head; snout short, on a fairly straight line with dorsal contour of head (curved in young), its length 3.52 (3.0–4.3) in head; posterior nostril usually slit-like, occasionally oval, paralleling the horizontal axis of the body; eye round, its length 3.80 (2.7–5.4) in head; interorbital 2.84 (2.4–3.3) in head; posterior groove of lower lip interrupted by a broad frenum; lips moderate.

Lateral line farthest from the dorsal contour of body at its origin, generally nearest at posterior end of dorsal fin, depressed slightly at caudal peduncle.

Length of dorsal base 2.12 (1.9–2.3) in standard length; dorsal sheath 1.30 (1.1–1.4) in dorsal base; ventral origin of dorsal sheath generally under first or second dorsal ray; soft dorsal 1.64 (1.2–1.7) in dorsal base; ninth dorsal spine (occasionally others) longest, its length 5.16

(4.0–6.9) in dorsal base; tip of longest spine generally a great deal lower than contour of soft dorsal (except in very young); last dorsal spine 1.91 (1.1–2.7) in first dorsal ray; first or second ray usually longest, its length 2.42 (2.1–2.8) in dorsal base; first, and usually second, ray simple, the remaining elements branched in adults. Origin of anal fin under third to seventh dorsal ray; anal base 1.66 (1.4–1.9) in dorsal base; third anal spine longest, its length 5.01 (3.7–6.3) in anal base; first ray (occasionally others) longest, its length 2.75 (2.0–4.2) in anal base. Base of upper pectoral ray on a vertical somewhere between second and fifth scale of lateral line; distance from upper end of pectoral base to first dorsal spine 1.64 (1.4–1.7) in dorsal base; third, or fourth, pectoral ray longest, its length 1.17 (0.9–1.3) in head; base of fin 3.46 (3.0–3.9) in longest ray. Origin of pelvic slightly posterior to origin of dorsal; first, or second, ray longest, its length 1.83 (1.4–2.2) in head; pelvic spine 1.53 (1.3–1.8) in longest ray.

Measurements in per mille of standard length based on 41 specimens from 58.2 mm to 275.0 mm (average 150.9 mm) in standard length; length of head 330 (305–363); length of maxillary 86 (73–108); length of eye 90 (61–120); length of snout 92 (73–110); width of interorbital space 117 (96–133); distance from first dorsal to pelvic 430 (398–464); distance from first dorsal spine to first anal spine 472 (425–507); distance from first anal spine to last dorsal ray 390 (350–420); caudal depth 177 (161–193); least depth of caudal peduncle 131 (118–147); distance from tip of snout to first dorsal 434 (400–460); distance from first dorsal spine to hypural 680 (653–739); distance from last dorsal ray to hypural 212 (183–244); length of dorsal base 472 (435–514); length of dorsal sheath 364 (334–411); length of soft dorsal base 287 (252–314); longest dorsal spine 94 (66–114); longest dorsal ray 196 (165–225); length of ultimate dorsal spine 89 (60–109); length of first dorsal ray 159 (110–202); distance from tip of snout to anal 601 (546–665); distance from first anal spine to hypural 482 (420–517); distance from last anal ray to hypural 199 (169–224); length of anal base 287 (249–318); length of longest anal spine 59 (44–79); length of longest anal ray 107 (65–138); distance from tip of snout to upper end of pectoral base 333 (292–362); distance from first dorsal to upper end of pectoral base 288 (260–313); width of pectoral base 82 (73–88); length of longest pectoral ray 284 (230–318); distance from tip of snout to pelvic 435 (400–493); length of longest pelvic ray 182 (163–204); length of pelvic spine 119 (103–137).

Fin and scale formulae: D. X. (IX–XI), 22 (21–25); A. III, 28 (27–30); P. 21 (19–22); L1 64 (58–69) + 6 (5–8); scales from first dorsal spine to lateral line 8 (8–9); scales from dorsal sheath to lateral line 6 (6–7); scales from anterior end of anus to lateral line 18 (17–19).

Color fairly stable, pattern stable, although occasionally obliterated by heavy pigmentation (see generic description). Ground color silvery overlain with brown or sooty tones. Dorsum most heavily pigmented. Fins dusky.

I have examined specimens of this species from the following localities: Puget Sound, Washington; Golden Gardens, Seattle, Washington; Bolinas Point, Lat. 37° 54' 06" N., Long. 122° 43' 13" W.; Elkhorn Slough, Lat. 36° 48' 45" N., Long. 121° 47' 15" W.; Pacific Grove, Lat. 36° 37' 20" N., Long. 121° 54' 08" W.; Newport Bay, Orange County, California; off Torrey Pines (between La Jolla and Del Mar), San Diego County, California; mouth of Rio Isidro, Baja California.

The recorded range of this species is from Port Wrangel, Alaska, to northern Baja California.

Taken commonly by anglers along rocky and sandy shores and around wharf piling. Taken incidentally, in purse seine catches of sardines. A moderately important commercial species.

The name *vacca* means cow, in reference to its viviparity.

11.5. Genus Embiotoca L. Agassiz

Embiotoca L. Agassiz, 1853, p. 386 (p. 8 in reprint) (ex parte); 1854, p. 366 (p. 28 in reprint); Girard, 1854d, p. 153; Troschel, 1854a, pp. 152, 153, 157; 1854b, pp. 164, 165, 166, 167; Wyman, 1854, pp. 80, 81; Girard, 1855, p. 320; Troschel, 1855a, pp. 30–34; 1855c, p. 345; Wyman, 1856, p. 204; Girard, 1858, p. 168; A. Agassiz, 1861, pp. 123, 124, 126, 133; Gill, 1862, p. 274; Blake, 1867, p. 371; Jordan and Gilbert, 1881e, p. 456; 1882b, p. 594; Eigenmann and Ulrey, 1894, pp. 382, 383, 392; Jordan and Evermann, 1896, p. 404; 1898, pp. 1495, 1504; Jordan and Sindo, 1902, pp. 354, 357; Boulenger, 1904, p. 670; Hubbs, 1918, p. 11; Jordan and Evermann, 1922, p. 472; Jordan, Evermann and Clark, 1930, p. 411; Barnhart, 1936, pp. 73, 74; David, 1943, p. 144.

Holconotus Gibbons, 1854e, p. 123 (ex parte); Troschel, 1855b, p. 334.

Taeniotoca A. Agassiz, 1861 p. 133 (genotype by monotypy, Taeniotoca lateralis); Jordan and Evermann, 1896, p. 404; 1898, pp. 1495, 1505; 1922, p. 472; Jordan, Evermann and Clark, 1930, p. 411; Blanco, 1938, p. 387.

Ditrema Günther, 1862, p. 244 (ex parte).

Damalichthys Gill, 1862, p. 275 (ex parte).

Embiotica Smith, 1880 (ex parte).

Phanerodon Eigenmann, 1893, pp. 130, 156 (ex parte).

Body moderately long (less than 250 mm in standard length), rather deep, its depth 1.9 to 2.4 in standard length; caudal peduncle short, its length 1.6 to 2.6 in head, deep, its depth 1.8 to 2.5 in head.

Head moderate in size, more than 2.6 in standard length; mouth terminal; jaws equal; maxillary short, 3.0 to 4.5 in head, not reaching a vertical from the anterior edge of orbit; snout bluntly conic, on a straight line with the dorsal contour of head; eye rounded; frenum present.

Lateral line farthest from the dorsal contour of the body at the origin of the dorsal fin, generally nearest at posterior end of dorsal.

Origin of dorsal fin slightly in advance of origin of pelvic; base of fin moderately long, its length 1.8 to 2.2 in standard length; dorsal sheath extending almost entire length of fin, its ventral origin under ultimate dorsal spine to second dorsal ray; spinous dorsal evenly graduated to about the sixth or seventh spine, then fairly even; tip of longest dorsal spine a good deal lower than the general contour of the soft dorsal fin; first, and often second, dorsal ray simple, remaining elements branched, in adults. Anal fin rays simple anteriorly, branched posteriorly; no lunar-shaped depression in body wall, dorsal to anal base; anal gland appearing as a fleshy organ on the anterior portion of the fin, its tubular opening directed obliquely downwards. Lowermost pectoral rays not frayed.

Scales from dorsal sheath to lateral line 6 to 8; scales from anterior end of anus to lateral line 18 to 21.

Embiotoca:

Εμβιος

FIGURE

living, and

τοκος

FIGURE

bringing forth, in reference to the viviparity of the family.

11.5.1. Embiotoca jacksoni L. Agassiz, Black Perch

Embiotoca jacksoni L. Agassiz, 1853, p. 387 (p. 9 in reprint); 1854, p. 366 (p. 28 in reprint); Girard, 1854d, p. 151; Troschel, 1854a, pp. 153, 155, 157, 160, 161, 162; 1854b, p. 166; Girard, 1855, p. 320; Troschel, 1855a, p. 32; 1855c, p. 345; Girard, 1858, p. 168, pls. xxvi (figs. 3, 4), xxvii, xxviii; 1859b, p. 87; A. Agassiz, 1861, pp. 123, 124, 126; Bean, 1880, p. 88; Jordan and Gilbert, 1881a, p. 28; Eigenmann, 1893, pp. 130, 156; Eigenmann and Ulrey, 1894, p. 392; Jordan and Starks, 1895, p. 797; Gilbert, 1895, p. 476; Jordan and Evermann, 1896, p. 404; 1898, p. 1504; Jordan and McGregor, 1899, p. 281; Jordan, 1905b, pp. 375, 377; Starks and Morris, 1907, p. 201; Starks, 1911, p. 209; Metz, 1912, p. 34, pl. IB; Osburn and Nichols, 1916, p. 168; Hubbs, 1918, p. 11; 1921, p. 184; Jordan and Evermann, 1922, p. 472; Fowler, 1923a, pp. 283, 285, 292, 300; 1923b, p. 78; Starks, 1926, p. 256; Hubbs, 1928, p. 13; Ulrey and Greeley, 1928, p. 16; Wales, 1928, p. 60, fig. 2; Clark, 1930, p. 140; Jordan, Evermann and Clark, 1930, p. 411; Walford, 1931, pp. 23, 103, fig. 79; Barnhart, 1936, pp. 73, 74, 78, fig. 233; Schultz and DeLacy, 1936, p. 215; Hewatt, 1946, p. 205; Roedel, 1948, pp. 22, 77, fig. 49; Fitch, 1952.

Holconotus fuliginosus Gibbons, 1854e, p. 123; Troschel, 1855b, p. 334.

Embiotoca cassidyi Girard, 1854d, p. 151; 1855, p. 320; Troschel, 1855c, p. 346.

Embiotoca webbi Girard, 1855, p. 320; Troschel, 1855c, p. 346; Girard, 1858, p. 173, pl. xxx.

Embiotoca cassidii Girard, 1858, p. 171, pls. xxvi (fig. 12), xxix.

Ditrema jacksoni Günther, 1862, p. 245; Jordan and Gilbert, 1881e, p. 456; 1882b, p. 595; 1882a, p. 50; Jordan and Jouy, 1882, p. 11; Jordan, 1885, p. 885 (p. 97 in reprint); 1887, p. 278; Eigenmann, 1889, p. 108; 1894b, p. 404; Bonnot, 1929, p. 230.

Embiotoca jacksonii Gill, 1862, p. 275.

Embiotica jacksoni Smith, 1880 (lapsus calami pro Embiotoca jacksoni).

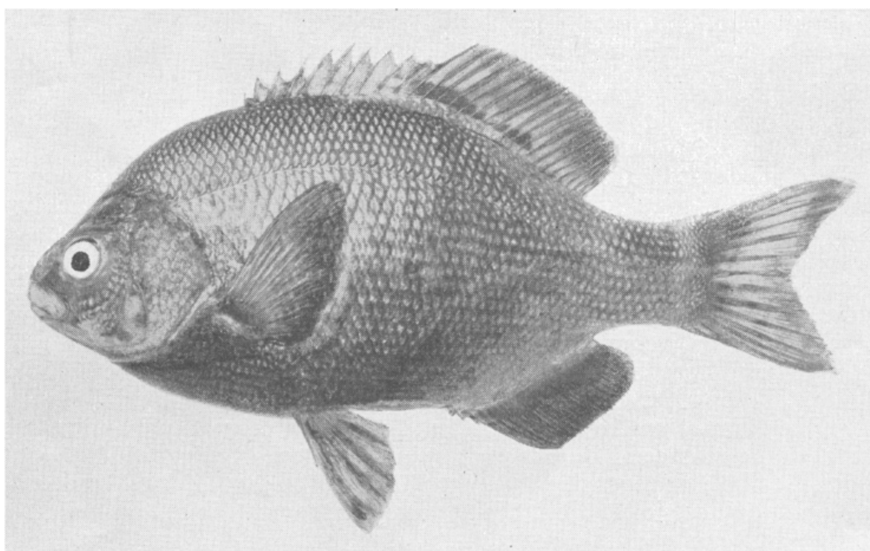

FIGURE 24. *Embiotoca jacksoni.* Black perch.

FIGURE 24. Embiotoca jacksoni. Black perch

Body deep, its depth 2.01 (1.9–2.1) in standard length; dorsal contour of body evenly curved, about the same as ventral; peduncular length 2.01 (1.7–2.6) in head; least depth of caudal peduncle 2.19 (1.9–2.5) in head.

Head 2.82 (2.6–3.0) in standard length; maxillary rather short, its length 3.79 (3.0–4.5) in head; dorsal contour of head very gently curved;

snout 3.06 (2.6–3.4) in head; posterior nostril oval to elliptical in shape, oblique to horizontal axis of body; length of eye 3.62 (3.0–4.9) in head; interorbital width 2.77 (2.4–3.2) in head. Lower lip interrupted by a broad frenum.

A series of enlarged scales between the pectoral and pelvic fin.

Length of dorsal base 2.04 (1.8–2.2) in standard length; dorsal sheath 1.06 (1.0–1.1) in dorsal base; soft dorsal 1.68 (1.5–1.8) in dorsal base; fifth dorsal spine occasionally longest; length of longest dorsal spine 3.78 (2.7–5.7) in dorsal base; last dorsal spine 1.37 (1.0–1.7) in first dorsal ray; first ray usually longest, its length 2.46 (1.9–3.1) in dorsal base. Origin of anal fin under fifth to eighth dorsal ray; anal base 1.88 (1.6–2.2) in dorsal base; third anal spine longest, its length 4.08 (3.1–5.8) in anal base; first or second anal ray usually longest, 1.97 (1.5–2.4) in anal base; posterior half of anal base with a definite row of small scales on fin. Base of upper pectoral ray on a vertical somewhere between third and fifth lateral-line scale; distance from upper end of pectoral base to first dorsal spine 1.48 (1.3–1.6) in dorsal base; third or fourth pectoral ray longest, its length 1.27 (1.1–1.4) in head; width of pectoral base 3.15 (2.7–3.4) in longest ray. Origin of pelvic fin slightly posterior to first dorsal spine; first or second ray longest, its length 1.62 (1.4–1.8) in head; pelvic spine 1.61 (1.3–1.8) in longest ray.

Measurements in per mille of standard length based on 50 specimens from 59.0 mm to 238.6 mm (average 107.5 mm) in standard length: length of head 354 (326–382); length of maxillary 94 (82–118); length of eye 100 (70–127); length of snout 116 (100–131); width of interorbital space 128 (114–139); distance from first dorsal to pelvic 498 (468–522); distance from first dorsal spine to first anal spine 548 (517–585); distance from first anal spine to last dorsal ray 391 (351–417); caudal depth 201 (178–228); least depth of caudal peduncle 162 (153–175); distance from tip of snout to first dorsal 470 (438–505); distance from first dorsal spine to hypural 674 (610–730); distance from last dorsal ray to hypural 198 (174–224); length of dorsal base 490 (444–529); length of dorsal sheath 460 (419–516); length of soft dorsal base 288 (257–319); longest dorsal spine 132 (91–167); longest dorsal ray 200 (165–236); length of ultimate dorsal spine 110 (73–137); length of first dorsal ray 148 (123–175); distance from tip of snout to anal 667 (640–727); distance from first anal spine to hypural 434 (368–458); distance from last anal ray to hypural 176 (143–196); length of anal base 258 (222–278); length of longest anal spine 65 (41–84); length of longest anal ray 131 (111–158); distance from tip of snout to upper end of pectoral base 354 (320–388); distance from first dorsal to upper end of pectoral base 328 (307–354); width of pectoral base 89 (77–101); length of longest pectoral ray 280 (259–297); distance from tip of snout to pelvic 475 (452–524); length of longest pelvic ray 219 (198–241); length of pelvic spine 136 (111–152).

Fin and scale formulae: D. X (IX–X), 20 (19–22); A. III, 26 (24–27); P. 22 (20–22); L1 55 (52–59) + 8 (6–10); scales from first dorsal spine to lateral line 10 (9–11); scales from dorsal sheath to lateral line 7 (6–8); scales from anterior end of anus to lateral line 20 (18–21).

Color variable; pattern fairly stable. Ground color reddish brown or olivaceous green. Dorsum more heavily pigmented than ventral regions. A series of approximately nine vertical bars of heavier pigmentation, each about the width of the pupil of eye, occur on the body. This barring is occasionally difficult to see because of the density of the ground color. Fins dusky, of the same general color as the body.

I have examined specimens of this species from the following localities: Bodega Lagoon, Lat. 38° 18' 18" N., Long. 123° 03' 25" W.; San Francisco Bay at the following points: San Francisco; Red Rock; Point Richmond, Lat. 37° 54' 31" N., Long. 122° 23' 20" W.; Berkeley Fishing Pier, Berkeley; Elkhorn Slough, Lat. 36° 48' 45" N., Long. 121° 47' 15" W.; Monterey Bay, Lat. 36° 33' 40" N., Long. 121° 56' 25" W., and Lat. 36° 37' 32" N., Long. 121° 54' 54" W.; kelp beds off Gaviota, Santa Barbara County; Laguna Beach, Orange County; Sunset Cliffs, San Diego County; and the following localities in Baja California: Todos Santos Island, San Benito Island.

The range of this species is from Bodega Lagoon, Sonoma County, to Abreojos Point, Baja California.

Taken commonly by anglers in rocky areas and around wharf piling. It forms a minor part of California's commercial "perch" catch.

The name *jacksoni* is in honor of Mr. A. C. Jackson who first reported the viviparity of the species to Dr. Louis Agassiz, and aided him in securing the type specimens.

11.5.2. Embiotoca lateralis L. Agassiz, Striped Perch

Embiotoca lateralis L. Agassiz, 1854, p. 366 (p. 28 in reprint); Troschel, 1855a, p. 32; A. Agassiz, 1861, pp. 123, 124, 126, 133; Gill, 1862, p. 275; Hubbs, 1918, p. 11; 1921, pp. 184, 189, 192, 199, 200; Barnhart, 1936, p. 74; Blanco, 1938, pp. 380, 384.

Holconotus agassizi Gibbons, 1854e, p. 122; Troschel, 1855b, p. 332.

Embiotoca lineata Girard, 1854b, p. 134; 1854c, p. 141; 1854d, p. 151; 1854a, p. 81; 1855, p. 320; Troschel, 1855c, p. 346; Girard, 1857b, p. 25; 1858, p. 174, pls. xxvi (figs. 5, 6), xxxi; 1859b, p. 87.

Embiotoca ornata Girard, 1855, p. 321; Troschel, 1855c, p. 347; Girard, 1858, p. 176, pl. xxvi (fig. 11); Gill, 1862, p. 275.

Embiotoca perspicabilis Girard, 1855, p. 321; Troschel, 1855c, p. 347; Girard, 1858, p. 178, pls. xxvi (figs. 1, 2), xxxii.

Taeniotoca lateralis A. Agassiz, 1861, p. 133; Cooper, 1868, p. 489; Bean, 1880, p. 88; Jordan and Starks, 1895, p. 797; Jordan and Evermann, 1896, p. 404; 1898, p. 1505; Jordan and McGregor, 1899, p. 281; Jordan, 1905b, p. 375; Evermann and Goldsborough, 1907, p. 278; Starks and Morris, 1907, p. 202; Starks, 1911, p. 209; Fowler, 1923a, pp. 283, 285, 292, 300; Hubbs, 1928, p. 13; Ulrey and Greeley, 1928, p. 17; Clark, 1930, p. 140; Jordan, Evermann and Clark, 1930, p. 411; Walford, 1931, pp. 23, 105, fig. 81; Blanco, 1935, p. 42; Barnhart, 1936, p. 78, fig. 234; Schultz, 1936, p. 190; Schultz and DeLacy, 1936, p. 137; Blanco, 1938, pp. 379, 380, 381, 382, 384, 387; Clemens and Wilby, 1946, pp. 27, 149, fig. 88; Hewatt, 1946, p. 206; Hubbs, 1948, p. 464; Roedel, 1948, pp. 22, 79, fig. 51.

Damalichthys lateralis Gill, 1862, p. 275.

Ditrema laterale Günther, 1862, p. 245; Bean, 1881, p. 265; Jordan and Gilbert, 1881e, p. 456; 1882b, p. 594; 1882a, p. 50; Jordan and Jouy, 1882, p. 11; Bean, 1884, p. 361; Jordan, 1885, p. 884 (p. 96 in reprint); Smith, 1885; Jordan, 1887, p. 277; Ryder, 1893, p. 95, fig.

Phanerodon laterale Eigenmann, 1893, pp. 130, 156; 1894b, p. 404.

Phanerodon lateralis Eigenmann and Ulrey, 1894, pp. 393, 394.

Phanerodon cateralis Bonnot, 1929, p. 230 (lapsus calami pro Phanerodon lateralis).

Ditrema jacksoni fide Schultz and DeLacy, 1936, p. 137 (in synonymy).

Embiotoca jacksoni fide Schultz and DeLacy, 1936, p. 137 (in synonymy).

Body deep, its depth 2.24 (1.9–2.4) in standard length; dorsal contour of body slightly more curved than the ventral; peduncular length 1.92 (1.6–2.1) in head; least depth of caudal peduncle 2.16 (1.8–2.5) in head.

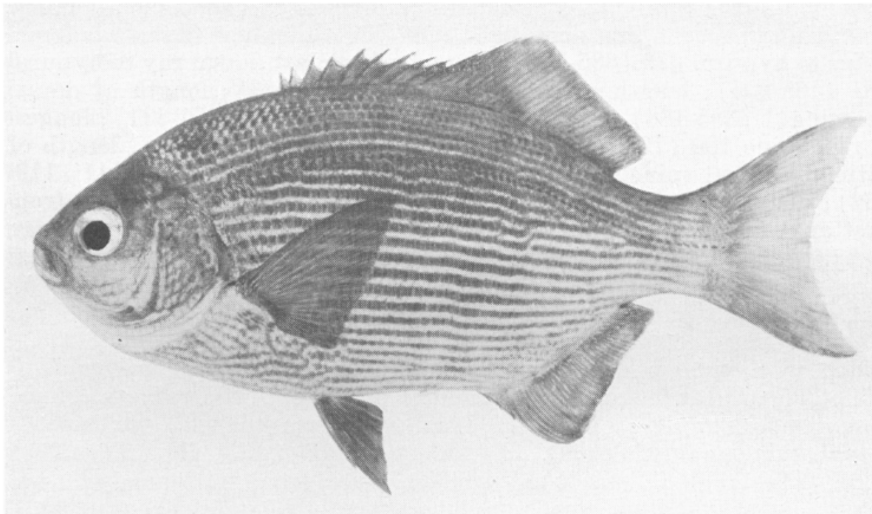

FIGURE 25. *Embiotoca lateralis.* Striped perch.

FIGURE 25. Embiotoca lateralis. Striped perch

Head 3.12 (2.8–3.4) in standard length; maxillary rather short, its length 3.65 (3.2–4.0) in head; dorsal contour of head fairly straight to first dorsal spine; snout 3.17 (2.8–3.5) in head; posterior nostril a rather narrow ellipse, oblique to horizontal axis of body; length of eye 3.77 (2.9–4.6) in head; interorbital width 2.75 (2.3–3.1) in head. Lower lip interrupted by a broad frenum.

No series of enlarged scales between the pectoral and pelvic fin.

Length of dorsal base 1.97 (1.8–2.1) in standard length; dorsal sheath 1.15 (1.1–1.2) in dorsal base; soft dorsal 1.68 (1.4–1.8) in dorsal base; sixth or seventh (occasionally fifth or eighth) dorsal spine longest, its length 5.19 (3.9–6.7) in dorsal base; last dorsal spine 1.58 (1.2–1.9) in first dorsal ray; first or second dorsal ray usually longest, its length 2.70 (2.3–3.1) in dorsal base. Origin of anal fin under fourth to eighth dorsal ray; anal base 1.77 (1.4–2.0) in dorsal base; third anal spine longest, its length 4.90 (3.9–6.3) in anal base; first, second or third anal ray usually longest, 2.02 (1.6–2.3) in anal base; posterior half of anal base without a row of small scales on fin. Base of upper pectoral ray on a vertical somewhere between second and fourth lateral-line scale; distance from upper end of pectoral base to first dorsal spine 1.73 (1.5–1.9) in dorsal base; third or fourth pectoral ray longest, its length 1.24 (1.0–1.3) in head; base of fin 3.18 (2.6–3.5) in longest ray. Origin of pelvic fin slightly posterior to first dorsal spine; first or second ray longest, its length 1.65 (1.5–1.7) in head; pelvic spine 1.61 (1.4–1.9) in longest ray.

Measurements in per mille of standard length based on 29 specimens from 48.4 mm to 221.3 mm (average 125.1 mm) in standard length: length of head 320 (294–350); length of maxillary 88 (77–104); length of eye 88 (58–119); length of snout 102 (90–118); width of interorbital space 117 (99–133); distance from first dorsal to pelvic 446 (413–502); distance from first dorsal spine to first anal spine 511 (463–565); distance from first anal spine to last dorsal ray 398 (368–430); caudal depth

190 (171–201); least depth of caudal peduncle 148 (138–169); distance from tip of snout to first dorsal 434 (387–463); distance from first dorsal spine to hypural 679 (635–708); distance from last dorsal ray to hypural 181 (165–205); length of dorsal base 506 (463–542); length of dorsal sheath 441 (385–486); length of soft dorsal base 301 (271–331); longest dorsal spine 100 (79–131); longest dorsal ray 190 (168–218); length of ultimate dorsal spine 91 (64–116); length of first dorsal ray 141 (118–162); distance from tip of snout to anal 644 (586–692); distance from first anal spine to hypural 451 (423–491); distance from last anal ray to hypural 167 (155–187); length of anal base 288 (243–316); length of longest anal spine 59 (43–77); length of longest anal ray 142 (125–166); distance from tip of snout to upper end of pectoral base 322 (294–372); distance from first dorsal to upper end of pectoral base 292 (268–330); width of pectoral base 82 (72–90); length of longest pectoral ray 270 (217–292); distance from tip of snout to pelvic 444 (402–478); length of longest pelvic ray 195 (174–220); length of pelvic spine 122 (96–143).

Fin and scale formulae: D. XI (X–XI), 24 (23–25); A. III, 30 (29–33); P. 22 (21–24); L1 63 (59–65) + 7 (6–8); scales from first dorsal spine to lateral line 9 (9–10); scales from dorsal sheath to lateral line 7 (6½–8); scales from anterior end of anus to lateral line 19 (18–21).

Color stable; pattern stable. A coppery ground color with darker brown overlaying the dorsum. A series of approximately fifteen horizontal stripes of blue on body below lateral line. Head with several series of blue spots and stripes. Fins coppery, of same tone as ground color of body.

I have examined specimens of this species from the following localities: San Juan Islands, Washington; Puget Sound, Washington; Golden Gardens, Washington; Willapa Bay, Pacific County, Washington; Point St. George, Del Norte County, California; West side of Point Delgada, Humboldt County, California; Duxbury Reef, Lat. 37° 53' 20" N., Long. 122° 41' 57" W.; Sausalito, Marin County, California; Red Rock, San Francisco Bay, California; Aptos, Santa Cruz County, California; Monterey Bay, Lat. 36° 37' 18" N., Long. 121° 54' 14" W. and Lat. 36° 37' 32" N., Long. 121° 54' 54" W.

The recorded range of this species is from Port Wrangel, Alaska, to northern Baja California.

Taken commonly by anglers in rocky areas and around wharf piling. It forms a minor part of California's commercial "perch" catch.

The name lateralis refers to the lateral blue striping of this species.

11.6. Genus Ditrema Temminck and Schlegel

Ditrema Temminck and Schlegel, 1844, p. 77, pl. xl, (fig. 2) (genotype by monotypy, no specific name given[*]); Richardson, 1846, p. 240; Blecker, 1853, p. 33 (names Ditrema temminckii) Brevoort, 1856, p. 256; Günther, 1860, p. 392; 1862, pp. 244, 245; Gill, 1862, p. 274; Jordan and Gilbert, 1881e, p. 456; 1882b, p. 586; 1882a, p. 50; Jordan, 1885, p. 884 (p. 96 in reprint); Eigenmann and Ulrey, 1894, pp. 382, 383, 390; Jordan and Evermann, 1898, p. 1510; Jordan and Sindo, 1902, pp. 354–356; Boulenger, 1904, p. 670; Fowler, 1949, p. 63.

Embiotoca Jordan and Snyder, 1901a, p. 358 (ex parte).

[*] "The genus Ditrema was established by Schlegel upon examination of two stuffed specimens and a native figure of a fish which offered the peculiarity of two anal orifices * * * He gave the fish no specific name * * * The figure by the artists of the United States Japan Expedition is identical with the one in the Fauna Japonica, though darker in coloring. It does not show the specific characters distinctly * * *." Brevoort, 1856, p. 265.

Body moderately long (less than 220 mm in standard length), rather deep, 2.1 to 2.4 in standard length; dorsal contour of body gently curved, about same as ventral; caudal peduncle fairly short, gradually tapering, its length 1.4 to 1.8 in head, rather stout, its least depth 1.9 to 2.7 in head.

Head relatively small, more than 2.9 times in standard length; mouth terminal, slightly oblique; jaws equal; maxillary fairly short, just reaching a vertical from the anterior nostril; snout bluntly conic, on a straight line with the anterior dorsal contour of head; posterior nostril usually oval in shape, oblique to the horizontal axis of body; eye shape variable from round to slightly longer than high; frenum present.

Lateral line farthest from the dorsal contour of body at its origin, generally nearest at posterior end of dorsal fin, depressed slightly at caudal peduncle.

Origin of dorsal fin approximately opposite origin of pelvics; base of dorsal fin moderately long, 1.9 to 2.2 in standard length; dorsal sheath extending almost entire length of fin, its ventral origin under ultimate dorsal spine to second dorsal ray; spinous dorsal evenly graduated to about ninth spine (occasionally others), the posterior elements of equal length; last dorsal spine approximately the same height as the anterior dorsal rays; second, and often third, dorsal ray simple, remaining elements branched. Anal base fairly long, its length 1.4 to 2.3 in dorsal base; posterior anal rays greatly elongated in males; a lunar-shaped depression in the body surface of the male, dorsal to the anterior portion of the anal fin. Lowermost pectoral rays not frayed.

Scales from dorsal sheath to lateral line 8 to 9; scales from anterior end of anus to lateral line 18 to 21.

Hubbs has suggested, in conversations, the possibility of two species of Ditrema. It is very possible that two such species coexist and are determinable by physiological and ecological methods. On the basis of preserved material examined by me, and the methods at my disposal, I find it impossible to distinguish more than one species. Ditrema, therefore, remains a monotypic genus until more evidence can be accumulated.

Ditrema-

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FIGURE

two, and

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FIGURE

aperture, in reference to the distinct openings for the digestive and reproductive systems.

11.7. Ditrema temmincki Bleeker

Ditrema Temminck and Schlegel, 1844, p. 77, pl. xl (fig. 2); Richardson, 1846, p. 240.

Ditrema temminckii Bleeker, 1853, p. 33; Brevoort, 1856, p. 256; Günther, 1862, p. 246; Steindachner and Döderlein, 1883, p. 31; Nystrom, 1887, p. 32; Eigenmann and Ulrey, 1894, p. 391; Jordan and Evermann, 1898, p. 1510; Boulenger, 1904, fig. 409; Jordan, 1905b, p. 375; Smith and Pope, 1906, p. 479; Snyder, 1912, p. 418; Shepherd, 1915, p. 457, fig. 1; Hubbs, 1918, p. 11; Barnhart, 1936, p. 74.

Ditrema laeve Günther, 1860, p. 392; 1862, p. 246; Nystrom, 1887, p. 32; Hubbs, 1918, p. 11; Barnhart, 1936, p. 74.

Ditrema temmincki Jordan and Gilbert, 1881e, p. 456; 1882b, p. 586; Jordan and Evermann, 1898, p. 1494; Jordan and Sindo, 1902, pp. 357–359, fig. 2; Jordan and Starks, 1905, p. 205; Mori, 1928, p. 6; Reeves, 1927, p. 10.

Ditrema smitti Nystrom, 1887, p. 32; Eigenmann and Ulrey, 1894, p. 391; Jordan and Evermann, 1898, p. 1494; Hubbs, 1918, p. 11; Barnhart, 1936, p. 74.

Embiotoca smitti Jordan and Snyder, 1901a, p. 358.

Ditrema temmincki jordani Franz 1910; Hubbs, 1918, p. 11; Barnhart, 1936, p. 74.

Body rather deep, its depth 2.34 (2.1–2.4) in standard length; peduncular length 1.55 (1.4–1.8) in head; least depth of caudal peduncle 2.33 (1.9–2.7) in head.

Head 3.25 (2.9–3.5) in standard length; mouth fairly small, length of maxillary 3.60 (3.3–4.0) in head; dorsal contour of head slightly sigmoid behind eye to gently curved; length of snout 3.08 (2.6–3.7) in head; length of eye 3.92 (3.0–4.7) in head; interorbital 3.06 (2.6–3.6) in head.

Length of dorsal base 2.03 (1.9–2.2) in standard length; dorsal sheath 1.28 (1.1–1.4) in dorsal base; soft dorsal 1.68 (1.5–1.8) in dorsal base; length of longest dorsal spine 5.56 (3.7–6.5) in dorsal base, its tip lower than general contour of soft dorsal fin; ninth (seventh to eleventh) spine longest; last dorsal spine 1.24 (1.0–1.3) in first dorsal ray; third (first to fifth) ray longest, its length 3.44 (2.6–4.6) in dorsal base. Origin of anal fin under third to sixth dorsal ray; anal base 1.85 (1.4–2.3) in dorsal base; third anal spine longest, its length 5.45 (3.7–6.7) in anal base; longest anal ray variable in length, usually found in the posterior third of fin; anterior anal rays simple, posterior elements branched; anal gland appearing as a fleshy organ on the anterior portion of fin, its rather long tubular opening directed downwards. Base of upper pectoral ray under second to fourth scale of lateral line; distance from upper end of pectoral base to first dorsal spine 1.75 (1.5–1.9) in dorsal base; fin moderately long, third, or fourth, ray longest, 1.27 (1.1–1.5) in head; base of fin 3.20 (2.8–3.5) in longest ray; first ray simple, remainder branched, except for ventral one or two. Origin of pelvic fin about opposite origin of dorsal; second or third ray longest, 1.91 (1.7–2.3) in head; pelvic spine 1.84 (1.4–2.1) in longest ray.

Measurements in per mille of standard length based on 50 specimens from 74.3 mm to 215.0 mm (average 146.0 mm) in standard length: length of head 308 (281–344); length of maxillary 86 (75–100); length of eye 79 (60–109); length of snout 100 (88–125); width of interorbital space 101 (90–121); distance from first dorsal to pelvic 426 (401–464); distance from first dorsal spine to first anal spine 485 (451–520); distance from first anal spine to last dorsal ray 378 (332–407); caudal depth 180 (162–200); least depth of caudal peduncle 132 (121–143); distance from tip of snout to first dorsal 407 (359–458); distance from first dorsal spine to hypural 689 (634–733); distance from last dorsal ray to hypural 209 (177–238); length of dorsal base 491 (447–516); length of dorsal sheath 384 (334–421); length of soft dorsal base 293 (265–324); longest dorsal spine 90 (74–127); longest dorsal ray 144 (110–180); length of ultimate dorsal spine 88 (71–127); length of first dorsal ray 109 (87–146); distance from tip of snout to anal 618 (572–668); distance from first anal spine to hypural 462 (433–503); distance from last anal ray to hypural 199 (173–216); length of anal base 266 (217–312); length of longest anal spine 49 (37–67); length of longest anal ray too variable; distance from tip of snout to upper end of pectoral base 316 (290–356); distance from first dorsal to upper end of pectoral base 281 (260–301); width of pectoral base 76 (69–87); length of longest pectoral ray 243 (214–270); distance from tip of snout to pelvic 431 (407–460); length of longest pelvic ray 162 (140–187); length of pelvic spine 89 (74–118).

Fin and scale formulae : D. X (IX–XI), 21 (19–22); A. III, 26 (24–28); P. 20 (19–22); Ll 72 (69–77) + 6 (5–8); scales from first dorsal to lateral line 12 (10–12).

I have not examined fresh specimens of this species. Jordan and Sindo (1902, pp. 358–359) give the following color notes for Ditrema temmincki:

"Color silvery, steel blue on back; lower limb of preopercle with a black spot in front and another at the angle, these very rarely obsolete; two black bars from eye toward maxillary, a dark blotch on upper end of opercle; upper half of spinous dorsal black; soft fin uncolored, or with a dark edge; anal and caudal fins dusky; pectorals uncolored, axil slightly dusky; tips of ventrals dark, with the first rays and the membrane between the fourth and fifth rays chalky white. The ground coloration is subject to considerable variation, but the two spots below the eye and the two stripes on snout are rarely absent. * * *"

"Those from Misake, obtained in rather deeper water than the others, were distinctly of a coppery red in life, with a redder line running laterally forming the chord to the arc of the curved lateral line."

The silvery, steel blue form is known locally in Japan as Umi-Tanago (Sea Surf-Fish) whereas the reddish form is termed Aki-Tanago (Red Surf-Fish).

I have examined specimens of the species from the following localities: Island of Honshu, Japan—Mutzu Wan, Aomoriken, Watanoha, Tottori, Wakasa San, Aoshima, Hamada, Misaki, Miyazu San, Toyama San, Sagami Sea, Asamushi, Usetzu San, Abaratsuba San, Ine; Island of Kyushu, Japan—Genkaishima; Oki Retto, Sea of Japan; near Fusan, Korea.

This species is known from the seas surrounding Japan and Korea, and from Chefoo, China.

Apparently found rather commonly in Japanese fish markets.

The name temmincki is in honor of Professor C. J. Temminck, the associate of Professor Schlegel.

11.8. Genus Neoditrema Steindachner and Doderlein

Neoditrema Steindachner and Döderlein, 1883, p. 32 (genotype by monotypy, Neoditrema ransonnetii); Eigenmann and Ulrey, 1894, pp. 383, 390; Jordan and Evermann, 1898, p. 1511; Jordan and Snyder, 1901b, p. 752; Jordan and Sindo, 1902, pp. 354, 355; Fowler, 1949, pp. 63, 65.

Body moderately short (to 155 mm in standard length), rather slender, its depth 2.6 to 3.1 in standard length; dorsal contour of body gently curved, about same as ventral; caudal peduncle fairly long, gradually tapering, its length 1.3 to 1.7 in head, fairly narrow, its least depth 2.2 to 2.9 in head.

Head relatively small, its length 3.0 to 3.6 in standard length; mouth terminal, somewhat oblique; jaws equal; maxillary short, its length 3.0 to 3.8 in head; females lacking teeth, males with one row of out-turned, wide set teeth; snout sharply conic, on a straight line with anterior profile of head; posterior nostril varying from elliptical to round; eye variable from round to slightly longer than high; posterior groove of lower lip without a frenum.

Lateral line farthest from the dorsal contour of body at its origin, generally nearest on the caudal peduncle. Deciduous scales on body.

Origin of dorsal fin about opposite the origin of the pelvics; base of dorsal fin rather short, its length 2.2 to 2.4 in standard length; dorsal sheath extending almost its entire length, its ventral origin under fifth to seventh ray; spinous dorsal graduated anteriorly to about the seventh spine, the remaining elements of equal height or very gradually decreasing in length. Origin of anal fin under the eighth to tenth dorsal ray; a small lunar-shaped depression in the body surface of the male, dorsal to the anterior portion of the anal fin. Lowermost pectoral rays not frayed.

Scales in the lateral line 69 to 76; scales from dorsal sheath to lateral line 5 to 6; scales from anterior end of anus to lateral line 16 to 18.

11.8.1. Neoditrema ransonneti Steindachner and Doderlein

Neoditrema ransonnetii Steindachner and Döderlein, 1883, p. 32; Jordan and Evermann, 1898, p. 1511; Shepherd, 1915, p. 456, fig. 1; Hubbs, 1918, p. 11; Fowler, 1949, p. 65.

Neoditrema ransonneti Eigenmann and Ulrey, 1894, p. 390; Jordan and Evermann, 1898, p. 1494; Jordan and Snyder, 1901b, p. 752; Jordan and Sindo, 1902, p. 355, fig. 1; Jordan, 1905b, p. 375; Snyder, 1912, p. 418; Reeves, 1927, p. 10; Mori, 1928, p. 6; Barnhart, 1936, p. 74.

Body relatively slender, its depth 2.88 (2.6–3.1) in standard length; peduncular length 1.53 (1.3–1.7) in head; least depth of caudal peduncle 2.57 (2.2–2.9) in head.

Head 3.26 (3.0–3.6) in standard length; mouth small, the maxillary just reaching a vertical from the posterior nostril, its length 3.26 (3.0–3.8) in head; dorsal contour of head, to first dorsal spine, slightly sigmoid to gently rounded; length of snout 3.63 (3.2–3.9) in head; eye fairly small, its length 3.26 (2.7–4.0) in head; interorbital 3.38 (2.9–3.7) in head.

Length of dorsal base 2.32 (2.2–2.4) in standard length; dorsal sheath 1.12 (1.0–1.2) in dorsal base; soft dorsal 1.36 (1.2–1.5) in dorsal base; seventh dorsal spine usually longest 3.48 (2.8–4.5) in dorsal base, its tip usually lower than general contour of soft dorsal fin; fifth, sixth or eighth spine occasionally longest; last dorsal spine 1.21 (0.9–1.5) in first dorsal ray; first, second or third ray longest, its length 2.59 (2.1–3.1) in dorsal base; first, and usually second, ray simple, the remaining elements branched in adults. Anal base 1.69 (1.4–2.0) in dorsal base; third anal spine longest, its length 4.76 (3.6–6.2) in anal base; first ray usually longest (although occasionally the longest ray is found in posterior region of fin), its length 3.40 (2.9–4.7) in anal base; anterior anal rays simple, posterior elements branched; anal gland appearing as a fleshy organ on the anterior portion of fin, its tubular opening directed downwards. Base of upper pectoral ray under second to fifth scale of lateral line; distance from upper end of pectoral base to first dorsal spine 1.92 (1.7–2.0) in dorsal base; fin moderately long, third or fourth ray longest, its length 1.20 (1.0–1.3) in head; base of fin 3.38 (2.9–3.8) in longest ray; first ray simple, remainder branched except for ventral one to three. Origin of pelvic fin about opposite origin of dorsal fin; first or second ray longest 1.57 (1.3–1.8) in head; pelvic spine 1.55 (1.2–1.7) in longest ray.

Measurements in per mille of standard length based on 50 specimens from 70.0 mm to 151.2 mm (average 87.3 mm) in standard length; length of head 307 (278–326); length of maxillary 94 (74–105); length of eye 95 (70–108); length of snout 85 (76–95); width of interorbital space 91 (79–99); distance from first dorsal to pelvic 347 (320–383); distance from first dorsal spine to first anal spine 411 (380–447); distance from first anal spine to last dorsal ray 322 (283–352); caudal depth 166 (140–184); least depth of caudal peduncle 120 (106–132); distance from tip of snout to first dorsal 390 (353–421); distance from first dorsal spine to hypural 665 (636–698); distance from last dorsal ray to hypural 246 (224–269); length of dorsal base 430 (410–449); length of dorsal sheath 382 (352–421); length of soft dorsal base 316 (273–343); longest dorsal spine 125 (94–155); longest dorsal ray 168 (138–195); length of ultimate dorsal spine 125 (94–155); length of first dorsal ray 149 (117–168); distance from tip of snout to anal 615 (573–657); distance from first anal spine to hypural 450 (405–495); distance from last anal ray to hypural 201 (180–218); length of anal base 255 (207–285); length of longest anal spine 54 (41–67); length of longest anal ray 75 (54–88); distance from tip of snout to upper end of pectoral base 314 (290–343); distance from first dorsal to upper end of pectoral base 223 (205–245); width of pectoral base 78 (67–85); length of longest pectoral ray 256 (220–279); distance from tip of snout to pelvic 414 (380–449); length of longest pelvic ray 196 (169–224); length of pelvic spine 128 (106–150).

Fin and scale formulae : D. VII (VI–VIII), 20 (19–22); A. III, 26 (24–28); P. 20 (19–21); Ll 72 (69–76) + 6 (5–7); scales from first dorsal spine to lateral line 7 (6–8).

I have not examined fresh specimens of this species. Jordan and Sindo (1902, p. 355) give the following color notes for Neoditrema ransonneti: "Color, dark olive brown above, the lower parts coppery or golden, with traces of faint dark streaks along the rows of scales; chin dusky; a dusky spot on upper part of opercle; no spots on preopercle or snout. Males with a jet black spot on the premaxillary, which is wanting in the females; fins dusky yellowish; the anal and dorsal black in front, the ventrals black at tip; a dark streak across base of pectoral." The jet black spot on the premaxillary mentioned above was lacking in some of the specimens I have seen.

I have examined specimens of this species from the following localities: Tokyo and Misaki, Island of Honshu, Japan; near Fusan, Korea.

This species is known from the seas surrounding Japan and Korea.

Apparently rather common in the markets of Japan.

The name ransonneti is in honor of Baron Ransonnet who discovered the original types in the market at Yokohama.

11.9. Genus Zalembius Jordan and Evermann

Zalembius Jordan and Evermann, 1896, p. 403 (type by original designation, Cymatogaster rosaceus Jordan and Gilbert); 1898, pp. 1494, 1499; 1922, p. 471; Jordan, Evermann and Clark, 1930, p. 410.

Body moderately long (less than 250 mm in standard length), rather deep; dorsal contour of body gently curved, about same as ventral; caudal peduncle fairly short, gradually tapering, its length 1.6 to 2.2 in head, rather narrow, its least depth 2.6 to 3.8 in head.

Head relatively small, more than 2.7 times in standard length; mouth terminal; jaws equal; maxillary fairly short usually not reaching vertical from anterior edge of orbit; snout bluntly conic, on a straight line with the anterior dorsal contour of the head; posterior nostril usually an ellipse, oblique to the axis of the body; eye slightly longer than high; frenum present.

Lateral line farthest from the dorsal contour of body at its origin, generally nearest at posterior end of dorsal fin, depressed slightly at caudal peduncle.

Base of dorsal fin moderately long, dorsal sheath extending almost its entire length; ventral origin of dorsal sheath usually under ultimate or penultimate dorsal spine; spinous dorsal graduated anteriorly to about the sixth spine, the remaining elements very gradually decreasing in length; last dorsal spine approximately the same height as the anterior part of the soft dorsal. Anal base short; third spine always longest; anal rays only slightly oblique to axis of the body; posterior anal rays of males (as well as rays of the caudal) often greatly elongated, reminiscent of the Cichlidae (this phenomenon appears to be confined to the younger males, the larger ones probably losing the elongations through wear or attack); margin of fin slightly sigmoid in adults (this most marked in males); no lunar-shaped depression in the body surface dorsal to the anal gland. Lowermost pectoral rays not frayed.

Scales from dorsal sheath to lateral line 4 to 5; scales from anterior end of anus to lateral line 14 to 16.

Color and pattern stable, characteristic of the genus. Ground color silvery white overlain with rose. Two large, distinctive chocolate spots on the body, the one ventral to the junction of the spinous with the soft dorsal, the other at the end of the dorsal fin. Usually two small black spots on the throat region of the males.

It is found in fairly deep water and is frequently taken incidentally by commercial fishermen.

11.9.1. Zalembius rosaceus (Jordan and Gilbert), Pink Perch

Cymatogaster rosaceus Jordan and Gilbert, 1881c, pp. 303–305.

Brachyistius rosaceus Jordan and Gilbert, 1881e, p. 456; Jordan and Jouy, 1882, p. 10; Jordan and Gilbert, 1882a, p. 51; Jordan, 1885, p. 884 (p. 96 in reprint); 1887, p. 278; Eigenmann and Eigenmann, 1892, p. 353; Eigenmann and Ulrey, 1894, pp. 395, 396.

Micrometrus rosaceus Jordan and Gilbert, 1882b, p. 589.

Zalembius rosaceus Jordan and Evermann, 1896, p. 403; 1898, p. 1500; 1900, fig. 581; Jordan and Sindo, 1902, p. 354; Jordan, 1905b, pp. 374, 376; Starks and Morris, 1907, p. 200; Hubbs, 1918, pp. 9, 12; Jordan and Evermann, 1922, p. 471; Fowler, 1923a, p. 292; Ulrey and Greeley, 1928, p. 17; Wales, 1928, p. 62, fig. 7; Jordan, Evermann and Clark, 1930, p. 410; Barnhart, 1936, pp. 75, 77, fig. 230; Roedel, 1948, pp. 22, 84, fig. 56.

Body rather deep, its depth 2.37 (2.1–2.6) in standard length; peduncular length 1.85 (1.6–2.2) in head; least depth of caudal peduncle 3.15 (2.6–3.8) in head.

Head 2.92 (2.7–3.0) in standard length; mouth fairly small, length of maxillary 3.77 (3.3–4.1) in head; dorsal contour of head fairly straight halfway to origin of dorsal fin, the remaining gently curved; length of snout 3.55 (3.1–3.9) in head; length of eye 3.35 (2.9–3.9) in head; interorbital 3.45 (3.0–3.9) in head.

Origin of dorsal fin slightly in advance of the origin of the pelvic; dorsal base 2.06 (1.9–2.2) in standard length; dorsal sheath 1.13 (1.0–1.3) in dorsal base; soft dorsal 1.75 (1.5–1.9) in dorsal base; longest dorsal spine 3.43 (2.7–4.2) in dorsal base, slightly higher than general contour

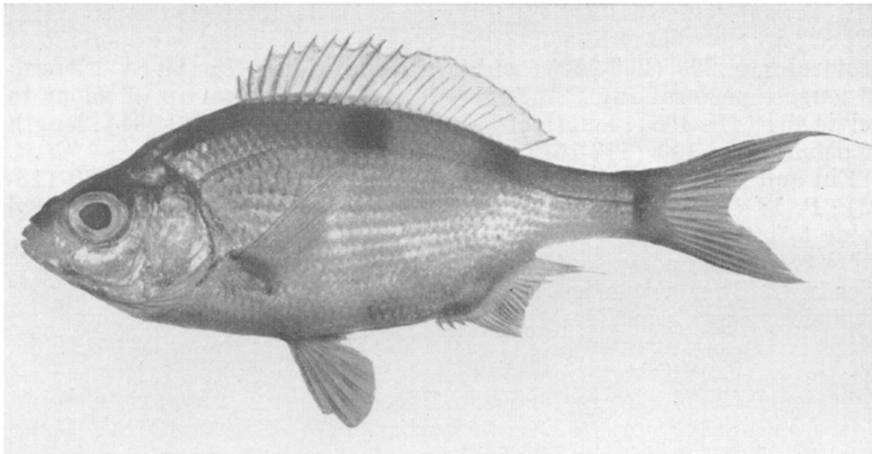

FIGURE 26. *Zalembius rosaceus*. Pink perch.

FIGURE 26. Zalembius rosaceus. Pink perch

of soft dorsal fin; sixth spine (occasionally fifth, seventh or eighth) longest; last dorsal spine 1.07 (0.9–1.5) in first dorsal ray; longest dorsal ray 3.32 (2.5–4.5) in dorsal base. Origin of anal fin under eighth to tenth dorsal ray; anal base 2.37 (1.8–2.9) in dorsal base; third anal spine 3.63 (2.7–5.1) in anal base; longest anal ray variable in position and length; usually anterior anal rays simple, the remaining ones branched, however this feature rather variable. Anal gland of males, appearing as a fleshy organ on the anterior portion of the fin, its tubular opening parallel with the contour of anal base. Base of upper pectoral ray under second or third scale of lateral line; distance from upper end of pectoral base to first dorsal spine 1.66 (1.3–1.8) in dorsal base; fin moderately long, third or fourth ray longest, 1.22 (1.1–1.5) in head; base of fin 3.74 (3.1–4.2) in longest ray; first ray simple, remainder branched except for ventral one to three. Origin of pelvic fin slightly posterior to first dorsal spine; first or second ray longest, 1.60 (1.4–2.0) in head; pelvic spine 1.52 (1.3–1.7) in longest ray.

Measurements in per mille of standard length based on 50 specimens from 39.3 mm to 167.5 mm (average 101.9 mm) in standard length: length of head 342 (325–363); length of maxillary 91 (82–106); length of eye 103 (87–117); length of snout 97 (86–108); width of interorbital space 100 (84–114); distance from first dorsal to pelvic 422 (379–469); distance from first dorsal spine to first anal spine 500 (445–531); distance from first anal spine to last dorsal ray 310 (260–356); caudal depth 158 (136–188); least depth of caudal peduncle 110 (86–135); distance from tip of snout to first dorsal 430 (397–439); distance from first dorsal spine to hypural 674 (651–701); distance from last dorsal ray to hypural 196 (177–230); length of dorsal base 485 (445–521); length of dorsal sheath 432 (338–470); length of soft dorsal base 277 (254–320); longest dorsal spine 142 (118–175); longest dorsal ray 148 (106–189); length of ultimate dorsal spine 111 (85–135); length of first dorsal ray 118 (94–160); distance from tip of snout to anal 683 (608–741); distance from first anal spine to hypural 389 (344–450); distance from last anal ray to hypural 185 (158–215); length of anal base 207 (163–251); length of longest anal spine 57 (43–75); distance from tip of snout to upper end of pectoral base 342 (318–366); distance from first dorsal to upper end of pectoral base 293 (260–352); width of pectoral base 76 (69–84); length of longest pectoral ray 282 (227–309); distance from tip of snout to pelvic 454 (415–496); length of longest pelvic ray 216 (170–234); length of pelvic spine 143 (113–161).

Fin and scale formulae: D. X (IX–XI), 18 (16–19); A. III, 20 (18–22); P. 18 (17–19); L1 52 (47–56) + 5 (4–6); scales from first dorsal spine to lateral line 6 (5–7).

I have examined specimens of this species from the following localities in California: "Albatross" stations D 5785, D 5786, D 5789, San Francisco Bay; San Francisco, off Golden Gate; Monterey Bay Lat. 36° 50' N., Long. 121° 48' 30" W., Lat. 36° 48' 09" N., Long. 121° 51' 36" W. and "Albatross" station 4483; Avila, San Luis Obispo County; 1–3 miles south of Point Arguello, Santa Barbara County; off Gaviota, Santa Barbara County; north of Santa Barbara, Lat. 34° 23' 47" N., Long. 119° 45' 27" W.; off Santa Monica Bay, Los Angeles County; San Pedro, Los Angeles County.

The known range of this species is from Drakes Bay, California, to San Diego, California.

The name rosaceus refers to the rosy hue of the body.

11.10. Genus Cymatogaster Gibbons

Cymatogaster Gibbons, 1854a (genotype by subsequent restriction of genus to monotypy by Gill, 1862, p. 275, Cymatogaster aggregata Gibbons)* ; Gill, 1862, p. 275; Eigenmann, 1894a, p. 381; Eigenmann and Ulrey, 1894, pp. 384, 396; Jordan and Evermann, 1896, p. 403; 1898, pp. 1494, 1498; Boulenger, 1904, p. 670; Jordan and Evermann, 1922, p. 471; Jordan, Evermann and Clark, 1930, p. 409; Barnhart, 1936, p. 73; Blanco, 1938, pp. 381, 384, 387.

Micrometrus Gibbons, 1854b, (ex parte); 1854e, p. 125 (ex parte); Troschel, 1855b, p. 339 (ex parte); Jordan and Gilbert, 1882b, pp. 586, 588 (ex parte).

Holconotus Girard, 1855, p. 322 (ex parte, non L. Agassiz); Troschel, 1855c, p. 350 (ex parte, non L. Agassiz).

Metrogaster L. Agassiz in A. Agassiz, 1861, p. 128 (genotype by monotypy, Cymatogaster aggregata Gibbons, see p. 133); Gill, 1862, p. 275.

Ditrema Günther, 1862, p. 245 (ex parte).

Sema Jordan, 1878, p. 399 (genotype by monotypy, Sema signifer Jordan = Cymatogaster aggregata Gibbons).

Body small (less than 150 mm in standard length), rather slender; dorsal contour of body gently curved, about same as ventral; caudal peduncle fairly short, gradually tapering, its length 1.7 to 2.4 in head, somewhat narrow, its least depth 2.4 to 3.1 in head.

Head relatively small, its length 2.6 to 3.3 in standard length; mouth terminal; jaws equal; maxillary rather short, its length 3.0 to 4.3 in head; snout bluntly conic, on a straight line with upper anterior profile of head; posterior nostril usually an ellipse, obliquely inclined from the axis of the body; eye rounded; interorbital moderately broad, its width 2.9 to 3.5 in head; frenum absent.

Lateral line farthest from the dorsal contour of body at its origin, generally nearest at posterior end of dorsal fin, depressed slightly at caudal peduncle. Axilla scaled.

Base of dorsal fin moderately long, its length 1.8 to 2.2 in standard length; dorsal sheath fairly long, its length 1.1 to 1.6 in base of dorsal;

* See footnote, p. 81.

ventral origin of dorsal sheath generally under fourth or fifth spine in advance of soft dorsal rays; spinous dorsal graduated, the fifth spine (occasionally others) being longest; last dorsal spine generally shorter than anterior part of soft dorsal, its height 1.0 to 1.4 in first dorsal ray; first dorsal ray usually longest, subsequent rays very gradually decreasing in length. Anal base fairly short, its length 1.7 to 2.5 in dorsal base; third spine always longest; anal rays raked moderately posteriorly; margin of fin barely sigmoid in adults (this more marked in males), fairly straight in juveniles; a small lunar-shaped depression often found in the body surface of the male, dorsal to the anterior portion of the anal fin. Lowermost pectoral rays not frayed.

Scales from scale sheath to lateral line 2½ to 4; scales from anterior end of anus to lateral line 11 to 13.

Color slightly variable, pattern stable; a sexual dimorphism, during breeding season. In the female: Ground color silver. Greenish dorsally; ventrally about eight horizontal sooty stripes with ground color showing between; belly silvery white. Three yellow vertical bars, about one orbit apart, lie posterior to the pectoral fin. Some yellow may be found on the most ventral sooty horizontal stripes. Dorsal plain or sooty. Caudal plain or lightly peppered with black, caudal region just posterior to hypural more heavily pigmented than rest of body. Anal plain, occasionally a splash of yellow on anterior portion of fin. Ventral and pectoral plain. Occasionally specimens, from slightly deeper water, have a very faint rosy overcast. In the male: The same color and pattern present, obscured, however, during the breeding season by a series of black horizontal stripes which cover the lateral body surfaces. All of the colors of the female may be seen beneath the heavier pigmentation which overlays the body.

11.10.1. Cymatogaster aggregata Gibbons,* Shiner Perch

Cymatogaster aggregata Gibbons, 1854a; Roedel, 1948, pp. 22, 80, fig. 52.

Cymatogaster aggregatus Gibbons, 1854d, p. 106; Gill, 1862, p. 275; Cooper, 1868, p. 489; Streets, 1877, p. 45; Jordan, 1880, p. 327; Smith, 1880; Jordan and Gilbert, 1881c, pp. 303, 304; Jordan and Gilbert, 1881a, p. 28; 1881e, p. 456; Jordan and Jouy, 1882, p. 10; Jordan, 1887, p. 278; Eigenmann and Eigenmann, 1892, p. 353; Eigenmann, 1893, p. 130; Eigenmann, 1894b; Eigenmann and Ulrey, 1894, p. 397, fig. 3; Jordan and Starks, 1895, p. 798; Gilbert, 1895, p. 476; Jordan and Evermann, 1896, p. 403; Starks, 1896, p. 551; Evermann and Meek, 1898, p. 82; Jordan and Evermann, 1898, p. 1498; 1900, figs. 579, 579a; Jordan, 1905a, fig. 92; 1905b, p. 376, fig. 306; Evermann and Goldsborough, 1907, p. 276, figs. 26, 27; Starks and Morris, 1907, p. 200; Starks, 1911, pp. 177, 209; Metz, 1912, p. 34, fig. 4b; Hubbs, 1918, p. 11; 1921, pp. 184–191, 200; Powers, 1921, pp. 3, 5, pl. 3; Jordan and Evermann, 1922, p. 471, fig.; Fowler, 1923a, pp. 283, 285, 292, 300; 1923b, p. 78; Hubbs, 1928, p. 13; Ulrey and Greeley, 1928, p. 15; Wales, 1928, p. 62, fig. 6; Bonnot, 1929, p. 229; Clark, 1930, p. 140; Jordan, Evermann and Clark, 1930, p. 409; Walford, 1931, p. 24; Barnhart, 1936, pp. 75, 77, fig. 228; Schultz, 1936, p. 189; Schultz and DeLacy, 1936, p. 136; Blanco, 1938, pp. 380, 382, 383; Gunter, 1942, p. 309; Clemens and Wilby, 1946, pp. 27, 147, fig. 86; Clark Hubbs, 1947, p. 147.

Micrometrus aggregatus Gibbons, 1854b; 1855e, p. 125; Troschel, 1855b, p. 339; A. Agassiz, 1861, pp. 128, 133; Bean, 1881, p. 265; Jordan and Gilbert, 1882b, p. 590; 1882a, p. 51; Bean, 1884, p. 361; Jordan, 1885, p. 884 (p. 96 in reprint); Ryder, 1885, pp. 140, 141; Smith, 1885; Eigenmann, 1889, pp. 107, 108; Eigenmann and Eigenmann, 1889a, p. 45; Eigenmann, 1890a, pp. 923–926.

Holoconotus rhodoterus Girard, 1854c, p. 141; 1854d, p. 152; 1854a, p. 81; 1855, p. 322; 1857b, p. 26; 1859b, p. 87.

Holconotus rhodopterus Troschel, 1855c, p. 350 (lapsus calami pro Holconotus rhodoterus).

Holconotus rhgdgterms Girard, 1858, p. 193, pls. xxvi (figs. 7, 8), xxxv, xxxvi (figs. 1–4) (lapsus calami pro Holconotus rhodoterus).

Metrogaster lineolatus A. Agassiz, 1861, p. 129 (listed in synonymy as Metrogaster lineolatus Agassiz MSS.)

Metrogaster aggregatus A. Agassiz, 1861, p. 133; Gill, 1862, p. 276.

Ditrema aggregatum Günther, 1862, p. 248.

Sema signifer [*] Jordan, 1878, p. 399; 1880, p. 327.

Cymatogatser aggregatus Schultz and DeLacy, 1936, p. 136 (in synonymy, lapsus calami pro Cymatogaster aggregatus Gibbons).

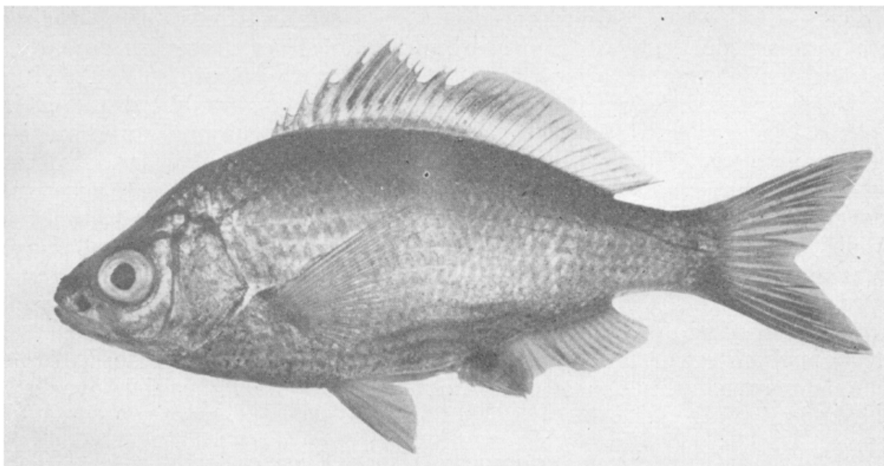

FIGURE 27. *Cymatogaster aggregata.* Shiner perch.

FIGURE 27. Cymatogaster aggregata. Shiner perch

Body relatively slender, its depth 2.52 (2.3–2.6) in standard length; peduncular length 2.10 (1.7–2.4) in head; least depth of caudal peduncle 2.72 (2.4–3.0) in head.

Head 2.91 (2.6–3.3) in standard length; mouth small, the maxillary usually not reaching a vertical from anterior edge of orbit, its length 3.58 (3.1–4.3) in head; dorsal contour of head, to first dorsal spine, straight to just barely sigmoid; length of snout 3.39 (3.0–3.8) in head; length of eye 3.62 (3.3–4.2) in head; interorbital 3.24 (2.9–3.5) in head.

Origin of dorsal fin opposite or generally slightly anterior to the origin of the pelvic; dorsal base 2.02 (1.8–2.2) in standard length; dorsal sheath 1.29 (1.1–1.6) in dorsal base; soft dorsal 1.56 (1.4–1.7) in dorsal base; longest dorsal spine 3.15 (2.5–4.1) in dorsal base, always higher than general contour of soft dorsal fin; fourth or sixth spine occasionally longest; last dorsal spine 1.21 (1.0–1.4) in first dorsal ray; longest dorsal ray 3.62 (2.9–4.5) in dorsal base; first ray usually longest; first two (occasionally one or three), rays unbranched, all other rays branched in adults. Origin of anal fin usually under sixth (occasionally fifth to

[*] W. I. Follett recently informed me that Dr. Carl Hubbs has examined the types of Sema signifer. Hubbs found the specimens actually to be the young of Embiotoca lateralis rather than of Cymatogaster aggregata. If this is the true situation; Sema signifer properly belongs in the synonymy of Embiotoca lateralis.

eighth) dorsal ray; anal base 2.01 (1.7–2.3) in dorsal base; third anal spine 5.15 (3.3–6.7) in anal base; longest ray 2.60 (2.0–3.2) in anal base; branching of the anal rays variable, usually following a pattern of a few to several simple rays in the anterior portion of the fin, with the remainder branched. Anal gland of males appearing as a fleshy organ on the anterior portion of the fin, its single small appendage directed downward or obliquely forward; this feature especially obvious during the breeding season. Base of upper pectoral ray under second or third scale of lateral line; distance from upper end of pectoral base to first dorsal spine 1.85 (1.5–2.1) in dorsal base; fin moderately long, third or fourth (occasionally second) ray longest, 1.26 (1.0–1.4) in head; base of fin 3.20 (2.7–3.7) in longest ray; first ray simple, remainder branched, except for ventral one to three (this dependent on age). Origin of pelvic fin under or generally slightly posterior to first dorsal spine; first or second ray longest, 1.80 (1.5–2.0) in head; pelvic spine 1.64 (1.3–1.9) in longest ray.

Measurements in per mille of standard length based on 49 specimens from 42.5 mm to 128.5 mm (average 79.0 mm) in standard length: length of head 344 (302–380); length of maxillary 96 (77–108); length of eye 95 (78–113); length of snout 101 (85–114); width of interorbital space 106 (89–120); distance from first dorsal to pelvic 397 (359–428); distance from first dorsal spine to first anal spine 460 (414–505); distance from first anal spine to last dorsal ray 342 (290–374); caudal depth 161 (143–176); least depth of caudal peduncle 126 (113–139); distance from tip of snout to first dorsal 425 (390–451); distance from first dorsal spine to hypural 661 (611–686); distance from last dorsal ray to hypural 174 (147–210); length of dorsal base 485 (445–530); length of dorsal sheath 389 (340–445); length of soft dorsal base 318 (274–354); longest dorsal spine 159 (122–197); longest dorsal ray 138 (112–163); length of ultimate dorsal spine 85 (64–104); length of first dorsal ray 103 (85–129); distance from tip of snout to anal 662 (627–735); distance from first anal spine to hypural 406 (367–439); distance from last anal ray to hypural 164 (140–189); length of anal base 246 (214–265); length of longest anal spine 49 (35–77); length of longest anal ray 94 (66–118); distance from tip of snout to upper end of pectoral base 346 (315–376); distance from first dorsal to upper end of pectoral base 268 (235–304); width of pectoral base 85 (77–94); length of longest pectoral ray 273 (236–312); distance from tip of snout to pelvic 438 (415–457); length of longest pelvic ray 190 (172–208); length of pelvic spine 117 (93–135).

Fin and scale formulae: D. IX (VIII–XI), 20 (19–22); A. III, 24 (22–25); P. 19 (19–21); L1 40 (36–43) + 5 (4–6); scales from first dorsal spine to lateral line 5.

I have examined specimens of this species from the following localities: Golden Gardens, Seattle, Washington; Crescent City, California, Lat. 41° 44' 41" N., Long. 124° 11' 44" W.; Humboldt Bay, California, Lat. 40° 48' 18" N., Long. 124° 10' 25" W.; Bodega Lagoon Inlet, California, Lat. 38° 18' 18" N., Long. 123° 03' 25" W.; Bolinas Lagoon, California, Lat. 37° 54' 31" N., Long. 122° 40' 51" W.; San Pablo Bay, Marin County, California; Elkhorn Slough, California, Lat. 36° 48' 45" N., Long. 121° 47' 15" W.; near the mouth of the Salinas River, California, Lat. 36° 44' 52" N., Long. 121° 48' 04" W.; and Lat. 36° 44' 48" N., Long. 121° 48' 15" W.; Pacific Grove, California, Lat. 36° 37' 32" N., Long. 121° 54' 54" W.; Avila and Gaviota, Santa Barbara County, California; Newport Bay, Orange County, California; Mission Bay, San Diego County, California.

The recorded range of this species is from Port Wrangel, Southern Alaska, to Todos Santos Bay, Baja California.

Commonly taken by sport fishermen. Slight commercial value as bait.

11.10.2. Cymatogaster gracilis sp. nov., Island Perch

Cymatogaster aggregatus Hewatt, 1946, p. 205.

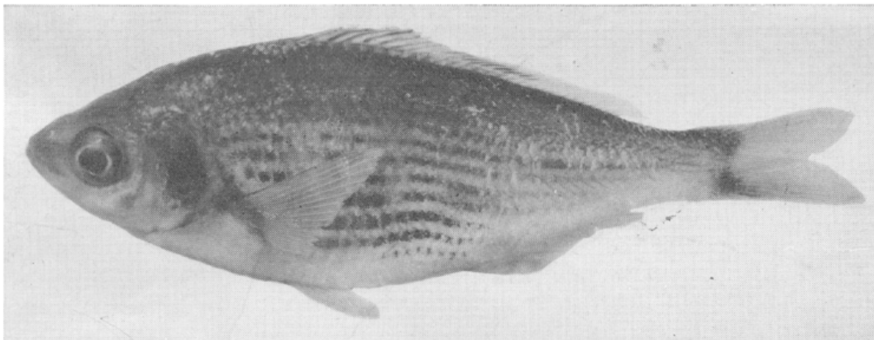

FIGURE 28. *Cymatogaster gracilis.* Island perch.

FIGURE 28. Cymatogaster gracilis. Island perch

Body slender, its depth 2.84 (2.6–3.2) in standard length; peduncular length 1.96 (1.7–2.2) in head; least depth of caudal peduncle 2.86 (2.7–3.1) in head.

Head 3.22 (3.0–3.3) in standard length; mouth fairly small, the maxillary variable, usually reaching a vertical from the anterior edge of orbit, its length 3.41 (3.0–4.3) in head; dorsal contour of head, to first dorsal spine, straight to just barely sigmoid; length of snout 3.41 (3.2–3.6) in head; length of eye 3.73 (3.4–4.0) in head; interorbital 3.38 (3.1–3.6) in head.

Origin of dorsal fin opposite (in juveniles examined) or slightly anterior to (in adults) the origin of the pelvic; dorsal base 1.97 (1.8–2.1) in standard length; dorsal sheath 1.32 (1.2–1.4) in dorsal base; soft dorsal 1.58 (1.4–1.6) in dorsal base; longest dorsal spine 4.02 (3.2–4.9) in dorsal base, always higher than general contour of soft dorsal fin; sixth spine occasionally longest; last dorsal spine 1.16 (1.0–1.4) in first dorsal ray; longest dorsal ray 4.53 (4.0–5.4) in dorsal base; first ray usually longest; first two (occasionally three or four) rays unbranched, all other rays branched in adults. Origin of anal fin usually under eighth (occasionally sixth to ninth) dorsal ray; anal base 2.28 (1.8–2.6) in dorsal base; third anal spine 5.03 (4.4–5.7) in anal base; longest ray 2.74 (2.6–3.0) in anal base; branching of the anal rays variable, usually following a pattern of a few to several simple rays in the anterior portion of the fin, with the remainder branched. Anal gland of males appearing as a fleshy organ on the anterior portion of the fin, its single small appendage directed downward or obliquely forward; this feature especially obvious during the breeding season. Base of upper pectoral ray under third or fourth scale of lateral line; distance from upper end of pectoral base to first dorsal spine 2.17 (1.9–2.5) in dorsal base; fin moderately long, third or fourth ray longest, 1.21 (1.1–1.3) in head; base of fin 3.40 (3.0–3.6) in longest ray; first ray simple, remainder branched, except for ventral one to three (this dependent on age). Origin of pelvic fin generally slightly posterior to, but occasionally opposite, first dorsal spine; first or second ray longest, 1.83 (1.6–1.9) in head; pelvic spine 1.70 (1.6–1.7) in longest ray.

Measurements in per mille of standard length based on 15 specimens from 85.7 mm. to 130.4 mm. (average 112.3 mm.) in standard length: length of head 309 (298–327); length of maxillary 92 (69–100); length of eye 83 (77–93); length of snout 92 (82–95); width of interorbital space 92 (82–104); total length 1131 (1109–1172); distance from first dorsal to pelvic 346 (312–376); distance from first dorsal spine to first anal spine 442 (417–491); distance from first anal spine to last dorsal ray 302 (264–322); caudal depth 144 (130–167); least depth of caudal peduncle 109 (101–118); distance from tip of snout to first dorsal 386 (376–402); distance from first dorsal spine to hypural 670 (641–700); distance from last dorsal ray to hypural 175 (152–192); length of dorsal base 512 (494–554); length of dorsal sheath 389 (372–400); length of soft dorsal base 324 (295–352); longest dorsal spine 118 (105–154); longest dorsal ray 113 (96–122); length of ultimate dorsal spine 83 (63–111); length of first dorsal ray 97 (71–139); distance from tip of snout to anal 668 (636–717); distance from first anal spine to hypural 378 (344–426); distance from last anal ray to hypural 158 (144–179); length of anal base 225 (199–262); length of longest anal spine 45 (39–51); length of longest anal ray 82 (74–99); distance from tip of snout to upper end of pectoral base 318 (305–336); distance from first dorsal to upper end of pectoral base 232 (211–255); width of pectoral base 79 (69–86); length of longest pectoral ray 256 (228–280); distance from tip of snout to pelvic 415 (401–428); length of longest pelvic ray 169 (155–186); length of pelvic spine 100 (92–107).

Fin and scale formulae: D. IX (IX–X), 21 (19–22); A. III, 24 (24–26); P. 20 (19–21); Ll 42 (38–44) + 5 (4–5); 5 scales from first dorsal to lateral line.

This species is known from the following localities: Pelican Bay, Santa Cruz Island, Lat. 34° 02' N., Long. 119° 42' W.; Santa Rosa Island, California; Catalina Harbor, Santa Catalina Island, California. The holotype (Stanford Natural History Museum No. 16760) is a female specimen 130.4 mm. in standard length from Pelican Bay. Ten paratypes (Nos. 16761 and 16762) are in the same museum.

The specific name gracilis is in reference to the graceful, slim form of this species.

11.11. Genus Hysterocarpus Gibbons

Hysterocarpus Gibbons, 1854a (genotype by monotypy, Hysterocarpus traski); 1854e, p. 124; Troschel, 1855b, p. 336; Girard, 1858, p. 190; A. Agassiz, 1861, p. 129; Günther, 1862, pp. 244, 251; Gill, 1862, p. 275; Jordan and Gilbert, 1882b, p. 586; Jordan, 1885, p. 884 (p. 96 in reprint); Eigenmann and Ulrey, 1894, pp. 384, 399; Jordan and Evermann, 1896, p. 403; 1898, pp. 1494, 1495; Boulenger, 1904, p. 670; Jordan and Evermann, 1922, p. 470; Jordan, Evermann and Clark, 1930, p. 412.

Sargosomus L. Agassiz in A. Agassiz, 1861, p. 129 (genotype by monotypy, Sargosomus fluviatilis=Hysterocarpus traski Gibbons).

Dacentrus Jordan, 1878, p. 667 (genotype by monotypy, Dacentrus lucens=Hysterocarpus traski Gibbons).

Body small (less than 150 mm in standard length), fairly deep; dorsal contour of body inclined steeply in head region, then gently curved; caudal peduncle fairly short, gradually tapering, its length 1.4 to 2.2 in head, somewhat deep, its least depth 2.1 to 2.7 in head.

Head relatively small; mouth terminal; jaws equal; maxillary short; snout bluntly conic, on a straight line with upper anterior profile of head; posterior nostril extremely small, about the size of the openings of the lateral line system of the head; eye rounded; interorbital moderately broad; frenum present.

Lateral line farthest from the dorsal contour of body at its origin, generally nearest at posterior end of dorsal fin, depressed slightly at caudal peduncle. Axilla scaled.

Base of dorsal fin moderately long, dorsal sheath extending almost its entire length; ventral origin of dorsal sheath under ninth to twelfth spine in advance of soft dorsal rays; spinous dorsal graduated, the sixth spine (occasionally fifth or seventh) being longest; last dorsal spine shorter than anterior dorsal rays; position of longest dorsal ray variable. Anal base fairly short; second spine always longest; anal rays raked moderately posteriorly; margin of fin slightly sigmoid in adults (this most marked in males), fairly straight in juveniles; a small lunar-shaped depression found in the body surface of the male, dorsal to the anterior portion of the anal fin. Lowermost pectoral rays not frayed.

Dorsal XVII (XV–XVIII), 11 (9–13). The high count of the spinous dorsal is unique and immediately characterizes the genus. Scales from scale sheath to lateral line 3½ to 5; scales from anterior end of anus to lateral line 12 to 15.

Hysterocarpus, at present, is a monotypic genus. There appears, however, to be two rather characteristic formae in the genus. The one is confined to rivers, the other to Clear Lake and, possibly other lakes of California. The fluviatile forma is a deep-bodied fish with short, robust spines, whereas the lacustrine forma is fairly slender with long, tenuous spines. There are other, less striking features which likewise differentiate the two forms. I have been conservative and tentatively applied the name formae to these two diverse groups. Their actual systematic status can only be determined through extensive breeding experiments, which were not undertaken. In the specific description there has been no attempt to differentiate the formae.

The only fresh-water representative of the family.

Υστερα

FIGURE

the womb, and

καρπός

FIGURE

fruit.

11.11.1. Hysterocarpus traski Gibbons, Fresh-water Viviparous Perch

Hysterocarpus traski Gibbons, 1854a; Jordan and Gilbert, 1882b, pp. 586, 587; 1882a, p. 51; Jordan and Jouy, 1882, p. 10; Jordan, 1885, p. 884 (p. 96 in reprint); 1887, p. 279; Eigenmann and Ulrey, 1894, p. 399; Eigenmann, 1894b, p. 404; Jordan and Gilbert, 1894, p. 140; Jordan and Evermann, 1896, p. 403; 1898, pp. 1494, 1496; 1900, fig. 577; Jordan and Sindo, 1902, p. 354; Jordan, 1905b, p. 374, figs. 307, 312; Snyder, 1905, p. 337; Rutter, 1908, p. 144; Snyder, 1908, p. 184; 1913, p. 71; Shepherd, 1915, p. 456, fig. 1; Hubbs, 1918, pp. 9, 10; Jordan and Evermann, 1922, p. 470, fig.; Bonnot, 1929, p. 230; Jordan, Evermann and Clark, 1930, p. 412; Evermann and Clark, 1931, p. 58; Walford, 1931, p. 23; Barnhart, 1936, p. 74.

Hysterocarpus traskii Gibbons, 1854e, p. 124; 1854d, p. 105; Troschel, 1855b, p. 336; Girard, 1856, p. 136; 1857b, p. 26; 1858, p. 190, pl. xxvi (fig. 14); A. Agassiz, 1861, p. 130; Günther, 1862, p. 251; Jordan, 1880, p. 327.

Sargosomus fluviatilis L. Agassiz, in A. Agassiz, 1861, p. 130.

Dacentrus lucens Jordan, 1878, p. 667; 1880, p. 327.
Docentrus lucens Rutter, 1908, p. 144 (in synonymy, lapsus calami pro Dacentrus lucens).
Decentrus lucens Jordan, Evermann and Clark, 1930, p. 412 (in synonymy, lapsus calami pro Dacentrus lucens).

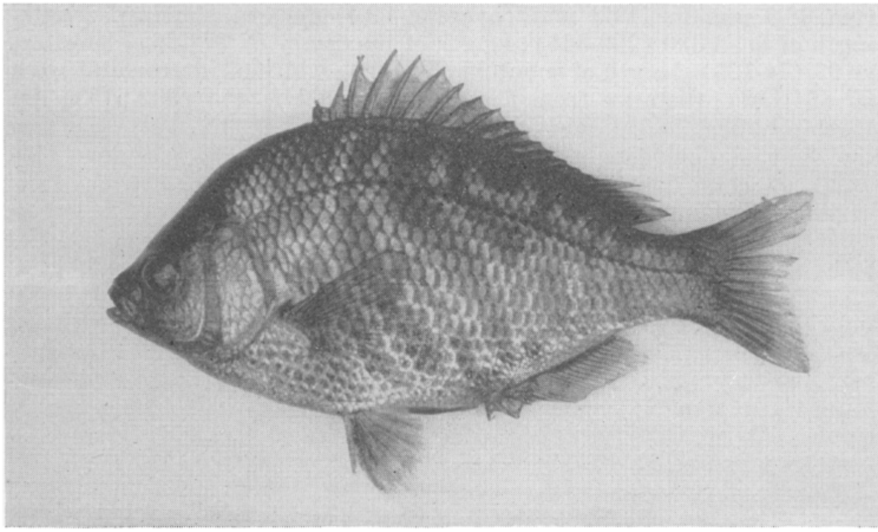

FIGURE. 29. *Hysterocarpus traski.* Fresh-water viviparous perch. Photograph by W. I. Follett.

FIGURE 29. Hysterocarpus traski. Fresh-water viviparous perch. Photograph by W. I. Follett

Body fairly deep, its depth 2.20 (1.9–2.5) in standard length; peduncular length 1.90 (1.4–2.2) in head; least depth of caudal peduncle 2.41 (2.1–2.7) in head.

Head 3.03 (2.7–3.3) in standard length; mouth small, the maxillary usually not reaching a vertical from anterior edge of orbit, its length 3.90 (3.3–4.7) in head; dorsal contour of head, fairly straight in fluviatile forms to slightly sigmoid in lacustrine forms; length of snout 3.49 (3.0–3.9) in head; length of eye 3.36 (2.9–4.3) in head; interorbital 3.16 (2.9–3.6) in head.

Origin of dorsal fin about opposite the origin of the pelvic; dorsal base 1.81 (1.6–2.0) in standard length; dorsal sheath 1.17 (1.0–1.2) in dorsal base; soft dorsal 3.54 (2.6–4.2) in dorsal base; longest dorsal spine 3.27 (2.4–4.6) in dorsal base, always higher than general contour of soft dorsal fin; last dorsal spine 1.60 (1.3–2.0) in first dorsal ray; longest dorsal ray 3.84 (3.0–4.9) in dorsal base. Origin of anal fin under second, third or fourth spine in advance of soft dorsal rays; anal base 2.32 (1.8–2.5) in dorsal base; second anal spine 3.08 (2.0–5.4) in anal base; longest ray 2.06 (1.6–2.6) in anal base; branching of anal rays usually following a pattern of several simple rays in the anterior portion of the fin, with the remainder branched. Anal gland of males, appearing as a fleshy organ on the anterior portion of the fin, its single appendage directed obliquely forward, this feature especially obvious during the breeding season. Base of upper pectoral ray under first or second scale of lateral line; distance from upper end of pectoral base to first dorsal spine 1.86 (1.5–2.1) in dorsal base; fin moderately long, third or fourth (occasionally second or fifth) ray longest, 1.31 (1.0–1.4) in head; base of fin

3.06 (2.6–3.6) in longest ray; first ray simple, remainder branched except for ventral one to three. Origin of pelvic fin generally opposite first dorsal spine; first or second ray longest, 1.40 (1.2–1.6) in head; pelvic spine 1.57 (1.3–2.0) in longest ray.

Measurements in per mille of standard length based on 49 specimens from 38.3 mm to 119.2 mm (average 69.1 mm) in standard length: length of head 330 (299–366); length of maxillary 87 (71–96); length of eye 99 (74–123); length of snout 95 (79–112); width of interorbital space 107 (84–118); distance from first dorsal to pelvic 455 (392–515); distance from first dorsal spine to first anal spine 525 (465–580); distance from first anal spine to last dorsal ray 364 (334–396); caudal depth 171 (152–195); least depth of caudal peduncle 136 (120–150); distance from tip of snout to first dorsal 427 (374–461); distance from first dorsal spine to hypural 697 (640–740); distance from last dorsal ray to hypural 152 (121–181); length of dorsal base 554 (496–592); length of dorsal sheath 475 (428–520); length of soft dorsal base 158 (125–208); longest dorsal spine 172 (132–219); longest dorsal ray 145 (118–174); length of ultimate dorsal spine 70 (49–89); length of first dorsal ray 113 (84–127); distance from tip of snout to anal 667 (644–694); distance from first anal spine to hypural 410 (383–433); distance from last anal ray to hypural 175 (153–208); length of anal base 239 (215–268); length of longest anal spine 81 (49–114); length of longest anal ray 117 (83–145); distance from tip of snout to upper end of pectoral base 339 (311–371); distance from first dorsal to upper end of pectoral base 299 (250–349); width of pectoral base 84 (74–93); length of longest pectoral ray 252 (222–284); distance from tip of snout to pelvic 448 (423–473); length of longest pelvic ray 236 (205–258); length of pelvic spine 151 (117–178).

Fin and scale formulae: D. XVII (XV–XVIII), 11 (9–13); A. III, 22 (19–23); P. 18 (17–19); L1 38 (36–40) (one specimen with 43) + 5 (3–5); scales from first dorsal spine to lateral line 7 (6–7).

Color stable; two separate and distinct pattern phases. Ground color brassy overlain with gray. Body soot colored dorsally, thinning out ventrally to salt and pepper becoming silvery white on belly. In the second phase there is, in addition to the above, a series of approximately eight slate gray bars which run vertically from the dorsal sheath, across the lateral body walls, and fade out just above the region of the belly. The last bar appears as a blotch just posterior to the hypural. In both phases the dorsal and anal fins are slightly dusky with the pectoral and pelvic fins plain. A slight pigmentation in the axilla, on the body. The two phases are not due to a sexual dimorphism.

I have examined specimens of this species from the following localities in California: Russian River, at Ukiah, Mendocino County; Clear Lake, at Lakeport, Lake County; Putah Creek, near Winters, Yolo County; Alameda Creek, at Sunol, Alameda County; Coyote Creek, Santa Clara County; San Joaquin River, at Stockton, San Joaquin County; Pajaro River, near Aromas and Sargent, Santa Cruz County; Nacimiento River, San Luis Obispo County, Lat. 35° 47' 02" N., Long. 120° 47' 25" W.

The species has been recorded from the following fresh water courses of California: Pit River, near Pittsville, Lassen County; Feather River, at Marysville, Yuba County; Clear Lake, Lake County; Russian River, at various stations; Napa River, Napa County; Sacramento and San Joaquin River System; Alameda Creek, Alameda County; Pajaro River, Santa Cruz County; Salinas River, Monterey County.

The name traski, is in honor of Dr. J. B. Trask who sent the first specimens to Dr. Gibbons.

11.12. Genus Micrometrus Gibbons

Micrometrus Gibbons, 1854b (genotype by subsequent restriction of genus to monotypy by A. Agassiz, 1861, Micrometrus minimus (Gibbons)).[*]

Ditrema Günther, 1862, p. 245 (ex parte).

Body small (less than 150 mm in standard length), variable in shape; caudal peduncle long, gradually tapering, its length 1.0 to 1.5 in head.

Head relatively small, its length 2.7 to 3.7 in standard length, being proportionately larger in young; posterior nostril usually elongate; maxillary short, its length 3.5 to 5.7 in head, relatively larger in young than in old individuals; interorbital moderately broad, its width 2.6 to 3.7 in head; a well defined frenum present.

Base of dorsal fin short, its length 2.2 to 2.9 in standard length; dorsal sheath long, almost covering dorsal base, its length 1.1 to 1.3 in base of dorsal; spinous dorsal graduated, the fifth or sixth spine (rarely others) being longest; last dorsal spine approximately as high as anterior part of soft dorsal, its height 0.9 to 1.3 in first dorsal ray; first dorsal ray usually longest, subsequent rays gradually decreasing in length. Anal base short, its length 3.2 to 6.2 in dorsal base; anal rays raked moderately posteriorly; opening of anal gland directed downwards. Base of upper pectoral ray under second to fourth scale of lateral line. Ventral rays moderate in length, the last ray shortest.

Scales from dorsal sheath to lateral line 3½ to 5; scales from anterior end of anus to lateral line 12 to 16.

Pigmentation in axilla, ranging from very little in Micrometrus (Brachyistius) frenatus to a large conspicuous black triangle in the subgenus Micrometrus.

Μικρος

FIGURE

small, and

μετρον

FIGURE

measure (quasi size)

11.12.1. Subgenus Micrometrus Gibbons

Cymatogaster Gibbons, 1854a (ex parte).

Micrometrus Gibbons, 1854b (genotype by subsequent restriction of genus to monotypy by A. Agassiz, 1861, Micrometrus minimus (Gibbons)); 1854e, p. 125 (ex parte); Troschel, 1855b, p. 339 (ex parte); A. Agassiz, 1861, pp. 123, 128, 133; Gill, 1862, p. 275; Jordan and Gilbert, 1882b, pp. 586, 588, 590, 936; Jordan, 1885, p. 884 (p. 96 in reprint); Jordan, 1917, p. 86; Jordan, Evermann and Clark, 1930, p. 409; Barnhart, 1936, p. 73.

Abeona Girard, 1855, p. 322 (genotype by monotypy, Abeona trowbridgii—Micrometrus minimus (Gibbons)); Troschel, 1855c, p. 349; Girard, 1858, p. 186; A. Agassiz, 1861, p. 133; Gill, 1862, p. 275; Jordan and Gilbert, 1881c, p. 303; Jordan and Gillbert, 1882b, pp. 586, 587; Jordan, 1885, p. 884 (p. 96 in reprint); Eigenmann and Ulrey, 1894, pp. 384, 398; Jordan and Evermann, 1896, p. 403; 1898, pp. 1494,

[*] Gibbons, in the Proceedings of the California Academy of Natural Sciences published in the Daily Placer Times and Transcript, established the genus Cymatogaster (May 18, 1854) with the two species C. aggregata and C. minimus and less than two weeks later (May 30, 1854) erected the genus Micrometrus for the same two species. A. Agassiz (1861, p. 133) restricted the genus Micrometrus to the single species M. minimus and Gill (1862, p. 275) limited the genus Cymatogaster to the species C. aggregatus. Thus, each of the two genera, originally based on the same two species became monotypic and concommittantly may be considered to have had genotypes established. This point of view has been universally accepted for more than 30 years and is in accordance with Opinion 10 of the International Commission on Zoological Nomenclature.

1496; Jordan and Sindo, 1902, p. 354; Boulenger, 1904, p. 670; Jordan, 1917, p. 86; Jordan and Evermann, 1922, p. 470.

Amphigonopterus Hubbs, 1918, p. 13 (type Abeona aurora Jordan and Gilbert by original designation); Jordan, Evermann and Clark, 1930, p. 409; Barnhart, 1936, p. 76.

Mouth terminal; jaws equal; snout rounded or bluntly conic; teeth very often tricuspid, although the constancy of this character is not marked.

Intestine long due to the herbivorous diet of the adult.

A deep lunar-shaped depression in the body surface of the male, dorsal to the anterior portion of the anal fin; lowermost pectoral rays frayed; the body with a large conspicuous black triangle in the axilla; a sexual dimorphism in the number of anal rays, the males having a higher count.

11.12.1.1. Micrometrus (Micrometrus) minimus (Gibbons), Dwarf Perch

Cymatogaster minimus Gibbons, 1854a; 1854d, p. 106.

Micrometrus minimus Gibbons, 1854b; 1854e, p. 125; Troschel, 1855b, p. 339; A. Agassiz, 1861, p. 129; Hubbs, 1918, p. 13; 1921, pp. 184–191, 193, 195, 199, 200, 202, fig. 1; Ulrey and Greeley, 1928, p. 16; Wales, 1928, p. 63, fig. 10; Jordan, Evermann and Clark, 1930, p. 409; Barnhart, 1936, pp. 76, 77, fig. 227; Blanco, 1938, p. 380; Hewatt, 1946, p. 205.

Ditrema minimum Günther, 1862, p. 249.

Abeona minima Gill, 1862, p. 275; Cooper, 1868, p. 489; Smith, 1880; Jordan and Gilbert, 1881b, p. 300; 1881e, p. 456; 1881a, p. 28; 1882b, p. 587; 1882a, p. 51; Jordan and Jouy, 1882, p. 10; Jordan, 1885, p. 884 (p. 96 in reprint); Smith, 1885; Jordan, 1887, p. 276; Eigenmann, 1890a, pp. 924, 925; Eigenmann and Eigenmann, 1892, p. 353; Eigenmann, 1893, p. 130; Eigenmann and Ulrey, 1894, p. 398; Jordan and Evermann, 1896, p. 403; 1898, p. 1497; Jordan and McGregor, 1899, p. 281; Gilbert, 1899, p. 25; Jordan and Evermann, 1900, fig. 578; Jordan, 1905b, p. 375; Starks and Morris, 1907, p. 200; Starks and Mann, 1911, p. 10; Metz, 1912, p. 34; Jordan and Evermann, 1922, p. 470; Fowler, 1923a, pp. 292, 300.

Holconotus trowbridgii Girard, 1854d, p. 152.

Holconotus trowbridgei Jordan, Evermann and Clark, 1930, p. 409 (in synonymy, lapsus calami pro Holconotus trowbridgii).

Abeona trowbridgii Girard, 1855, p. 322; Troschel, 1855c, p. 349; Girard, 1858, p. 186, pl. xxxiv (figs. 6–10).

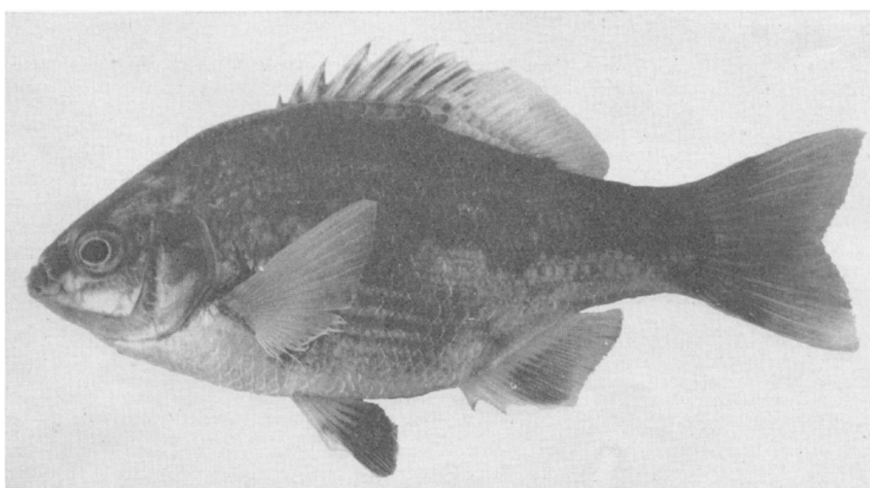

FIGURE 30. *Micrometrus (Micrometrus) minimus* (Gibbons). Dwarf perch.

FIGURE 30. Micrometrus (Micrometrus) minimus (Gibbons). Dwarf perch

Body deep, its depth 2.2 (2.0–2.4) in standard length; dorsal contour of the body slightly more curved than ventral; peduncular length 1.39 (1.1–1.5) in head; least depth of caudal peduncle 1.95 (1.7–2.1) in head.

Head 3.07 (2.7–3.7) in standard length; mouth small, the maxillary usually not reaching a vertical from anterior edge of orbit, its length 4.31 (3.7–5.1) in head; snout on a relatively straight line with upper anterior profile, its length 3.44 (2.9–3.9) in head; posterior nostril usually parallel to upper anterior profile; eye slightly longer than high, its length 3.10 (2.5–3.5) in head; interorbital 3.06 (2.8–3.5) in head, its fleshy portion overhanging eye slightly on anterior dorsal rim of orbit, this not sharply marked in young.

Lateral line farthest from the dorsal contour of body at its origin, generally nearest at posterior end of dorsal fin, depressed slightly at caudal peduncle. Pigmented spot in axilla naked.

Origin of dorsal fin opposite, or slightly posterior to, the origin of pelvic; dorsal base 2.51 (2.2–2.7) in standard length; dorsal sheath 1.15 (1.0–1.2) in dorsal base; ventral origin of dorsal sheath generally under penultimate dorsal spine; base of soft dorsal 1.81 (1.6–2.1) in dorsal base; longest dorsal spine 2.14 (1.7–2.9) in dorsal base; height of longest dorsal spine closely approximating greatest height of soft dorsal; last dorsal spine 1.14 (1.0–1.2) in first dorsal ray; longest dorsal ray 2.05 (1.7–3.0) in dorsal base; occasionally first dorsal ray unbranched, otherwise all rays branched in adult. Origin of anal fin under first to fourth dorsal ray; anal base 1.75 (1.3–2.2) in dorsal base; third spine always longest, 2.38 (1.9–3.4) in anal base; first ray usually but not always longest, its length 1.69 (1.3–2.3) in anal base; margin of fin barely sigmoid in adults, straight or slightly convex in juveniles; first two, occasionally three, anal rays unbranched in adults. Distance from upper end of pectoral base to first dorsal spine 1.28 (1.1–1.4) in dorsal base; fin moderately long, third or fourth ray longest, 1.19 (1.0–1.3) in head; base of fin 3.16 (2.7–3.8) in longest ray; first ray simple, remainder branched, except for ventral one to three (this dependent on age). Origin of pelvic fin under or slightly anterior to first dorsal spine; first or second ray longest, 1.51 (1.2–1.6) in head; pelvic spine 1.53 (1.3–1.9) in longest ray.

Measurements in per mille of standard length based on 50 specimens from 30.2 mm to 94.5 mm (average 57.0 mm) in standard length: length of head 326 (266–364); length of maxillary 76 (63–96); length of eye 106 (80–132); length of snout 95 (81–109); width of interorbital space 106 (89–122); distance from first dorsal to pelvic 458 (414–490); distance from first dorsal spine to first anal spine 488 (424–531); distance from first anal spine to last dorsal ray 377 (334–447); caudal depth 217 (179–237); least depth of caudal peduncle 165 (145–181); distance from tip of snout to first dorsal 461 (417–498); distance from first dorsal spine to hypural 647 (607–679); distance from last dorsal ray to hypural 254 (226–284); length of dorsal base 400 (370–440); length of dorsal sheath 346 (300–384); length of soft dorsal base 220 (179–252); longest dorsal spine 188 (149–218); longest dorsal ray 196 (144–229); length of ultimate dorsal spine 125 (87–151); length of first dorsal ray 143 (96–175); distance from tip of snout to anal 631 (563–682); distance from first anal spine to hypural 459 (413–529); distance from last anal ray to hypural 235 (201–260); length of anal base 230 (196–312); length of longest anal spine 97 (77–117); length of longest anal ray 135 (113–163); distance from tip of snout to upper end of pectoral base 331 (252–371); distance from first dorsal to upper end of pectoral base 309 (286–341); width of pectoral base 86 (70–99); length of longest pectoral ray 274 (220–305); distance from tip of snout to pelvic 442 (408–483); length of longest pelvic ray 216 (186–240); length of pelvic spine 142 (103–172).

Fin and scale formulae: D. IX (VIII–XI), 14 (13–16); A. III, (15–19) in females, (17–21) in males; P. 21 (18–22); L1 40 (37–45) + 4 (3–6); scales from first dorsal spine to lateral line 6 (5–7).

Color slightly variable, pattern stable. Ground color silver overlain with green and yellow, greenish dorsally with blue reflections; an irregular dark line along longitudinal axis of body; yellow or yellow orange often on lateral body walls; dark color (green or brown) forming two very characteristic blotches on dorsal sheath, the first one about at meeting of spinous with soft dorsal, the second at end of fin; two vertical, ill defined, bars extending downward on lateral surfaces from these blotches; fins plain or slightly dusky.

I have examined specimens of this species from the following localities in California: Bodega Lagoon, Lat. 38° 19' 37" N., Long. 123° 03' 16" W.; Bolinas Point, Lat. 37° 54' 13" N., Long. 122° 43' 35" W.; Duxbury Point, Lat. 37° 53' 41" N., Long. 122° 42' 18" W.; Angel Island, San Francisco Bay; Richmond, Lat. 37° 54' 31" N., Long. 122° 23' 20" W.; Pacific Gas & Electric Pumping Station, San Francisco; Moss Beach, San Mateo County; Elkhorn Slough, Lat. 36° 48' 45" N., Long. 121° 47' 15" W.; Monterey Bay, Lat. 36° 37' 20" N., Long. 121° 54' 08" W.; San Clemente Island; Bird Rock, San Diego County; Crown Point, Mission Bay; and from the first point south of the mouth of Rio San Isidro, Baja California.

The recorded range of this species is from San Francisco to Baja California. This range is here extended approximately 30 miles northward.

Common in tide pools. Rarely taken by fishermen because of its herbivorous diet. No commercial value.

The name minimus, smallest, refers to the diminutive size of the species.

11.12.1.2. Micrometrus (Micrometrus) aurora (Jordan & Gilbert), Reef Perch

Abeona aurora Jordan and Gilbert, 1881b, pp. 299, 300; 1881e, p. 456; 1882b, p. 588; 1882a, p. 51; Jordan and Jouy, 1882, p. 10; Jordan, 1885, p. 884 (p. 96 in reprint); 1887, p. 278; Eigenmann and Eigenmann, 1892, p. 353; Eigenmann and Ulrey, 1894, p. 399; Jordan and Evermann, 1896, p. 403; 1898, p. 1497; Jordan, 1905b, p. 375; Jordan and Evermann, 1922, p. 470.

Amphigonopterus aurora Hubbs, 1918, p. 13; 1921, pp. 183–188, 190–195, 198–202; Ulrey and Greeley, 1928, p. 15; Jordan, Evermann and Clark, 1930, p. 409; Barnhart, 1936, pp. 76, 77; Blanco, 1938, p. 380; Hewatt, 1946, p. 205; Hubbs, 1948, p. 460.

Body relatively slender, depth 2.67 (2.4–2.8) in standard length; dorsal contour of body gently curved, about same as ventral; peduncular length 1.25 (1.0–1.4) in head; least depth of caudal peduncle 2.17 (1.9–2.5) in head.

Head 3.34 (2.8–3.7) in standard length; mouth quite small, the maxillary reaching, or extending slightly beyond, a vertical from the posterior nostril, its length 4.55 (4.0–5.7) in head; snout rounded slightly above maxillary, then following a relatively straight line with the dorsal contour of head, its length 3.37 (2.9–4.3) in head; posterior nostril inclined

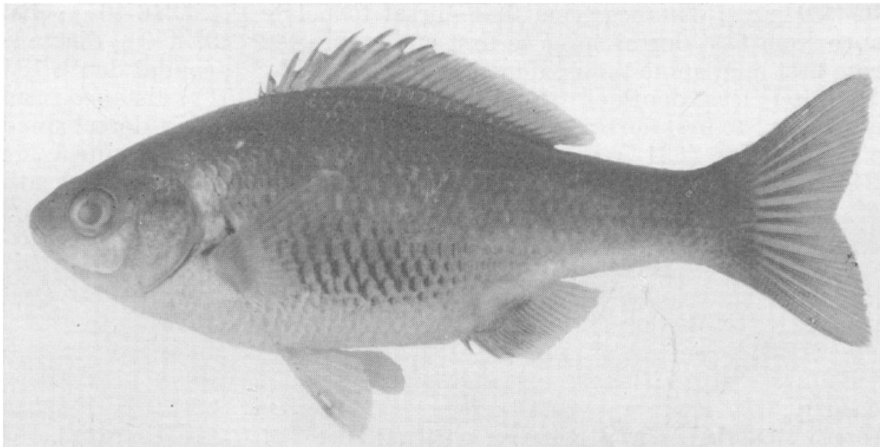

FIGURE 31. *Micrometrus (Micrometrus) aurora.* Reef perch.

FIGURE 31. Micrometrus (Micrometrus) aurora. Reef perch

slightly from the axis of the body; eye rounded, its length 3.47 (2.8–4.7) in head; interorbital width 2.94 (2.6–3.3) in head.

The distance between the lateral line and the dorsal contour of the body gradually diminishing from about the vertical of the origin of the dorsal sheath, to a point opposite the least width of the caudal peduncle where it again becomes slightly depressed. Pigmented triangle in axilla naked.

Origin of dorsal fin opposite, or slightly anterior to, origin of pelvic; dorsal base 2.44 (2.2–2.6) in standard length; dorsal sheath 1.11 (1.0–1.2) in dorsal base; ventral origin of dorsal sheath generally under antepenultimate or penultimate dorsal spine; soft dorsal 1.57 (1.4–1.8) in dorsal base; longest dorsal spine 2.94 (2.5–3.6) in dorsal base, usually slightly higher than general contour of soft dorsal fin; fourth dorsal spine occasionally longest; last dorsal spine 1.09 (0.9–1.3) in first dorsal ray; longest dorsal ray 2.59 (2.2–3.2) in dorsal base; first, and often second, rays simple, all other rays branched. Origin of anal fin under fifth to eighth dorsal ray; anal base 2.15 (1.6–2.7) in dorsal base; third, occasionally second, spine longest, 2.44 (2.0–3.3) in anal base; longest ray 1.78 (1.5–2.1) in anal base; margin of fin straight or just barely sigmoid in adults; first to twelfth (usually ten or eleven, occasionally nine) rays unbranched in adults. Lunar depression found just above anterior end of anal base in males shows incipiently in the females as a group of very tiny scales in the same area. Distance from upper end of pectoral base to first dorsal spine 1.63 (1.4–1.8) in dorsal base; pectoral fin short, third (second to fourth) ray longest, 1.23 (1.0–1.4) in head; base of fin 3.36 (2.9–3.8) in longest pectoral ray; first ray simple, remainder branched, except for ventral one to three (this dependent on age). Origin of pelvic under, or slightly posterior to, first dorsal spine; first or second ray longest, 1.48 (1.2–1.9) in head; pelvic spine 1.60 (1.4–1.7) in longest ray.

Measurements in per mille of standard length based on 50 specimens from 37.7 mm to 132.0 mm (average 80.0 mm) in standard length: length of head 301 (276–356); length of maxillary 66 (49–82); length of eye 87 (60–118); length of snout 89 (74–102); width of interorbital space

102 (89–118); distance from first dorsal to pelvic 376 (346–405); distance from first dorsal spine to first anal spine 442 (409–490); distance from first anal spine to last dorsal ray 311 (292–348); caudal depth 185 (168–210); least depth of caudal peduncle 138 (130–151); distance from tip of snout to first dorsal 398 (371–445); distance from first dorsal spine to hypural 668 (631–703); distance from last dorsal ray to hypural 264 (244–284); length of dorsal base 410 (383–445); length of dorsal sheath 369 (330–408); length of soft dorsal base 261 (227–298); longest dorsal spine 139 (114–153); longest dorsal ray 158 (138–178); length of ultimate dorsal spine 108 (86–127); length of first dorsal ray 119 (103–136); distance from tip of snout to anal 637 (592–684); distance from first anal spine to hypural 430 (389–478); distance from last anal ray to hypural 241 (219–263); length of anal base 192 (160–239); length of longest anal spine 79 (58–108); length of longest anal ray 107 (86–131); distance from tip of snout to upper end of pectoral base 304 (266–345); distance from first dorsal to upper end of pectoral base 252 (234–274); width of pectoral base 72 (64–85); length of longest pectoral ray 244 (223–272); distance from tip of snout to pelvic 419 (391–451); length of longest pelvic ray 204 (183–234); length of pelvic spine 127 (110–156).

Fin and scale formulae: D. VIII (VII–IX), 17 (16–18); A. III, (18–20) in females (Hubbs, 1918, p. 13 has reported counts as low as 13), (18–23) in males; P. 18 (17–20); L1 47 (43–52) + 5 (4–5); scales from first dorsal spine to lateral line 6 (5–6).

Color variable, pattern stable in adults; ground color silver overlain with black, green, and often orange; young occasionally all silvery. Dorsum bluish or greenish black, color becoming lighter on sides, belly silvery; opercle and lower sides peppered with black; an orange gold horizontal stripe often extending from behind pectoral and fading out near hypural. Scales on lower body wall, posterior to pectoral, with crescent-like black pigment on edges. This pigmentation forms a series of oblique, narrow bars from the pectoral region to the anus. In the young silvery forms these are, of course, absent.

I have examined specimens of this species from the following localities in California: Tomales Bay, Marin County; Bolinas Point, Lat. 37° 54' 13" N., Long. 122° 43' 35" W.; Sail Rock, Pillar Point, San Mateo County; Pacific Grove, Lat. 36° 37' 20" N., Long. 121° 56' 20" W.; Monterey Bay, Lat. 36° 37' 20" N., Long. 121° 54' 08" W.; 2 miles north of Point Buchon, San Luis Obispo County; Santa Rosa Island, Lat. 34° 00' 11" N., Long. 120° 02' 40" W. and Lat. 33° 59' 30" N., Long. 120° 13' 15" W.; and from 1¼ miles south of the mouth of Rio San Isidro, Baja California.

The recorded range of this species is from Monterey, California, to Todos Santos Bay, Baja California. This range is here extended approximately 120 miles northward.

Common in tide pools. Rarely taken by fishermen because of its herbivorous diet. No commercial value.

The name aurora means sunrise.

11.12.2. Subgenus Brachyistius Gill

Brachyistius Gill, 1862, p. 275 (genotype by monotypy, Brachyistius frenatus Gill); Jordan and Gilbert, 1882b, pp. 589, 936; Jordan, 1885, p. 884 (p. 96 in reprint); Eigenmann and Ulrey, 1894, pp. 384, 395; Jordan and Evermann, 1896, p. 403; 1898, pp. 1494, 1499; 1922, p. 471; Jordan, Evermann and Clark, 1930, p. 409.

Mouth superior, oblique; upper jaw slightly shorter than lower; snout pointed; teeth bluntly conic.

Occasionally a very slight depression found in the body surface of the male, dorsal to the anterior portion of the anal fin, adumbrates the conspicuous concavity which characterizes the subgenus Micrometrus. The lowermost pectoral rays are not frayed. The heavy pigmentation of the axilla, which is so conspicuous in the subgenus Micrometrus is represented by a semicircle of black in Micrometrus (Brachyistius) aletes and as a very light peppered black area in Micrometrus (Brachyistius) frenatus; no sexual dimorphism in the number of rays in the anal fin.

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FIGURE

sail, or dorsal fin.

11.12.2.1. Micrometrus (Brachyistius) frenatus (Gill), Kelp Perch

Brachyistius frenatus Gill, 1862, p. 275; Cooper, 1868, p. 489; Jordan and Gilbert, 1881b, p. 300; 1881c, p. 304; 1881e, p. 456; 1882a, p. 51; Jordan and Jouy, 1882, p. 10; Smith, 1885; Jordan, 1885, p. 884 (p. 96 in reprint); 1887, p. 278; Eigenmann and Eigenmann, 1892, p. 353; Eigenmann, 1893, p. 130; Eigenmann and Ulrey, 1894, p. 395; Jordan and Starks, 1895, p. 797; Jordan and Evermann, 1896, p. 403; 1898, p. 1499; 1900, fig. 580; Jordan, 1905b, p. 375; Starks and Morris, 1907, p. 200; Starks, 1911, p. 209; Hubbs, 1918, p. 12; Jordan and Evermann, 1922, p. 471; Hubbs, 1928, p. 13; Ulrey and Greeley, 1928, p. 15; Wales, 1928, p. 60; Jordan, Evermann and Clark, 1930, p. 409; Barnhart, 1936, pp. 75, 77, fig. 229; Schultz, 1936, p. 189; Schultz and DeLacy, 1936, p. 136; Roedel, 1948, pp. 22, 85, fig. 57, Fitch, 1952.

Ditrema brevipinne Günther, 1862, p. 248; Lord, 1866, p. 354; Bean, 1881, p. 265; Jordan and Gilbert, 1881b, p. 300.

Micrometrus frenatus Bean, 1881, p. 265; Jordan and Gilbert, 1882b, p. 589.

Brachyistius brevipinnis Clemens and Wilby, 1946, pp. 27, 148, fig. 87.

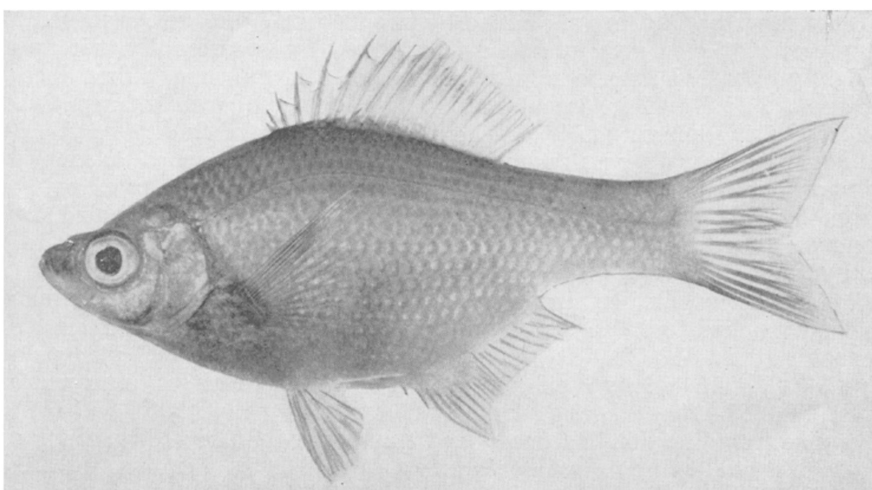

FIGURE 32. *Micrometrus (Brachyistius) frenatus* (Gill). Kelp perch.

FIGURE 32. Micrometrus (Brachyistius) frenatus (Gill). Kelp perch

Body relatively slender, its depth 2.54 (2.2–2.8) in standard length; dorsal contour of body slightly more curved than ventral; peduncular length 1.32 (1.1–1.5) in head; least depth of caudal peduncle 2.11 (1.9–2.4) in head.

Head 3.15 (2.8–3.4) in standard length; mouth small, the maxillary reaching to a vertical taken somewhere between the posterior margin of the anterior nostril and the end of the posterior nostril, its length 4.04 (3.5–4.8) in head; dorsal contour of the head variable from a type strongly sigmoid to one which is almost a straight line; snout straight, 3.39 (3.0–3.7) in head; eye rounded, its length 3.48 (2.8–4.1) in head; interorbital 3.33 (3.0–3.7) in head.

Lateral line farthest from the dorsal contour of the body at its origin, generally nearest at posterior end of dorsal fin, depressed slightly at caudal peduncle.

Origin of dorsal fin, opposite or somewhat anterior to the origin of the ventral; dorsal base 2.69 (2.4–2.9) in standard length; dorsal sheath 1.22 (1.1–1.3) in dorsal base; ventral origin of dorsal sheath under ultimate or penultimate dorsal spine; soft dorsal 1.74 (1.6–1.9) in dorsal base; longest dorsal spine 2.22 (1.7–2.8) in dorsal base, usually slightly higher than general contour of soft dorsal fin; seventh dorsal spine occasionally longest; last dorsal spine 1.10 (0.9–1.2) in first dorsal ray; longest dorsal ray 1.97 (1.6–2.2) in dorsal base; first ray unbranched, all other rays branched in adults. Origin of anal fin under third to sixth dorsal ray; anal base 1.55 (1.3–1.8) in dorsal base; longest anal spine 3.32 (2.4–4.8) in anal base; longest anal ray 1.71 (1.3–2.0) in anal base; the rays very variable, anterior one or two simple, followed by three to six branched rays which are succeeded by two to six simple ones, the remaining posterior elements branched, last anal ray occasionally not split entirely to base. Distance from upper end of pectoral base to first dorsal spine 1.38 (1.1–1.6) in dorsal base; pectoral fin moderately long, third or fourth ray longest, 1.19 (1.1–1.4) in head; base of fin 3.60 (3.1–4.0) in longest pectoral ray; first ray simple, remainder branched, except for ventral one to three. Origin of pelvic opposite or posterior to a vertical from the first dorsal spine; first or second, but occasionally third, ray longest; longest ray 1.59 (1.4–1.7) in head; pelvic spine 1.51 (1.3–1.6) in longest ray.

Measurements in per mille of standard length based on 35 specimens from 63.4 mm to 121.5 mm (average 91.3 mm) in standard length: length of head 319 (290–348); length of maxillary 79 (67–89); length of eye 93 (71–116); length of snout 95 (81–102); width of interorbital space 96 (81–109); distance from first dorsal to pelvic 396 (350–445); distance from first dorsal spine to first anal spine 436 (386–482); distance from first anal spine to last dorsal ray 362 (309–396); caudal depth 217 (184–242); least depth of caudal peduncle 151 (134–171); distance from tip of snout to first dorsal 416 (382–452); distance from first dorsal spine to hypural 653 (614–684); distance from last dorsal ray to hypural 288 (251–317); length of dorsal base 373 (340–410); length of dorsal sheath 307 (272–339); length of soft dorsal base 216 (191–241); longest dorsal spine 169 (138–196); longest dorsal ray 191 (162–222); length of ultimate dorsal spine 140 (113–172); length of first dorsal ray 153 (124–175); distance from tip of snout to anal 607 (554–646); distance from first anal spine to hypural 475 (429–510); distance from last anal ray to hypural 241 (213–264); length of anal base 242 (199–277); length of longest anal spine 74 (56–93); length of longest anal ray 141 (113–205); distance from tip of snout to upper end of pectoral base 330 (290–370); distance from first dorsal to upper end of pectoral base 271 (236–337); width of pectoral base 72 (66–80); length of longest pectoral ray 260 (221–290); distance from tip of snout to pelvic 445 (414–490); length of longest pelvic ray 201 (180–226); length of pelvic spine 135 (115–152).

Fin and scale formulae: D. VIII (VII–IX), 14 (13–16); A. III, 23 (21–24); P. 18 (17–18); Ll 41 (37–44) + 5 (4–6); scales from first dorsal spine to lateral line 6 (5–6).

Color variable from rosy to coppery brown; dorsal to lateral line, coppery or olivaceous brown; below lateral line, lighter coppery tan. The entire body may be overlain with rose and shows no distinctive markings on body except for a small amount of peppery black pigmentation in the axilla. Fins plain or rosy; anal fin may be dusky anteriorly.

I have examined specimens of this species from the following localities in California: Tomales Bay, Marin County; Sausalito, Marin County; San Francisco; Monterey Bay, Lat. 36° 37' 20" N., Long. 121° 54' 08" W.; Stillwater Cove, Monterey County; Gaviota, Santa Barbara, and Summerland, Santa Barbara County; Rock Point, Santa Monica; Corona del Mar; Scripps Pier, La Jolla; and from Todos Santos Island, Baja California.

The recorded range of this species is from Vancouver Island to Turtle Bay, Baja California.

The specific name frenatus means bridled.

11.12.2.2. Micrometrus (Brachyistius) aletes sp. nov., Guadalupe Perch

Brachyistius frenatus Jordan and McGregor, 1899, p. 281; Osburn and Nichols, 1916, p. 168.

Body depth 2.41 (2.0–2.6) in standard length; dorsal contour of body slightly more curved than ventral; peduncular length 1.40 (1.3–1.5) in head; peduncle moderately deep, its least depth 2.14 (2.0–2.2) in head.

Head 3.02 (2.9–3.0) in standard length; maxillary quite small, reaching or extending slightly beyond a vertical from the anterior nostril, length 3.94 (3.8–4.1) in head; dorsal contour of head, to first dorsal spine, strongly sigmoid in the specimens examined; length of snout 3.44 (3.1–3.8) in head; eye rounded, its length 3.06 (2.8–3.2) in head; inter-orbital width 3.46 (3.2–3.6) in head.

Lateral line farthest from the dorsal contour of the body at its origin, generally nearest at posterior end of dorsal fin, depressed slightly at caudal peduncle.

Origin of dorsal fin opposite, slightly anterior to or behind, the origin of the pelvics; dorsal base 2.74 (2.6–2.8) in standard length; dorsal sheath 1.18 (1.1–1.2) in dorsal length; ventral origin of dorsal sheath under ultimate dorsal spine in all specimens examined; soft dorsal 1.85 (1.6–2.1) in dorsal length; longest dorsal spine 1.83 (1.6–1.9) in dorsal base, usually slightly higher than general contour of soft dorsal fin; seventh dorsal spine occasionally longest; last dorsal spine 1.05 (0.9–1.2) in first dorsal ray; longest dorsal ray 1.82 (1.6–2.0) in dorsal base; first ray simple, all other rays branched in adults. Origin of anal fin under second to fourth dorsal ray; anal base 1.51 (1.4–1.6) in dorsal base; longest anal spine 3.23 (2.4–4.6) in anal base; longest anal ray 1.78

(1.6–1.9) in anal base; the rays variable, in adult the pattern of one simple ray followed by three to five branched ones, which are in turn, usually succeeded by four simple rays, the remaining elements being branched, is the type generally found; however, in one adult the first eleven rays were simple and the remainder branched. Distance from upper end of pectoral base to first dorsal spine 1.27 (1.1–1.3) in dorsal base; pectoral fin moderately long, third or fourth ray longest, 1.22 (1.1–1.3) in head; base of fin 3.67 (3.1–3.9) in longest pectoral ray; first ray simple, remainder branched, except for ventral one to three. Origin of pelvic approximately opposite first dorsal spine; first, or occasionally third, ray longest; longest ray 1.58 (1.5–1.6) in head; pelvic spine 1.44 (1.3–1.5) in longest ray.

Measurements in per mille of standard length based on 11 specimens from 66.3 mm to 97.3 mm (average 82.4 mm) in standard length: length of head 332 (316–342); length of maxillary 84 (79–88); length of eye 109 (94–116); length of snout 97 (86–106); width of interorbital space 96 (91–103); distance from first dorsal to pelvic 417 (384–484); distance from first dorsal spine to first anal spine 448 (413–515); distance from first anal spine to last dorsal ray 369 (353–394); caudal depth 212 (197–224); least depth of caudal peduncle 155 (145–166); distance from tip of snout to first dorsal 443 (431–461); distance from first dorsal spine to hypural 629 (605–647); distance from last dorsal ray to hypural 280 (260–302); length of dorsal base 366 (349–380); length of dorsal sheath 308 (292–317); length of soft dorsal base 197 (172–210); longest dorsal spine 199 (180–218); longest dorsal ray 200 (184–216); length of ultimate dorsal spine 148 (118–173); length of first dorsal ray 154 (136–167); distance from tip of snout to anal 615 (581–652); distance from first anal spine to hypural 475 (435–500); distance from last anal ray to hypural 236 (217–253); length of anal base 242 (221–261); length of longest anal spine 77 (54–96); length of longest anal ray 135 (128–147); distance from tip of snout to upper end of pectoral base 346 (314–365); distance from first dorsal to upper end of pectoral base 288 (264–332); width of pectoral base 74 (66–79); length of longest pectoral ray 272 (244–290); distance from tip of snout to pelvic 457 (424–486); length of longest pelvic ray 210 (197–222); length of pelvic spine 145 (139–151).

Fin and scale formulae: D. IX (VIII–IX), 14 (13–14); A. III, 22 (21–23); P. 17 (17–18); Ll 41 (38–44) + 5 (4–6); scales from first dorsal spine to lateral line 5 (5–6).

Color in alcohol dark brown above lateral line, lighter tan on sides below lateral line. Head and mouth dark brown. Body without distinctive bars or stripes, except for a semicircle of pigmentation in axilla.

This species is known from Guadalupe Island, Baja California. The holotype (California Academy of Science Museum No. 2092) is a female specimen 97.3 mm in standard length from Guadalupe Island. The ten paratypes are Nos. 2088, 2089, 2090, 2091, 2093, 2094, 2095, 2096 in the same museum and No. 5913 in the Stanford Natural History Museum.

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FIGURE

wanderer, in allusion to its distribution far from the mainland.

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