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BULLETIN

OF

THE BINGHAM OCEANOGRAPHIC COLLECTION

VOL. II, ART. II.

Scientific Results of the Second Oceanographic Expedition of the "Pawnee" 1926.

NEMATOGNATHI, APODES, ISOSPONDYLI, SYNENTOGNATHI, AND THORACOSTRACI FROM PANAMA TO LOWER CALIFORNIA

WITH A GENERIC ANALYSIS OF THE EXOCŒTIDÆ

BY C. M. BREDER, JR.

New York Aquarium

Issued March, 1928.

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INTRODUCTION

The introduction given for the preceding number of this volume (Breder 1928) applies also to the present. The Chart of the cruise, Figure 1, is repeated here for convenience in reference. The truly deep water forms are not treated, being reserved for use in connection with other material.[1] The treatment is uniform with the other articles by the present author.

Mr. Wilfred Swancourt Bronson has again given noteworthy assistance in rendering the drawings. His series of colored plates, mostly in oil, is reserved for listing in the next article on fishes of the 1926 report, as most are in combination with various species of Acanthopteri, which that article is to cover.

In this paper there are described two new genera and two new species. They are as follows:

Hirundichthys
Prognichthys
Anchovia mundeoloides
Prognichthys tringa

[1] These fishes are not listed as were similar ones in Vol. I, No. 1, (Breder 1927), but will be catalogued and numbered as used in connection with other reports.

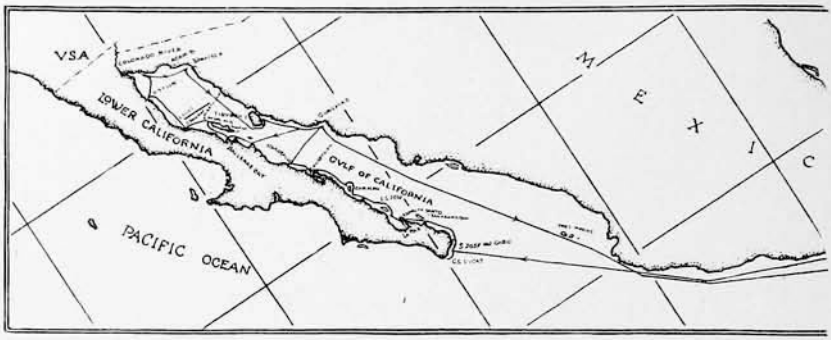

Fig. 1. Chart of the second oceanographic

ANNOTATED SYSTEMATIC LIST OF SPECIES.

Order NEMATOGNATHI.

Family **SILURIDÆ.**

1. **Felichthys pinnimaculatus** (Steindachner).

The critical characters of the two specimens at hand are as follows:

s.l. mm.	snout to dorsal	anal fin	spot on anal
370	3.5	28	present, small
209	3.4	21	present, large

The characters of the smaller example would make it *F. felis* (Linnæus), of the Atlantic, except for the large anal spot which surely does not outweigh the low anal count. Unless this form is much more variable than credited we suspect that we have here a misplaced Atlantic fish in the case of the smaller specimen. The larger, unquestionably of the Pacific, however, has a low anal count and the shortest dorsal to snout distance recorded. In this latter respect the smaller is intermediate but tends toward the Pacific species.

715 (2) ——.

2. **Galeichthys gilberti** Jordan & Williams.

703 (1) ——.

Order APODES.

Family **LEPTOCEPHALIDÆ.**

3. **Leptocephalus caudilimbatus** (Poey).

A single specimen of 480 mm. which cannot be differentiated from the Atlantic form on a basis of existing descriptions. Comparison with specimens may show these to be differentiable. Otherwise it stands as a new form from the Pacific.

cruise of the "Pawnee."

1149 (1) Conception Bay. May 2. At night. Hook on bottom.

Family **MYRIDÆ.**

4. **Myrophis vafer** Jordan & Gilbert.

1036 (4) Conception Bay. May 2. At night.
1039 (16) Santa Rosila. May 4. At night.
1045 (1) Hidden Harbor. April 29. Seine.
1046 (17) San Francisquito Bay. May 12.
729 (1) Angelus Bay. May 13. Otter Trawl, 13 to 23 faths.
952 (3) Carmen Island, Ballaenas Bay. April 30.

Family **OPHICHTHYIDÆ.**

5. **Myrichthys tigrinus** Girard.

1035 (6) Conception Bay. May 2. At night.
1037 (1) San Jose del Cabo. April 14. Surface at night.
1043 (1) Hidden Harbor. April 29. Seine.
716 (2) ——.

6. **Bascanichthys panamensis** Meek & Hildebrand.

Known previously only from the type locality, Chame Point, Panama.

1038 (2) Conception Bay. May 2. At night.
1042 (2) Off Rey Island, Bay of Panama. March 31. At night with light
1044 (1) Hidden Harbor. April 29. Seine.

Family **MURÆNIDÆ.**

7. **Muræna argus** (Steindachner).

717 (2) ——.

8. **Muræna lentiginosa** Jenyns.

753 (1) ——.

9. **Uropterygius necturus** (Jordan & Gilbert).

1148 (1) Espritu Santo Island. April 21. 6 faths.

LEPTOCEPHALI LARVÆ.

735 (1) Salina Bay, Carmen Island. April 29.
736 (30 approx.) Conception Bay. May 1. Seine.
737 (8) San Francisco Bay, Mexico. May 7. Surface.
738 (12 approx.) Lat. 12.48.30 N., Long. 92.51.30 W. June 2. 100 faths. At night. Trawl. Depth on Chart 2200.
739 (20 approx.) San Francisco Bay. May 7. Seined.
740 (50 approx.) Angeles Bay. May 12. Surface at night.
741 (1) Bahia Hunda, Panama. April 5. Taken at night. Surface.
742 (1) San Francisco Bay, Mexico. May 4. Surface at night.
758 (6) Off Cape Corrientis, Mexico. May 29. Trawl, at night. About 200 faths.
759 (50 approx.) West coast of Mexico. May 8. Trawl, 12 ft. dia. 286 faths. At night.
760 (2) Lat. 11.05 N. Long. 99.20.45 W. June 3. Chart depth 2000. Depth trawl 100. At night.
761 (8) ——.

Order ISOSPONDYLI.

Family **ALBULIDÆ.**

10. **Albula vulpes** (Linnæus).

One example (No. 721) is only 44 mm. s. l. but shows no larval characteristics.

1198 (1) Perlas Islands. April 2–3.
707 (1) ——.
721 (1) Georges Bay, Senora, Mexico. May 23. Seine.

Family **CLUPEIDÆ.**

11. **Clupanodon cæruleus** (Girard).

The examples of this species appear to be in two chief size groups, those that range between 62 and 100 mm. (1153 and 1078) and the rest which range between 25 and 42 mm., evidently of a recent spawning.

1078 (44) Ballenas Bay, Carmen Island. April 30.
1153 (32) Puerto Refugio. May 14. Dip net at night.
1157 (1) Between San Felipe and Shoal Point. May 20. Trawl 17 faths.
1158 (400) San Francisco Bay. May 7. Seine.

1159 (8) Cape San Lucas. April 15. At night with light.
1161 (10) Gonzago Bay. May 17. Seine.
1163 (13) Angelus Bay. May 12. Surface at night.

12. **Sardinella thrissina** (Jordan & Gilbert).

1029 (8) Esprito Santo. April 19. At night. Common.
1030 (8) Salina Bay, Carman Island. April 27.
1129 (1) Arroya de San Luis. April 18. Surface at night.
1154 (7) San Jose. April 24.

13. **Opisthonema libertate** (Günther).

Two size groups are represented, those averaging about 60 mm. (1103 and 1085) and the rest averaging about 130 mm.

724 (1) Rey Island, Perlas Islands. March 31. Seine.
1015 (1) Senora Mexico, off Georges Island. May 23. Sardina machete.
1016 (1) San Francisco Bay, Mexico. May 7.
1024 (8) Conception Bay. May 2. At night.
1085 (2) Bahia Hunda, Panama. April 6. Seine.
1103 (3) Perlas Islands, Panama. March 30. Surface at night.
1179 (7) St. Elmo Bay, Perlas Islands. April 1. Shore Call.
936 (5) Perlas Islands. March 31. Lat. 8.29.40 N. Long. 78.52.30 W. 19 to 24 faths.

14. **Perkinsia othonops** R. S. Eigenmann.

Thirteen specimens (1145) of this little known form of a small size, range from 47 to 63 mm. in s. l. The only differences the present series show are those to be expected with age. They are compared with the type in Table 1 and also with the measurements of *Jenkinsia acuminata* (Gilbert). The latter comparison

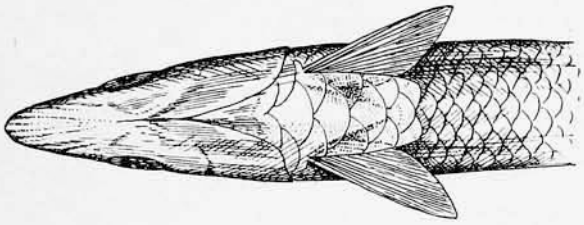

Fig. 2. Ventral view of *Perkinsia othonops* showing formation of the pectoral sheath.

is made for it is suspected that the two are identical. Specifically the differences are slight and at this size the important generic character, the presence of an adherent ventral corselet under which the pectorals fold is not reliable. That is, only two of the present series (1145) show it. At this size it evidently most often falls off with the exceedingly deciduous scales. Without these two examples showing this curious character, the writer, on the basis of the liter-

ature, would have doubtless confounded these fishes with *J. acuminata*. The measurements of the latter and the type of *P. othonops* are taken from Jordan & Evermann 1896.

TABLE 1. PROPORTIONS OF *Perkinsia othonops*

	TYPE	(1150)	(1145)	(1145)	(1152)	*J. acuminata*	Smallest (1152)
mm. s. l.	305	100	63	47	38	38	32.5
Head	4	3.8	3.6	3.5	3.4	3.5	3.3
Depth	5	5.1	5	5.2	5.9	6	6.5
Eye	3	3.5	3.5	4.1	4.1	4.5	4.0
Interorbital	4.5	4.1	4.1	5.3	5.0	3	7.0
Maxillary	3	2.8	2.7	2.8	2.6	3	2.9
Ventrals	3.5	3.3	3	3	3	——	2.9
Pectorals	1.6	1.6	1.7	2	2.1	——	1.9
Dorsal	17	17	17	18	17	16–17	17
Anal	10	10	10	11	10	10–11	10
Scales	50	55	56	57	58	60	undeveloped

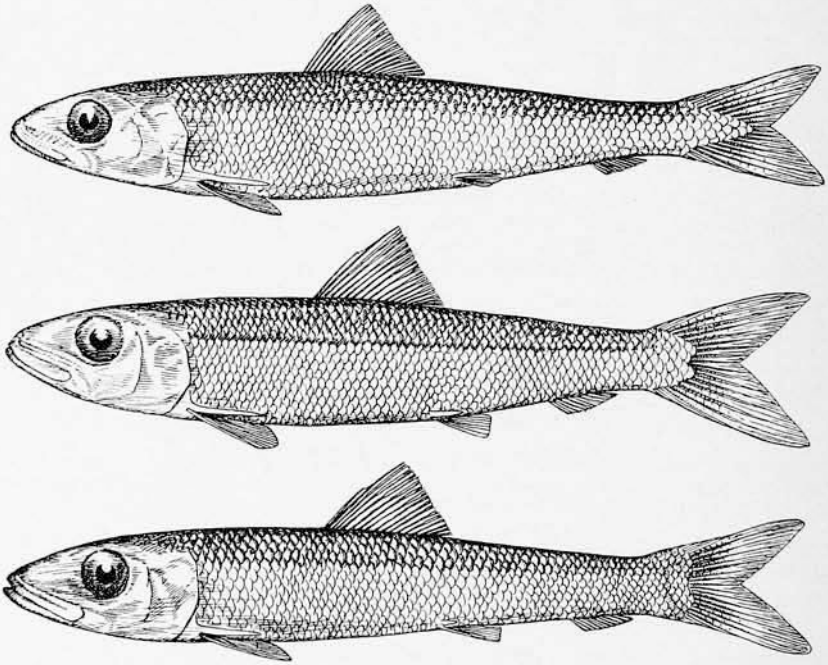

Fig. 3. *Perkinsia othonops*. Three sizes. From bottom up; 37, 56, 97 mm. s.l.

Another series (1150) ranges from 71 to 100 mm. in s. l. Of these 19 specimens 6 retain at least parts of either or both the pectoral and pelvic shields. It is noteworthy that the largest although almost completely denuded of scales retains both in perfect condition.

The structure of this pectoral sheath is peculiar and it could be easily withdrawn and leave the appearance of having been simply scaled in that region as described for *Jenkinsia acuminata*. Figure 2 gives a ventral view of this structure. The scales are absolutely transparent and glass-like as shown. The backwardly converging ridges shown in the figure include the area from which the scales spring and it is against these that the pectorals fold when slipped under the sheath. It would seem that the existence of individuals normally scaled where the pectoral and ventral corselets are to be found is necessary to reëstablish the validity of *J. acuminata*.

A third series (1152) of small examples ranges from 30 to 49 mm. in s. l. Below a length of 35 mm. they have a distinctly larval appearance with the scales as yet undeveloped. Figure 3 shows a series of different sized specimens for comparison. Adult pigmentation starts as a dark line separating the tan upper parts from the lighter lower. Then, as development proceeds, a dark dorsal

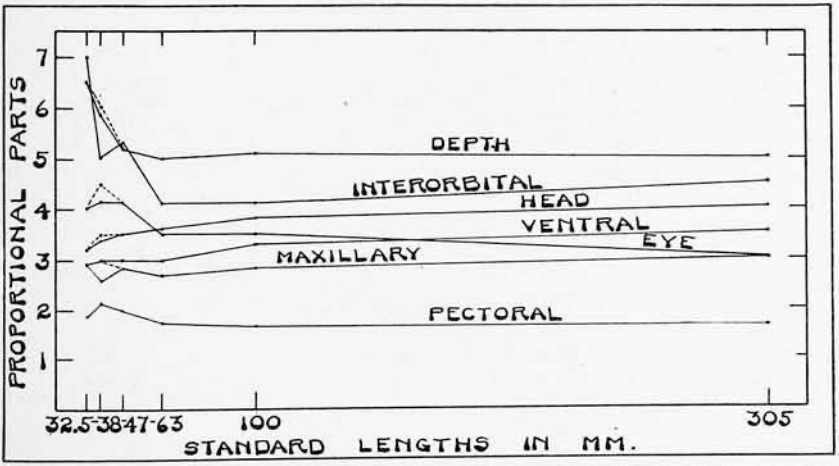

Fig. 4. Diagram showing changes in proportional parts of *Perkinsia othonops* with size. The dotted lines refer to the measurements given for "*Jenkinsia acuminata*."

median line widens, ultimately meeting the more lateral and earlier ones and giving the large fish a very dark back. The scales at the base of the tail encroach progressively on the rays with age. This is also indicated in Figure 3. A graphical comparison of the data given in Table 1 is shown in figure 4.

All of the material was measured except 1152, of which an unselected sample

of 127 examples was used, and 1162 of which a similar sample of 98 was used. The data obtained follows:

	Max.	Min.	Mode
(1145) May 17, Gonzago Bay	63	47	54
(1151) May 14, Puerto Refugio	97	85	96
(1150) April 30, Carmen Island	101	74	78 and 88
(1152, 747, 745, 744) May 7, San Francisco Bay	49	30	34
(1156) May 20, San Felipe	54	42	48
(1160) May 17, Gonzago Bay	73	35	38 and 64
(1162) May 12, Angelus Bay	49	29	38

There is not sufficient data here to attempt the construction of a growth curve but it is evident that there is a spawning in the early part of the year, probably in February or March, and evidently our other specimens are of a year earlier. Examination of the organs of an 89 mm. example from 1150 showed it to be male with the gonads just developing, suggesting maturity being reached in two years.

747 (4) San Francisco Bay, Mexico. May 7. Seine.
745 (3) San Francisco Bay, Mexico. May 7. Surface at night.
744 (1) San Francisco Bay, Mexico. May 7. Surface.
1151 (4) Puerto Refugio. May 14. Dip net at night.
1152 (500) San Francisco Bay, Mexico. May 7. Seined.
1145 (13) Gonzago Bay. May 17. Surface at night.
1150 (19) Ballenas Bay, Carmen Island. April 30.
1156 (5) Between San Felipe and Shoal Point. May 20. Trawl 17 faths.
1160 (36) Gonzago Bay. May 17. Seine.
1162 (200) Angelus Bay. May 12. Surface at night.

There is also the following small material:

1172 (16) Bahia Hunda, Panama. April 5. Surface, taken at night.

Family **ENGRAULIDÆ.**

15. **Anchovia exigua** (Jordan & Gilbert).

1166 (1) Perlas Islands, N. E. of Rey Island. Lat. 8.29.40 N. Long. 78.52.30 W. March 30–31.

16. **Anchovia arenicola** Meek & Hildebrand.

1086 (3) Bahia Hunda, Panama. April 6. Seine.
1167 (26) Perlas Islands. N. E. of Rey Island. Lat. 8.29.40 N. Long. 78.52.30 W. Mar. 30–31.

17. **Anchovia ishana** (Jordan & Gilbert).

We note that Meek & Hildebrand 1923 state "pectorals scarcely reaching base of ventrals 1.6 to 1.8 in head," and according to their key this species falls

under "ee . . . pectoral fins longer, reaching nearly or quite to base of ventrals." Our material has pectorals 1.6 to 1.8 in head but reaching only about two-thirds of the distance to ventrals, which, according to the key "e pectoral fins short, not nearly reaching base of ventrals" should run them to another group, i.e. *exigua, arenicola* etc. Actually in our specimens of *arenicola* and *exigua* the pectorals barely reach one-half of the distance. However our material agrees with Meek & Hildebrand's figure (Plate XIII, fig. 2) in this respect and not with their key and description. Except for the above which is probably typographical, as the figure bears out, our material agrees with the Meek & Hildebrand 1923 description and not with the Jordan & Evermann 1896 description.

1163 (26) San Felipe Bay. May 19. Seine.
1164 (1) San Jose Island. April 24.
1165 (6) Between San Felipe and Shoal Point. May 20. Trawl. 17 faths.
728 (3) Between San Felipe and Shoal Point. May 19. Trawl. 10–14 faths.

18. **Anchovia curta** (Jordan & Gilbert).

726 (3) Rey Island, Perlas Islands. March 31. Seine.

19. **Anchovia mundeoloides** new species.

Type No. 1168 Bingham Oceanographic Collection. Standard length 129 mm., total length 154 mm.

Head 4.1; depth 4.0; dorsal 12½; anal 32½; scales about 38.

Body compressed, deep; the ventral outline more rounded than the dorsal; head rather long; snout shorter than eye, its length 5.3 in head; eye 3.7; tip of mandible half a pupil in advance of eye; maxillary half a pupil short of gill

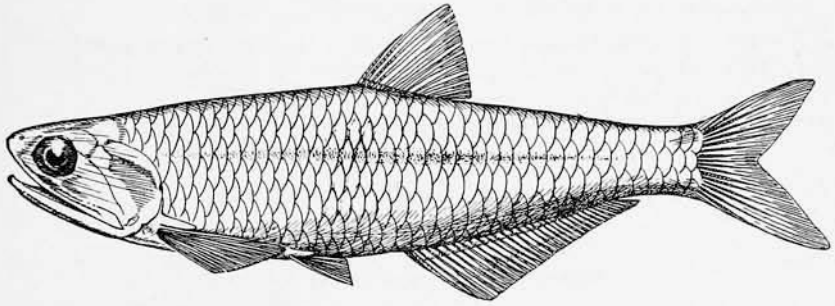

Fig. 5. *Anchovia mundeoloides* new species. Type.

opening; teeth in jaws small persistent; gill-rakers ⅔ eye, about 20 on lower limb of first arch; dorsal and anal with low scaly sheath; origin of dorsal midway between front of eye and base of caudal, origin of anal under middle of dorsal;

base of anal rather short, 3.2 in length of body; pectorals scarcely reaching base of ventrals, 1.3 in head; ventrals 2.4 in head, lower caudal lobe the longer, scales very deciduous (all gone).

Coloration—Pale silvery with a dark lengthwise band, not as wide as pupil and most distinct under dorsal, rapidly becoming obsolete anterior to it. Back with a dusky line its entire length about as wide as lateral one. This line appears to be made up of about six closely placed rows of dots. Base of caudal suffused with an orange spot. See Figure 5.

This species resembles *A. panamensis* (Steindachner), *A. mundeola* (Gilbert & Pierson), *A. spinifera* (Cuvier & Valenciennes) and *A. lucida* (Jordan & Gilbert). It differs from *mundeola* to which it appears to be closest in the more posterior insertion of the anal, the slightly greater length of the latter, the greater body depth and the more anterior insertion of the dorsal (midway between caudal and front of eye instead of middle of eye), the length of the lower jaw, the length of the maxillary and in coloration.

It differs from *panamensis* in the deeper body, the longer anal base, the insertion of the dorsal and other differences in which *panamensis* resembles *mundeola* as mentioned under that head.

It differs from *spinifera* in the shorter and more numerous gill-rakers.

It differs from *lucida* in the more numerous anal rays, in the smaller head, the smaller eye and the shorter maxillary.

There are eighteen paratypes of from 111 to 128 mm. in standard length which show very little variation from the type.

Named in reference to its similarity to *mundeola*.

1168 (1) TYPE—San Filipe Bay. May 19. Seine.
1169 (18) Paratypes do.

There is also the following very small material:

1171 (4) Bahia Hunda, Panama. April 5. Surface. Taken at night.
1173 (30 approx.) San Felipe Bay. May 19. Boat trawl. 3 faths.
1174 (1) San Francisco Bay. May 7. Seined.
748 (30 approx.) San Francisco Bay. May 7. Surface at night.

Order INIOMI.

Family **SYNODONTIDÆ.**

20. **Synodus scituliceps** Jordan & Gilbert.

One example, by far the smallest, of 32.5 mm. s. l. (No. 1183) shows the subdermal ventral spots which agree in number with the lateral bars of those of a somewhat larger size as in the case of *S. fœtens* (Linnæus). See Breder 1927. As this specimen was taken at the surface it suggests the possibility of these larval markings being associated with a juvenile life.

The mounted specimen (1189) is colored olive-green above and silvery below.

722 (3) Hidden Harbor. April 27. Seine and dynamite. Near Donzante Island.
705 (4) ——.
1009 (2) Lat. 30.28 H., Long. 114.34 W. May 18. Trawl.
1175 (4) St. Elmo Bay, Perlas Islands. April 1. Shore Call.
1176 (6) Conception Bay. May 3.
1177 (1) San Jose Island. April 24.
1178 (9) April 9. Trawl. 10 faths.
1183 (1) Bahia Hunda, Panama. April 5. Taken at night. Surface.
1189 (1) Carmen Island. (Mounted.)
1195 (1) San Francisquito Bay. May 7. No. 7.
1199 (4) Bahia Hunda, Panama. April 5–6.

Order SYNENTOGNATHI.

Family **BELONIDÆ.**

21. **Strongylura fodiator** (Jordan & Gilbert).

702 (1) Bahia Hunda, Panama. April 5–6.

22. **Strongylura pacificus** (Steindachner).

1182 (2) St. Elmo Bay, Perlas Islands. April 1. Shore Call.

23. **Strongylura exilis** (Girard).

One of these has the tips of the pectorals dusted with dusky suggestive of *S. stolzmanni* (Steindachner).

719 (4) ——.

24. **Strongylura stolzmanni** (Steindachner).

None of these specimens show the abruptly black pectoral tips and we suspect the character to be worthless. It is questioned whether this form is really distinct from *exilis*. A further study should be made. Possibly a Gulf race is represented here.

754 (6) ——.
853 (3) Arroya de San Luis. April 18.
755 (1) Conception Bay. May 3.
756 (2) Between Shoal Point and San Filepe. May 20. Trawl 17 faths.
757 (2) Tiburon Island. May 25. Surface at night.

Family **HEMIRHAMPHIDÆ.**

25. **Hyporhamphus unifasciatus** (Ranzani).

743 (1) 247.
733 (1) Bahia Hunda, Panama. April 6. Seine.
1041 (6) San Jose del Cabo. April 14. Surface at night.

1084 (3) Bahia Hunda, Panama. April 6. Seine.
1191 (3) Rey Island, Perlas Islands. March 31. Seine.
1192 (4) Georges Bay, Senora, Mexico. May 23. Seine.
767 (3) Bahia Hunda, Panama. April 5. Taken at night. Surface.
1196 (6) San Francisquito Bay. May 7. No. 7.
700 (1) Bahia Hunda, Panama. April 5–6.
718 (9) ——

26. **Hyporhamphus gilli** Meek & Hildebrand.

The following color notes are added to the description of *gilli* as compared with *unifasciatus*. The caudal of the former is margined with a dusky band nearly equal to the diameter of pupil whereas in *unifasciatus* the dark edging is not one half pupil. This is paralleled proximally by a hyline band about equal to pupil. The dorsal and anal tips are sharply marked with black in *gilli* whereas in the present large series of unifasciatus they are either plain or faintly dusky.

1102 (1) Perlas Islands, Panama. March 30. Surface at night.

27. **Hemirhamphus brasiliensis** (Linnæus).

This single specimen is referred to *brasiliensis* on the strength of Nichols & Breder MS.

708 (1) ——.

Family **EXOCŒTIDÆ.**

The examination of the "Arcturus" flying fishes with J. T. Nichols (Nichols & Breder MS.) together with the subsequent examination of those from the "Pawnee" 1926 collection and the present material, led to the following attempt to analyze the relationships of the genera a little more clearly than has been done in the past. This analysis is in complete agreement with the phylogenetic tree of Nichols & Breder MS. but carries the analysis of those forms with large posterior ventrals a step further in detail. For purposes of this analysis it has seemed best to describe two groups as full genera (*Hirundichthys* and *Prognichthys*). They are natural and necessary divisions representing steps in the differentiation of these fishes.[2] The analytic key is self explanatory. For details see under the various generic heads. These data with the papers referred to above are considered as preliminary material for the basis of a monographic revision of the group.

The cross section of the body usually figuring in keys of this family although of significance, is not considered as parallel to the other characters and it is felt that it would be more confusing than otherwise in the key proper because of its comparative nature. *Fodiator* and *Parexocœtus* are fairly elliptical in cross

[2] For purposes of taxonomy they may later be recognized as subgenera dependent on how comprehensive one thinks it desirable to make the genus.

section as compared with the relatively quadrate sections of most species of *Cypselurus*, *Prognichthys*, *Exonautes* and *Hirundichthys*. *Halocypselus* although falling within the two-winged group has a fairly elliptical section, as has *Evolantia*. Those forms usually referred to as being quadrate in section, that is, the forms with large posteriorly placed ventrals, vary greatly in this respect from species to species and show much individual variation, a part at least of which is due to crowding and other effects incidental to preservation. On compression the scales bend most readily along the low-running lateral line which with the group character of a broad flat back greatly increases the suggestion of a quadrate form. At best this character, although recognized, is difficult of accurate definition and is easily affected by the exigencies of preservation.

Mandibular barbels are omitted entirely from the discussion for, as Nichols & Breder MS. and others have amply shown, they are for most part a juvenile character, being present or absent in closely related members of the same genus, e. g. *Halocypselus evolans* and *obtusirostris* and then appearing "sporadically" in other genera, e. g. *Cypselurus*. "Sporadically" is placed in quotes advisedly for it is clearly a lack of knowledge of the significance of these structures that makes it impossible at the present time for us to analyze them intelligently. However, we do know enough about them to feel sure that they cannot be *ipso facto* of anything like generic significance. The tendency to develop barbels, especially in the young, seems to carry through the whole family and may or may not find expression, depending on factors that we do not understand at present.

The wing patterns also have been omitted from the generic discussion because of the pronounced differences of those of closely related forms and the similarities of obviously remotely related species. Although we have some knowledge of the extensive changes in the wing patterns of certain forms with age (Nichols & Breder MS.) it is still so scant as to be more confusing than otherwise, for generic considerations at least.

ANALYSIS OF THE GENERA OF EXOCŒTIDÆ.

A. Vomer, palatines, pterygoids and tongue with teeth; pectoral fins moderate or short, not reaching beyond middle of dorsal fin.

B. Dorsal fin elevated, its height equal to or exceeding base; ventrals long, reaching to or beyond origin of anal; pectorals moderate, reaching well beyond ventral insertion, to nearly middle of dorsal.

C. Snout pointed, much longer than eye, lower jaw acute; ventrals just reaching anal origin; dorsal base about equal to dorsal height. *Fodiator*

CC. Snout not especially pointed, shorter than eye; ventrals reaching beyond anal origin, dorsal base less than dorsal height. *Parexocœtus*

BB. Dorsal fin not elevated, its height about ⅔ its base; ventrals short, not nearly reaching anal; pectorals short, scarcely reaching ventral insertion..... *Evolantia*

AA. Vomer, palatines, pterygoids and tongue usually toothless (sometimes a few on vomer or palatines); pectoral fins long, always reaching beyond middle of dorsal, usually to base of caudal.

D. Ventral fins inserted before middle of body, much nearer tip of snout than base of caudal, small, not nearly reaching front of anal..... *Halocypselus*

DD. Ventral fins inserted after middle of body, nearer base of caudal than tip of snout, large, reaching at least to middle of anal and usually to at least its end.

E. Anal fin long, its base a little less than that of dorsal, its first ray nearly opposite first ray of dorsal; anal rays 11 or 12.

F. Second pectoral ray simple; third divided; fourth and fifth longest..... *Exonautes*

FF. Second pectoral ray divided; third and fourth longest..... *Hirundichthys*

EE. Anal fin short, its base ½ to ⅔ length of base of dorsal, its insertion behind first ray of dorsal, anal rays 9 or 10.

G. Second pectoral ray simple; third divided; fourth and fifth longest, muzzle broad and short..... *Prognichthys*

GG. Second pectoral ray divided; third and fourth longest; muzzle not especially broad and short..... *Cypselurus*

The Exocœtidæ although cosmopolitan in warm seas would seem to have had their most recent center of distribution in the eastern Pacific for there the most primative genera, *Fodiator* and *Evolantia*, are to be found, and also the Pacific shows a much greater variety of living forms. All species known from the Atlantic have close relatives in the Pacific and it is not unlikely that they were derived severally from them before the closure of the isthmus, although, of course, at least some may have come into the West Indian fauna over the high seas from the East Indies around the southern tip of Africa.

Genus **Fodiator** Jordan & Meek.

Type—*Exocœtus acutus* Cuvier and Valenciennes.

Exocœtus acutus Cuvier & Valenciennes. Hist. Nat. Poiss, XIX, 125, 1846.

Fodiator acutus Jordan & Meek, Proc. U. S. Nat. Mus. 1885, 45.

28. **Fodiator acutus** (Cuvier & Valenciennes).

The present large series of both adults and juveniles allows of an examination of the reduction of the "half-beak" condition of the young with age. The data is given in Table 2 and graphically shown in Figure 6. The measurement of

TABLE 2. BEAK LENGTHS OF *Fodiator acutus*

No.	s. l. mm.	Beak mm.	%
1066	62	14	21 −
	57	12.5	22 −
	51	12	23 +
	53.5	12	22 +
	44	13	29 +
	44	11	25.0
	42	13	30 +
1082	115	3	03 −
	114	3	03 −
	113	2.5	02 +
	107	3	03 −
	110	3	03 −
	97	3.5	04 −
	115	3	03 −
	96	3	03 +
1101	142	3.5	02 +
	114	3	03 −
	72	9	12 +
1193	65	7.5	11 +
704	145	4	03 −
	160	4	02 +
	69	9	13 +
	147	4	03 −
	147	4	03 −
	135	3.5	03 +
	142	3.5	03 −
	148	3	02 +
	136	3.75	03 +
	144	3.5	02 +
	160	4	02.5
	147	4	03 −
1011	153	3	02 −
	138	3.5	03 −
	150	3	02.0
	143	4	03 −
1005	162	3.5	02 +
	160	3.5	02 +
	37	8.5	20 +
	42	9	21 +
	37	8	21 −
1012	50	11	22.0
	42	9	21 +
	47	11	23 +
	48	11	23 −
	50	11	22.0

the beak is made from the tip of the snout to the end of the mandible. The apparent discrepancy between the number measured and the number of fish in the collection is due to the omission of those with broken beaks.

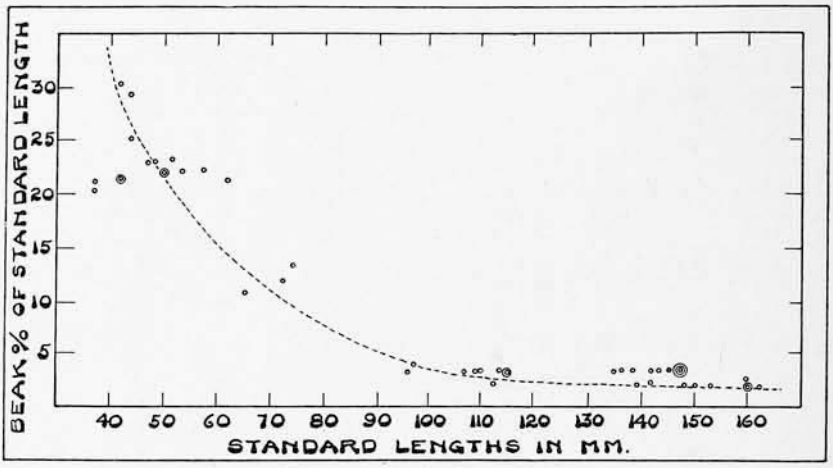

Fig. 6. Diagram of beak changes in *Fodiator*.

The approximate trend of development is indicated by the dotted line in Figure 6. It is noted that the individual variation is much greater in the young fish with their long beaks than in the adults.

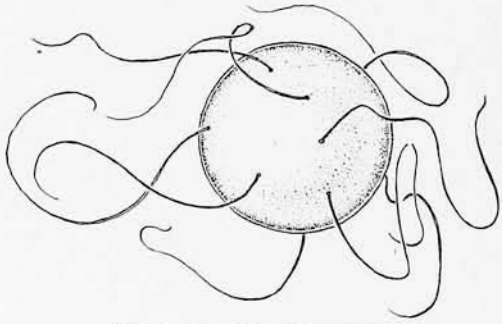

Fig. 7. Egg of *Fodiator acutus*.

The eggs of a gravid female were found to range from 1.40 mm. to 1.70 mm. and average 1.53 mm. Figure 7 represents a typical one. The fish measured 153 mm. s. l. (No. 1011).

1004 (9) Conception Bay. May 1. At night.
1005 (5) Gonzago Bay. May 17. At night, surface.

1011 (5) Conception Bay. May 2. (One female with eggs.)
1012 (5) Conception Bay. May 3.
1040 (2) San Jose del Cabo. April 14. Surface at night.
1066 (7) Cape San Lucas. April 15. At night with light.
1082 (8) Bahia Hunda, Panama. April 6. Seine.
1101 (3) Perlas Islands, Panama. March 30. Surface at night.
1193 (1) San Francisquito, Gonzago Bay, San Filepe.
704 (3) ——.

Genus **Parexocœtus** Bleeker.

Type—*Parexocœtus mento* Bleeker.
Parexocœtus mento, Bleeker, Nederl, Tydsch, Dierk III, 1865, 126.

Genus **Evolantia** Snodgrass & Heller.

Type—*Evolantia microptera* Snodgrass & Heller.
Evolantia microptera Snodgrass & Heller, Proc. Wash. Ac. Sci. V. 1903 (Sept. 12), 189.

Genus **Halocypselus** Weinland.

Type—*Exocœtus evolans* Linnæus (?).
Exocœtus evolans Linnæus, Systema Naturæ, Ed. XII, 521, 1766. (?).
Halocypselus mesogaster Weinland, Proc. Bost. Soc. Nat. Hist., VI, 1869, 385. Synonym of *evolans*. (?).

The reasons for retaining this name and not following Jordan 1924, is fully set forth by Nichols & Breder MS. It may be added however that we consider the genus *Exocœtus* (Artedi) Linnæus unavailable and impossible of certain definition. Jordan himself in attempting to clarify the conditions and properly establish *Exocœtus* admits that "At best the case is uncertain. ." He also states the following: "In case, however, the name *Exocœtus volitans* is to be used for a species with long ventrals, it is a question as to whether it refers to the common form called *Exocœtus heterurus* by Rafinesque (the name revived by Jordan & Meek) or with the less abundant form, called *Exocœtus volitans* by Lütken, and by Jordan and Meek. If it is referable to *Exocœtus heterus* it would become *Cypselurus* as here understood. If, on the other hand, it is referable to *Exocœtus volitans*, it could form the type of the genus here called *Prognichthys*, but as the case is clearly impossible of accurate definition the name *Exocœtus* is considered unavailable for any form.

29. **Halocypselus obtusirostris** (Gunther).

Three specimens of a good size compared with two *H. evolans* from the Atlantic collection of this year show them to be readily separable on the basis of significant characters given in the following tabulation.

No.	s. l.	Anal origin referred to dorsal	Snout to ventral referred to ventrals to last dorsal ray	Scales, dorsal to lateral line
			H. obtusirostris	
762	137	Anterior to	Less (3)	7
1055	52	Anterior to	Less (5)	7
	159	Anterior to	Less (6)	7
			H. evolans	
611	82	Posterior to	Equal to (0)	6
613	155	Posterior to	Greater (1)	6

The numbers in parenthesis under *obtusirostris* indicate the greatest number of the dorsal rays, counting from the last, that the distance from the snout to ventrals reach. Those under *evolans* indicate the distance past the base of the last dorsal ray as measured by the unit distance between the last and next to last dorsal ray. See figure 8. It is apparent that the two species diverge in

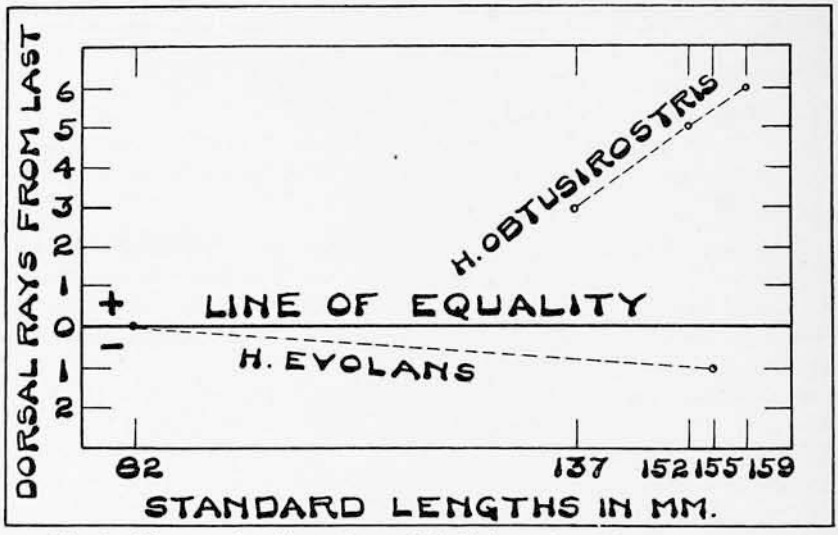

Fig. 8. Diagram of positions of ventrals in *Halocypselus* with reference to size.

this respect with growth. In other words, the smaller the fish the less reliable this character becomes. However, with this goes an increasing divergence in other characters as shown by Nichols & Breder, MS.

The wing pattern in all the present *obtusirostris* is dark with a light posterior margin and a light median portion. The dark parts are somewhat darker than in the *evolans* wing. In the material Nichols and Breder worked on this edging was reversed but their largest *obtusirostris* was only 57 mm. That is,

young *evolans* has a pale margin while *obtusirostris* has a dark one. Thus, in *evolans*, we have a retention of the post-larval wing pattern throughout life and a reversal of it in *obtusirostris*. As they start with complementary wing patterns it places another character among those which these fish approximate with age. Figure 9 shows the pattern of our largest *obtusirostris* which suggests a pattern disrupted by growth, the dark band probably originally edging the fin in youth.

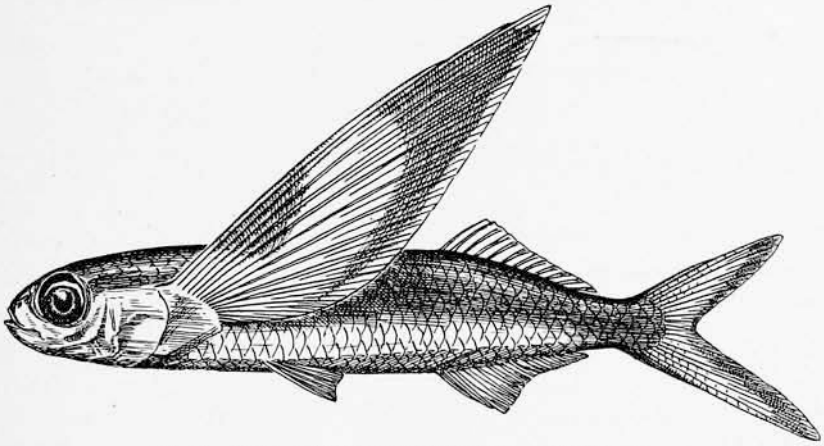

Fig. 9. Adult *Halocypselus obtusirostris*. 159 mm. s.l.

With these large *obtusirostris* at hand we may construct an analysis of the two forms with reference to age as given in Table 3.

TABLE 3.

	H. evolans	*H. obtusirostris*
Anal origin	Behind dorsal	Before dorsal
Position of ventrals	Move backward with age (relatively)	Move forward with age (relatively)
Scales dorsal to lateral line	6 to 7	7 to 8
Pectoral pattern	Dark with pale margin and no light central area throughout life	Pale with dark margin in young changing to a light margin and a light center separated by a dark band with age.
Mandibular barbel	None at any size	Young with barbel

If we can consider the barbel as a primitive character, which it may be, (Nichols & Breder MS.) and *obtusirostris* as the more primitive of the two having a quite different larval wing pattern, then *evolans* with its constant wing pattern

and lack of barbel would represent a dropping out of the more primitive larval stage. There is, however, nothing to definitely prove that evolution did not move in the exact opposite direction and the barbeled larvæ of Exocœtidæ generally may represent a specialized larval condition beneficial in the general conditions they live under.

762 (1) ——.

1055 (2) 100 miles off the coast of Nicaragua. Lat. 11.05 H., Long. 89.20.45 W., June 4. Flew aboard.

Genus **Exonautes** Jordan & Evermann.

Type—*Exocœtus exiliens* P. L. S. Mueller, Noremberg Ed. Linnæus Syst. Nat. 209. 1776.

Exonautes exiliens Jordan & Evermann, Rept. U. S. Fish Comm. XXI, 1895 (1896) 322.

Genus **Hirundichthys** new genus.

Type—*Exocœtus rubescens* Rafinesque.

Exocœtus rubescens Rafinisque, Amer. Monthly Mag. 1818, 205.

Synonym of *Exocœtus volitans* Jordan & Meek, Proc. U. S. Nat. Mus. 1885, 57.

This genus[3] differs from *Exonautes* Jordan & Evermann, in which it has been included, by the possession of a split second pectoral ray and in having the third and fourth pectoral rays the longest instead of the fourth and fifth. It is related to *Exonautes* in manner parallel to that in which *Cypselurus* is related to *Prognichthys*. That is to say, *Exonautes* and *Prognichthys* may be considered as retaining throughout life certain characters which are juvenile in *Hirundichthys* and *Cypselurus* respectively.

Hirundichthys (*Hirundo*—a genus of swallows; *ichthys*—fish).

Genus **Prognichthys** new genus.

Type—*Exocœtus gibbifrons* Cuvier & Valenciennes.

Exocœtus gibbifrons Cuvier & Valenciennes, Hist. Nat. Poiss., XIX, 118, 1846.

This genus differs from *Cypselurus* Swainson[4] in which it has been included

[3] By some, both this and *Prognichthys* will be considered as properly subgenera. However, with the present diversity of opinions concerning generic criteria it was thought best to consider them both genera and leave their ultimate disposition to further consideration. See also footnote 2, page 12.

[4] Swainson (Class'n Fishes, etc., II, 296, 1839) originally used *Cypselurus* for those flying fishes possessing mandibular barbels but as the original species to which he applied it (*E. nuttalli* Le Sueur, Journ. Ac. Nat. Sci. Phila. 1821, 10, pl. IV, fig. 1) had a short anal (*E. furcatus* Mitchill, Trans. Lit. and Phil. Soc. N. Y., 1, 1815, 149) Jordan & Evermann (Bull. U. S. Nat. Muse. 1896, 730) showing that the mandibular barbles were not of generic rank, used it as a subgenus for those forms with short anals. See also Jordan, 1924.

by the possession of a second simple pectoral ray at all ages, by having the fourth and fifth pectoral rays longest, and by a broader and more obtuse muzzle. It is here used to include two species, *gibbifrons* from the Atlantic and *tringa* from the Pacific. It is probably cosmopolitan in warm seas although rare as compared with *Cypselurus* to which it is evidently closely related. For a discussion of its relationships see under the description of *Prognichthys tringa*.

Prognichthys (*Progne*—a genus of swallows, the martins; *ichthys*—fish).

30. **Prognichthys tringa** new species.

Type No. 763, Bingham Oceanographic Collection. Standard length 163 mm., total length 205 mm.

Head 3.9; depth 5.1, dorsal 11½, anal 8½, lateral line 39. Head broad and flat above, interorbital 3.1, little greater than eye; body robust, little compressed, only slightly quadrate; snout descending rather rapidly 3.8, muzzle blunt; eye large, 3.3; maxillary 4.4. Pectoral fins reaching a little beyond base of last dorsal ray but not to produced tips, their length 1.5. First pectoral ray simple, its length two in length of fin; second ray also simple, its length 1.5 in

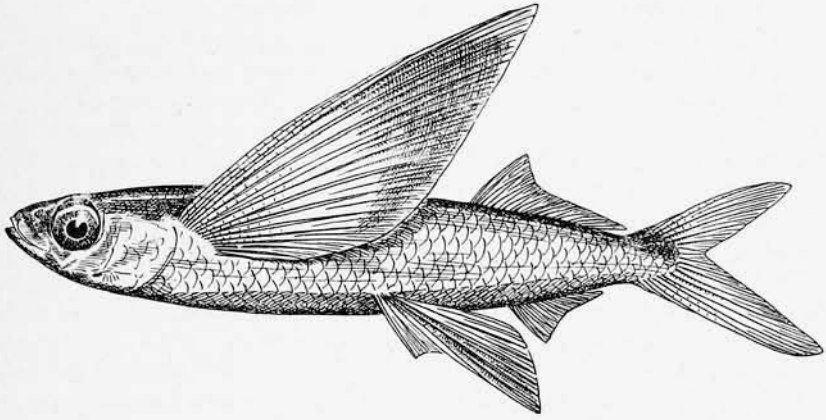

Fig. 10. *Prognichthys tringa* new species. Type.

length of fin, about ¼ longer than first; third ray divided; fourth longest. Origin of ventrals midway between posterior margin of pupil and caudal base; length of ventrals 3.2, their tips reaching base of last anal ray. Origin of dorsal well in advance of anal; base of latter 1.7 in dorsal; longest dorsal ray second, equal to postorbital part of head, 2.3 in head, ultimate dorsal ray elevated, equal to diameter of eye; lower caudal lobe equal to ventrals, 0.8 in head; least depth of peduncle about equal to eye, 3.4 in head; 19 scales in lateral line before ventrals; 26 scales before dorsal; 7½ scales between lateral line and dorsal.

Coloration—Slaty above, lighter rather abruptly below the median line, on evident markings or streaks; pectorals pale dusky on the distal half, edged with a very narrow light border, the tip of the fin light and the proximal half light; ventrals pale except for the two middle rays which are dusky. This gives the appearance of a median dark streak when the fin is folded. Caudal dusky, dorsal and anal light and plain. See Figure 10.

Known from the type specimen only.

This species is clearly close to the little known *P. gibbifrons* (Cuvier & Valenciennes) of the Atlantic. It differs from the latter in the larger head, 3.9 instead of 4.6, greater depth 5.1 instead of 6.0, narrower and flatter interorbital scarcely wider than eye instead of ½ wider, longer and less obtuse snout, 3.8 instead of 4, smaller eye, 3.3 instead of 3, longer first pectoral ray 2 in fin instead of 2.5, more anterior insertion of ventrals, midway between posterior margin of pupil and last caudal vertebræ instead of posterior margin of eye, smaller ventrals, 3.2 instead of 2.9, less scales in lateral line before ventrals, 19 instead of 25 and less predorsal scales 26 instead of 30. The coloration differs in that there is no suggestion of lengthwise streaks above, the pectorals are not uniformly colored, having a light tip and a light area on the inner rays.

For the purposes of key construction the following may suffice:

A. Head 4.6; interorbital ½ wider than eye, slightly concave; first pectoral ray 2.5 in fin; preventral scales in lateral line 25; predorsal scales 30, pectoral uniform dusky, body streaked above with brown spots on each scale row. *gibbifrons*

AA. Head 3.9; interorbital little wider than eye, flattish; first pectoral ray 2.0 in fin; preventral scales in lateral line 19; predorsal scales 26; pectoral not uniform dusky, with a prominent light tip and a light area on inner rays; body not streaked, uniform slaty above..... *tringa*

The relationship with *Cypeselurus* is suggested by the fact that the young of the latter genus appear to have simple second pectoral rays and do have an exceedingly simous aspect. On examination with a lense the second ray of young *Cypselurus*, however, shows the rudimentary split except in the very smallest sizes. At such sizes, 15 mm. and less, the other pectoral rays are only a little earlier in splitting, often all of the pectoral rays remaining simple to nearly that size. Thus as the fish develops this ray becomes more and more divaricated along with the development of the snout. In other words the genus *Prognichthys* retains in the adult form certain characters that mark the young of *Cypselurus*. We thus take it that *Prognichthys* represents a fixed larval condition of *Cypselurus*, similar to the broader concept generally applied in reference to the relationships of the *Hemirhamphidæ* and *Belonidæ* in the same order.

Tringa—a genus of Sandpipers with a not dissimilar wing shape.

763 (1) Type ——.

Genus **Cypselurus** Swainson.

Type—*Exocœtus nuttalli* Le Sueur.

Exocœtus nuttalli Le Sueur, Journ. Ac. Nat. Sci. Phila. 1821, 10 pl. IV, fig. 1.

Cypselurus nuttalli Swainson, Class'n Fishes, etc. II, 296, 1839.

Synonym of *Exocœtus furcatus* Mitchill Trans. Lit. and Phil. Soc. N. Y., 1, 1815, 149.

31. **Cypselurus heterurus** (Rafinesque).

Three specimens in a tank of Pacific fishes are clearly referable to this Atlantic species. If we could be sure that they were not picked up in the Atlantic it would form an extension of range for the species.

764 (3) ——.

32. **Cypselurus callopterus** (Günther).

720 (1) ——.

Order THORACOSTEI.

Family **FISTULARIIDÆ.**

33. **Fistularia corneta** Gilbert & Starks.

Some of these appear to be the most northernly records for the species.

1013 (1) Lat. 24.30 N. Long. 108.55 W. 100 faths. 12 ft. dia. Hoop Trawl.
1014 (1) Arroyoa de San Luis. April 18. Surface.
1091 (1) Bahia Hunda, Panama. April 6. Seine.

34. **Fistularia depressa** Günther.

1188 (1) 247.
1200 (9) Bahia Hunda, Panama. April 5–6.
706 (1) ——.
723 (1) Off White Friars, Mexico. April 12. 620 faths.
732 (1) Bahia Hunda, Panama. April 6. Seine.

Family **SYNGNATHIDÆ.**

35. **Hippocampus ingens** Girard.

The mounted specimen (1190) is colored a uniform brilliant vermillion. A colored field sketch by Mr. Bronson with the same data and presumably the same specimen shows a fish predominantly orange but with some variation and a suggestion of dusky bands. This phase is apparently similar to that not uncommon to *Hippocampus hudsonius* DeKay in the latitude of New York

1006 (1) No data (Dried).
1007 (3) Cape San Lucas. April 16. Surface at night.
1190 (1) Conception Bay (Mounted).

36. **Syngnathus carinatum** (Gilbert).

1010 (1) Tiburon Island. May 25. Surface at night.
1017 (4) San Felipe Bay. May 18. Surface at night.
1184 (10) Senora, Mexico (off Adder Bay). May 22. Trawl, 17 faths.

37. **Syngnathus leptorhynchum** (Girard).

1185 (1) Tiburon Island. May 25. Surface at night.
1186 (1) Conception Bay. May 3.
1187 (1) San Felipe Bay. May 18. At night, surface.

ATLANTIC MATERIAL

The following specimens were collected on the Atlantic side incidental to the main work of the trip.

Family **MURÆNIDÆ.**

Gymnothorax funebris Ranzani.

610 (2) Key West, Florida. March 20.

Family **CLUPEIDÆ.**

Clupanodon pseudohispanicus (Poey).

600 (1) Palm Beach, Florida. March 24. Taken with a gig.

Sardinella macrophthalmus (Ranzani).

607 (1) Key West, Florida. March 8. Surface.

Family **HEMIRHAMPHIDÆ.**

Hemirhamphus brasiliensis (Linnæus).

608 (3) Key West, Florida. Feb. 24.

Family **EXOCŒTIDÆ.**

Halocypselus evolans (Linnæus).

611 (1) Key West, Florida. Feb. 20. Surface, dip net.
613 (1) Caribbean Sea. March 24.

Exonautes rondeletii (Cuvier & Valenciennes).

612 (1) Key West, Florida. Feb. 20. Surface, dip net.

Exonautes volitans (Linnæus).

614 (1) Caribbean Sea. March 24.

Also one small *Cypselurus* (615) from the Atlantic (?) and another (619) from Key West Harbor. Feb. 25. Surface. *C. furcatus?*

Family **SYNGNATHIDÆ.**

Hippocampus stylifer Jordan & Gilbert.

609 (1) Key West, Florida. March 10. 30 faths.

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