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ZOOLOGICA

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Department of Tropical Research Contribution Number 301

THE FISHES OF PORT-AU-PRINCE BAY, HAITI

With a Summary of the Known Species of Marine Fish of the Island of Haiti and Santo Domingo

By William Beebe, Sc.D.
AND
John Tee-Van

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THE FISHES OF PORT-AU-PRINCE BAY, HAITI*

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By William Beebe, Sc.D.

and

John Tee-Van

(Figures 1–268 inclusive and Plate A)

OUTLINE

Introduction

The preparing of this annotated account of the marine fishes of the republic of Haiti was the major problem planned on the Tenth Expedition of the Department of Tropical Research of the New York Zoological Society. As described elsewhere, we operated from a four-masted schooner "The Lieutenant" anchored near shore as a base.

Having learned on numerous expeditions of the value of effort concentrated upon a limited area, we chose a very definite region. This was the southeastern corner of Port-au-Prince Bay, which body of water in turn forms an exceedingly small proximal portion of the great Gulf of Gonave. Even here, with the Bizoton shore and the city of Port-au-Prince forming the eastern and southern sides of our area, we did not go farther afield than Sand Cay and Lamentin Reefs, three miles respectively to the north and the west. The exact physical boundaries of this zone may be considered as lying between the parallels 18° 32′ and 35′ north latitude, and the meridians 72° 22′ and 27′ west of Greenwich. While almost all ot the species were obtained within this area, a few were purchased at the market from fishermen who had seined them in more distant portions of the bay. The limitation of our zone of activities necessitated the omission of the fresh-water river and lake fish of the families *Cichlidae* and *Poecilidae*, which we have reserved for separate consideration. This does not apply to the fresh-water representatives occurring within our zone, of dominantly marine families such as the gobies and sciaenids, which are included in the list.

If we roughly estimate the shore line of the republic of Haiti at a minimum of eleven hundred miles, we covered in our collecting only one two-hundred-and-twentieth of this. Nevertheless within a period of less than one hundred days, from February 2nd to May 10th, 1927, we secured 6122 specimens of 270 species

*Contribution New York Zoological Society Department of Tropical Research No. 301

of Haitian fish, comprising 84 families. This may well be considered as representative of the fish fauna of Haiti.

Until now no adequate list of Haitian fishes has existed. The only comparable modern faunal list of West Indian Fishes is "The Fishes of Porto Rico," by Evermann and Marsh. This was published thirty years ago with a list of 291 species. Dr. Nichols has in preparation a new and up to date list for Porto Rico.

There is no department of fisheries in the present occupational scheme of the Americans in Haiti, so duplicate collections were made for the Service Technique of the Haitian government, and all possible economical information was gathered and put at their disposal.

There is a small open-air fish market in addition to the main fish market at Port-au-Prince, but these cater to only a very small percentage of piscivorous natives. In fact the annual importation of dried, pickled, and canned fish into Haiti amounts annually to fifteen million pounds.

In the gathering of our collection we used every available method, from hook-and-lines to nets, seines, set-traps; air-rifles, harpoons, poisons, dynamite and high explosive bombs dropped from airplanes. On the surface we worked with water buckets and glass-bottomed boats, while diving helmets enabled us to reach an extreme depth of ten fathoms.

Although the present paper is concerned with the marine fishes of the republic of Haiti, yet in ichthyological literature most references refer vaguely to the entire island of Haiti or Santo Domingo. Of this island the Haitian Republic occupies only the western third.

In order to round out the value of our list, we have added a list of all additional marine species recorded from the island as a whole. This brings the total number of marine fish known from the island of Haiti to 324. All of these will, probably, ultimately be taken in the Gulf of Gonave.

The logic of physical distribution demands that, for a moment, we disregard national boundaries and concern ourselves with the location of the island of Haiti. With the exception of Cuba it is the largest of the West Indies and lies between 17° 39′ and 20° north latitude, and 68° 20′ and 74° 30′ west longitude. The Atlantic Ocean bounds it on the north and the Caribbean Sea on the south, and it lies almost exactly between Cuba and Porto Rico, separated from them respectively by the Windward and Mona Passages. Cuba is less than sixty miles distant, with the northern portion of the Bartlett Deep pushing up between to a depth of 1983 fathoms. In the other direction Porto Rico is seventy miles away, connected to Haiti by a bank averaging 250 to 300 fathoms deep.

As to the topography of the restricted area of our operations, it lies almost wholly on the littoral platform which borders much of the coast. The maximum depth of Port-au-Prince Bay is 85 fathoms, but this does not occur nearer than forty miles from our station. Our greatest depth was 20 fathoms, but the whole locality was very irregular in contour, with numerous cays and coral reefs lying awash or occasionally rising above the surface. The senior author, in his study of reef ecology, was able to distinguish eight more or less distinct zones from the shore outward, the enumeration of which, in the present connection, will suffice:

1.—Fresh-water streams and springs flowing into the bay.
2.—High-tidal, land-locked, salt-water lagoons.
3.—Inter-tidal zone of mangroves and mud.
4.—Submerged shallows of bare sand and hairy algae.
5.—Thalassia growth, pure culture and transition.
6.—Typical coral reef.
7.—Deeps below coral growth.
8.—Surface Nekton and Plankton, diurnal and nocturnal.

In the make-up of this paper we have followed a definite arrangement, one which has stood protracted use in the field in connection with the fresh-water fishes of British Guiana and the oceanic collections of the Arcturus. The following table shows the sequence of treatment:

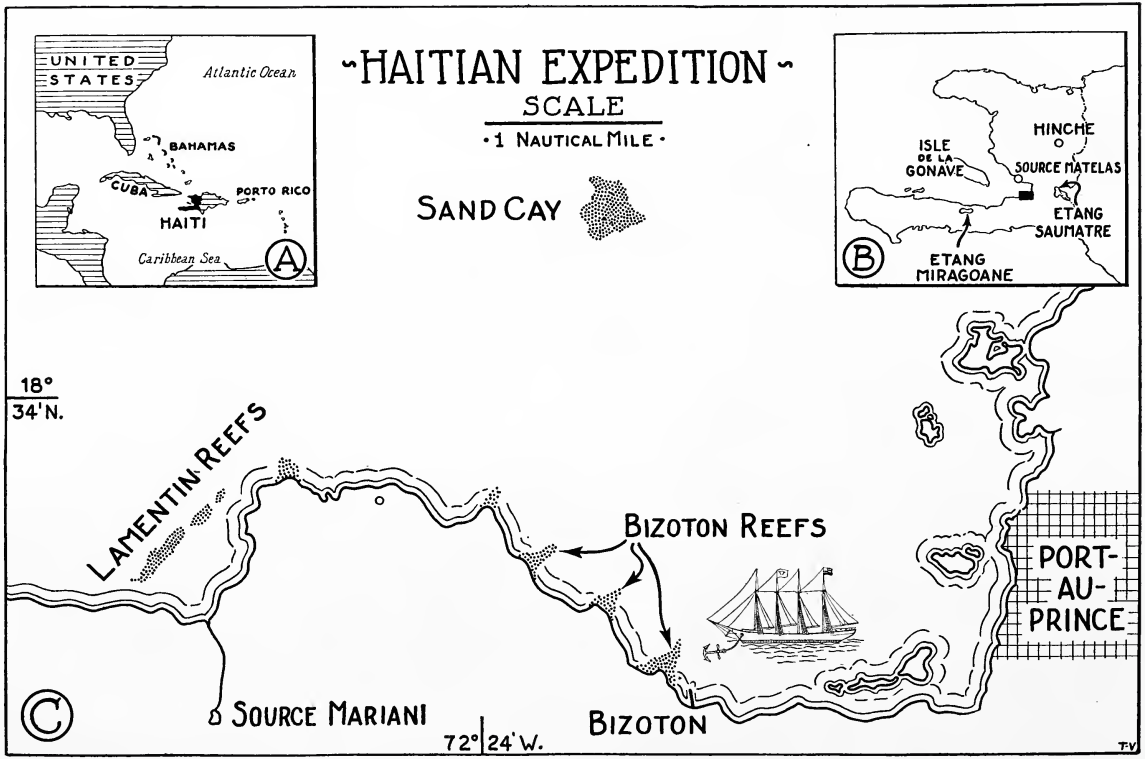
Names.
References (The type reference and a good recent account).
Field Characters for identification at sight.
Description, Size and Weight, Color.
General Range.
Occurrence in Port-au-Prince Bay.
Abundance. Method of Capture.
Food. Enemies.
Proportion of Sexes.
Size at Maturity.
Spawning Season.
Eggs. Young.
General Habits.
Study Material—Drawings, Photographs, Specimens.

The republishing of complete descriptions of the species represented in Haiti seemed to be needless, and anyone interested can be connected with the literature of the species through the second reference mentioned under each fish.

We have gone to considerable trouble in providing illustrations of every species, using the same type of outline drawing as Nichols and Breder in their "Marine Fishes of New York," and we have to thank them for the use of 69 of their electrotypes. These illustrations, with the exception of those of new species, are to be regarded as character sketches made as accurately as possible. Owing to their size, fin rays are in most cases only indicated, although whenever possible the correct number has been shown.

During our stay in Haiti the American High Commissioner and his wife, General and Mrs. John H. Russell lost no opportunity to aid our work, and in this they were heartily seconded by President and Madame Borno. A complete list of those who rendered valuable assistance would require a roll-call of the entire American Force of Occupation—aviators, scientists, officers of the marines and heads of all departments. In particular we must mention Commander V. Wood and Dr. George Freeman.

The expedition was made possible by the generosity of the following members of the New York Zoological Society:



A.—Haiti in relation to the West Indies.

B.—Haiti showing localities where collections were made. The black rectangle shows the position and extent of the large map C.

C.—Eastern end of Port-au-Prince Bay showing the localities mentioned in this report.

George F. Baker
John C. Berwind
Robert Brewster
Coleman du Pont
Marshall Field
Edward S. Harkness
Anthony R. Kuser
Ogden Mills
Lewis R. Morris
George D. Pratt
Mortimer L. Schiff
Frederic C. Walcott
Harrison Williams

We are indebted to the following institutions for the loan of specimens for comparison:—the U. S. National Museum, the Bingham Oceanographical Collection of the Peabody Museum through Mr. A. E. Parr, and the American Museum of Natural History through Mr. John T. Nichols. We are especially grateful to the last named gentleman, to Dr. E. W. Gudger of the American Museum and Mr. C. M. Breder, Jr. of the New York Aquarium for advice and suggestions. We would also like to thank Dr. S. F. Hildebrand for the use of the manuscript and page proof of the third part of "The Marine Fishes of Panama."

We are also indebted to Floyd Crosby for photographs of fishes, to Helen Tee-Van for colored plates made in the field, to Fritz Maximilian of the Service Technique of Haiti, who was assigned to us by Dr. Freeman to assist in making drawings, and to Edith Thane for some of the line drawings.

Additional information as to the general environment, and the activities of the Haitian Expedition may be found in the following publications which have already appeared:

"Beneath Tropic Seas," by William Beebe (Putnams), 1928
"The Haitian Expedition," Zoological Society Bulletin, Vol. XXX, No. 5, September, 1927.

Systematic Table of Contents

A. Class ELASMOBRANCHII

B. Class PISCES

The following new species are described in this paper:

Anchoviella longipinna
Leptocephalus microphthalmus
Rypticus bornoi
Scorpaenodes russelli
Pomacentrus freemani
Leptophilypnus crocodilus
Gobiosoma macrodon
Labrisomus haitiensis
Labrisomus albigenys
Cremnobates argus
Ophioblennius ferox
Acanthemblemaria arborescens
Acanthemblemaria variegata
Stathmonotus corallicola

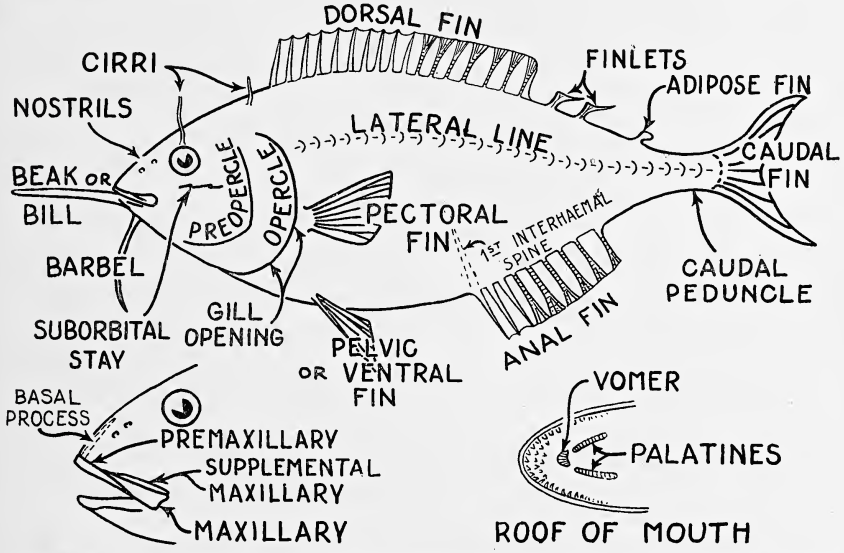
KEY TO FAMILIES OF PORT-AU-PRINCE BAY

NOTE.—These keys do not attempt to show relationships and are in the widest sense artificial. In scope they treat only of the locality and species mentioned in this paper, and will not necessarily work in other localities, either for the families or species.

To identify a fish, start at Key A under No. 1 and see which of the two alternatives the specimen fits best. Then go to the number or Key indicated at the end of the proper alternative, and continue the process until a family name is reached.

The keys to the genera and species are slightly different from this key to families, and in these the alternatives are labelled A, AA; B, BB, etc. With these keys choose the alternative A or AA according to which one fits best. Then decide between the pair of alternatives immediately under the chosen one, regardless of what the letter may be,—thus under BB the next pair of alternatives may be D and DD. Continue this until the species is reached. Comparison of the fish with the illustration and the field characters ought to determine whether it is actually that species or whether it represents a form not found by us.

The accompanying diagram and notes illustrate most of the characters used in identification.



Because a fish continues to grow all during its life and does not reach a definite maximum size as a bird or mammal does, absolute measurements as to length, size of head, depth, etc., are of very little value. Because of this, dimensions are stated in terms of proportion. Thus, Head 3.4 means that the length of the head goes into the body length 3.4 times. Depth of body and size of head are compared to the body length, while eye, maxillary and smaller measurements are compared to the head.

Actual measurements of a fish are taken in a straight line, as with a pair of dividers. The standard length is taken from the snout to the base of the caudal fin. When total length is mentioned it includes the caudal fin. Depth is the greatest vertical distance from the upper to the lower contour of the body. The

length of the head is from the snout to the most posterior point of the opercle, exclusive of spines which may project further backward. The diameter of the eye is its greatest diameter. The maxillary is measured from the tip of the snout to the posterior edge of the maxillary. The interorbital space is the least distance from eye to eye, measured across the top of the head. The snout is measured from its tip to the front of the eye.

The pectoral and the pelvic or ventral fins are paired, while all others are single and found only along the midline of the body. The shapes and positions of these fins vary tremendously and one or more may be completely lacking. Thus the dorsal may be a continuous fin or divided so as to form 2 or 3 fins; it may be followed by finlets. The ventral fins occasionally are found beneath the lower jaw. The adipose fin is small, placed on the posterior dorsal surface and contains neither spines nor rays.

The supporting elements of the fins are usually quite constant in number, and their number is often of importance in classification. These elements are of two types—spines, which are rigid, solid and sharp-pointed; and rays, which are segmented, flexible and often branched at their tips. In descriptions the spines are denoted by a Roman numeral and the rays in Arabic.

Gill rakers are bony excrescences found regularly placed along the gill arches in some fishes. The isthmus is the portion of the body extending forward on the ventral side, just between the gill covers. The gill membranes often cover it or are attached to it. The nictitating membrane is a membrane which can be drawn up over the eye—it is found in some of the Haitian sharks.

Key A

1.—Fishes with cartilaginous skeletons and with more than one gill opening on each side of the body (Sharks, Rays, Skates, Mantas)
See Key B, p. 23

—Fishes with bony skeletons and with a single external gill-opening on each side....2

2.—Bones of the head fused into a tubular snout, with the jaws at the tip.
See Key C, p. 23

—No tubular snout....3

3.—A sucking disk placed either on the dorsal surface of the head, or on the belly, the latter formed partly or entirely by the ventral fins.
See Key D, p. 24

—No sucking disk on head or belly....4

4.—Body enclosed in a hard bony box, only the fins and the caudal peduncle freely movable; ventral fins absent; dorsal fin single, of soft rays only.
Ostraciidae, p. 261

—Body not enclosed in a bony box and with the above mentioned characters. 5

5.—One or both jaws prolonged into a long bill....See Key E, p. 24

—Jaws not prolonged into a bony bill....6

6.—Pectoral fins enlarged, forming conspicuous "wings"...See Key F, p. 24

—Pectoral fins not forming wings, not especially enlarged or wide....7

7.—Eels: Body very elongate, more or less snake-like; premaxillaries rudimentary or wanting; ventral fins wanting; no spines in the fins; gill openings not especially large....See Key G, p. 24

—Without the above characters....8

8.—Fishes with the carpal bones greatly elongated, forming an arm, which

supports the rather broad pectoral fin; gill openings reduced to a small opening situated near the base of the arm.....9
—Fishes without the above series of characters.....10
9.—Body more or less compressed, not depressed; mouth large, terminal, nearly vertical.....*Antennariidae*, p. 270
—Body depressed, skin sometimes with bony tubercles or spines; mouth small, usually inferior.....*Ogcocephalidae*, p. 271
10.—Fishes which lie flat on one side, with both eyes on the other side; upper side dark, lower side pale.....See Key H, p. 25
—Fishes with one eye on each side of the body.....11
11.—Ventral fins present.....12
—Ventral fins absent.....53
12.—Ventral fins placed on the abdominal portion of the body.....13
—Ventral fins placed on the thoracic or subjugular part of the body, i. e., placed below, or in front of the base of the pectoral fins.....14
13.—Dorsal fin single, composed of rays only, or rarely with a very small spine just anterior to fin.....See Key I, p. 25
—Dorsal fins 2, the anterior composed of spines, the posterior chiefly of soft rays.....See Key J, p. 25
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—Ventral fins with number of spines and rays not definitely one spine and five rays. (Occasionally the ventral fins may resemble barbels and be found near the chin).....46
15.—Lateral line absent; spinous portion of dorsal fin least developed; caudal fin rounded or pointed.....*Eleotridae*, p. 217
—Without the above combination of characters.....16
16.—Suborbital with a bony stay extending across the cheek; cheeks sometimes mailed.....17
—No suborbital stay across the cheeks; cheeks not mailed.....18
17.—Lowermost rays of pectoral fin detached; head bony and hard..*Triglidae*, p. 191
—Pectoral fins entire, no detached rays; head large, with prominent ridges; body and head often with dermal flaps.....*Scorpaenidae*, p. 185
18.—Some or all of the dorsal or anal spines disconnected, the former depressible in a groove.....19
—Dorsal spines, if present, all or nearly all connected by membrane....20
19.—Anal fin preceded by two free, rather short spines (sometimes obsolete in the very old and joined by membrane in the very young); oesophagus normal, without teeth; preopercle entire; teeth, if present, moderate; caudal fin broadly forked; often with a series of enlarged scales along the posterior part of the sides.....*Carangidae*, p. 103
—Anal fin long, not preceded by free spines, with 3 or more connected spines; ventral fins sometimes wanting in adults; oesophagus provided with lateral sacs which are toothed internally.....*Stromateidae*, p. 102
20.—Dorsal and anal fins followed by a series of detached finlets; anal fin not preceded by free spines; caudal peduncle with a prominent lateral keel;

caudal fin broadly forked....21*
—Dorsal and anal fins not followed by finlets....22
21.—More than 20 gill rakers on the lower limb of the 1st gill arch; rather robust fishes with the anterior part of the body in a corselet. *Thunnidae*, p. 98
—Fewer than 20 gill rakers on the lower limb of the 1st gill arch; teeth in jaws rather strong, somewhat compressed, sometimes triangular, with sharp cutting edges; no corselet; elongate rather slim fishes. *Scombridae*, p. 97
22.—Ventral fins broad, very large and black; small fishes growing to 6 or 8 inches long with very conspicuous vertical dark cross bands; found only in the company of Portuguese Man-of-War....*Nomeidae*, p. 103
—Without the above combination of characters....23
23.—Caudal peduncle armed with a strong spine, capable of being turned outward....*Acanthuridae*, p. 183
—Caudal peduncle not armed with a strong spine....24
24.—Two long unbranched barbels on the lower surface of the under jaw. *Mullidae*, p. 171
—Throat without two long barbels....25
25.—A single nostril on each side of the head; lateral line ending under the soft dorsal fin; anal fin with 2 spines....*Pomacentridae*, p. 192
—Two nostrils on each side of head....26
26.—Lateral line extending to tip of middle rays of caudal fin....27
—Lateral line not extending onto the caudal fin....29
27.—3 anal spines, the second usually strong; dorsal fins separate. *Centropomidae*, p. 121
—One or two anal spines, dorsal fins deeply notched....28
28.—Preopercular margin with a membranous border, never with bony serrae; upper jaw with a pair of very large canines at the tip, these usually curved inward and backward, one of them often obsolete. *Otolithidae*, p. 177
—Preopercular margin with bony serrae or at least with one or more spines, or membranous without spines and without large canines at the tip of the lower jaw....*Sciaenidae*, p. 172
29.—Gills 3½ (half of the gill-filaments of the last arch missing) the slit behind the last arch very small or wanting (Parrot-fish and Wrasses)....30
—Gills 4; a long slit behind the last one....32
30.—Teeth in jaws coalesced at the sides, usually forming a continuous cutting edge, and with an evident median suture between the groups of teeth of each side of the jaw....*Scaridae*, p. 207
—Teeth in the jaws nearly or quite distinct, some of the anterior ones enlarged and forming canines....31
31.—Dorsal fin with 11 to 14 spines....*Labridae*, p. 200

* Occasionally the dolphins (Coryphaenidae) have the dorsal rays broken up into "finlets." This family may be readily separated from the two families mentioned under 21 by having the dorsal fin beginning on the head. Also a few of the *Carangidae* have finlets; this family may be recognized by the two free spines before the anal fin.

—Dorsal fin with 8 to 9 spines.....*Coridae*, p. 202

32.—Teeth setiform like the teeth of a brush or at least very slender, movable; body very short and deep; soft fins completely scaled; gill-membranes attached to the isthmus.....33

—Teeth not very slender or bristle-like, usually fixed; gill-membranes free from the isthmus or nearly so.....34

33.—Spinous and soft dorsal fins continuous; teeth numerous, slender, bristle-like *Chaetodontidae*, p. 179

—Dorsal fins deeply notched or divided; teeth slender, but scarcely bristle-like.....*Ephippidae*, p. 178

34.—Upper jaw extremely protractile, the basal process of the premaxillary very long, entering a groove at top of the cranium just underneath the skin; scales large, silvery.....*Gerridae*, p. 167

—Premaxillaries moderately or not at all protractile.....35

35.—Dorsal fin very long, beginning on the head, no definite spines; caudal fin widely forked.....*Coryphaenidae*, p. 101

—Dorsal fin shorter, not beginning on the head, the anterior portion with spines, either very weak or well developed.....36

36.—Dorsal spines very weak, 6 in number, the spinous dorsal very low and forming but a very small portion of the very long dorsal fin; elongate fishes with conical head furnished with fairly large curved conical teeth; tail crescentic, the tips produced into filaments..*Malacanthidae*, p. 177

—Dorsal spines strong, usually greater in number, in one case less than 6.....37

37.—Anal spines 2; dorsal fins well separated; scales large....*Amiidae*, p. 118

—Anal spines 3; dorsal fin continuous or rarely divided.....38

38.—Maxillary not or only partly sheathed by the preorbital bone; opercles usually ending in one or two flat spines.....39

—Maxillary slipping for the most part under the preorbital and more or less completely shielded by the latter; opercle without spines.....43

39.—Vomer without teeth; dorsal fin continuous; soft dorsal and anal fin large, almost as large as the caudal fin.....*Lobotidae*, p. 145

—Vomer and palatines usually with teeth.....40

40.—Anal fin nearly as long as the dorsal and similar to it; head and body everywhere with rough scales; body rather deep, compressed; post-ocular part of head shortened; scarlet fish with large eyes. *Priacanthidae*, p. 144

—Anal fin shorter than dorsal; head not everywhere covered with rough scales, body usually quite elongate and generally more or less compressed; postocular part of head not shortened.....41

41.—Supplemental maxillary (a small bone found lying along the upper edge of the maxillary) present.....*Epinephilidae*, p. 124

—Supplemental maxillary bone absent.....42

42.—Lateral line continuous, parallel more or less with the back. *Serranidae*, p. 133

—Lateral line running close to the back, interrupted below center of soft dorsal fin and continued again lower down on the center of the caudal peduncle.....*Pseudochromidae*, p. 143

43.—Teeth on jaws not all incisors, canines or molars present; alimentary canal comparatively short; carnivorous fishes.....44
—Teeth on anterior part of jaws incisors; no molars or canines; alimentary canal very long; herbivorous fishes.....*Kyphosidae*, p. 166
44.—Vomer with teeth, these sometimes very small; teeth in jaws usually unequal, some of them more or less canine-like..*Lutianidae*, p. 146
—Vomer without teeth.....45
45.—Teeth on sides of jaws not molar-like, all pointed but with no marked canines; preopercle usually serrate.....*Haemulidae*, p. 154
—Teeth on sides of jaws molar-like, the anterior teeth conical or more or less incisor-like; preopercle entire.....*Sparidae*, p. 163
46.—Ventral fins with more than five rays; body covered with firm, strongly serrated scales; anal fin with 4 strong spines.....*Holocentridae*, p. 78
—Ventral fin with fewer than five rays.....47
47.—Dorsal fin with soft rays only[1].....48
—Dorsal fin consisting of spines only, or partly of spines or at least of simple unbranched rays.....49
48.—Dorsal fin single, continuous around the caudal with the anal fin. *Ophidiidae*, p. 251
—Dorsal fin double, the anterior fin a single ray placed on the posterior part of the head, widely separated from the second dorsal fin; ventral fins long.....*Bregmacerotidae*, p. 73
49.—Pectoral fins divided into two parts, the anterior part nearly as long as the head, composed of about six rays, the other part produced, reaching nearly to base of caudal in adult (shorter in young), used as organs of flight.....*Cephalacanthidae*, p. 191
—Pectoral fins not divided; dorsal spines usually numerous, gill membranes usually more or less united to the isthmus.....50
50.—Body with scales.....*Clinidae*, p. 228
—Body without scales.....51
51.—Dorsal fin composed of spines only.....*Chaenopsidae*, p. 249
—Dorsal fin composed of rays or of spines and rays.....52
52.—Top of head not covered with short spines.....*Blennidae*, p. 241
—Top of head covered, especially anteriorly, with short, forward pointing thick-set spines.....*Emblemariidae*, p. 244
53.—Gill membranes free from the isthmus.....54
—Gill membranes broadly united to the isthmus.....55
54.—Body extremely elongate, band shaped, tapering posteriorly; no scales; caudal fin wanting.....*Trichiuridae*, p. 100
—Body compressed, rather short, rounded, with a caudal fin..*Stromateidae*, p. 102
55.—Dorsal fins 2, the anterior of 1 to 3 spines and inserted just behind the cranium, the posterior one separate and composed of soft rays only; body short and deep, much compressed.....56
—Dorsal fin continuous, composed of soft rays only.....57
56.—First dorsal with 3, rarely 2, spines, the first spine very large, the second

[1] The family *Emblemariidae* under No. 52, may at times be judged to fall under this heading.

locking it when erected; scales rather large, bony, forming a coat of mail. *Balistidae*, p. 253

—First dorsal fin with a single spine with a rudiment at the base; scales minute, bearing very slender spines making the surface of the body rough velvety..... *Monacanthidae*, p. 254

57.—Teeth in each jaw divided by a median suture; body not covered with large bony spines, naked or with small prickles.....58

—Teeth in each jaw undivided, no median suture; body covered with strong bony spines..... *Diodontidae*, p. 267

58.—Nostrils without a distinct tube or tentacle; a single opening on each side; back compressed and produced into a short prominence over the pectoral fins..... *Canthigasteridae*, p. 266

—Nostrils with a distinct tube or tentacle back rounded, not compressed. *Tetraodontidae*, p. 263

Key B

Sharks, Skates, Rays, etc.

1.—Body fusiform in shape, pectoral fins not attached to the head; gill openings at side of body (Sharks).....2

—Head and body depressed and disk-like; gill-openings on under side of body; tail slender, usually with one or more serrated spines (Rays, Stingarees, Skates, Mantas).....5

2.—Nictitating membrane absent; nostrils with a naso-oral groove and with a prominent barbel; first dorsal fin inserted over the ventrals. *Orectolobidae*, p. 26

—Nictitating membrane present.....3

3.—Teeth depressed, paved, several series functioning... *Galeorhinidae*, p. 26

—Teeth more or less compressed, triangular, one or two series functioning..4

4.—Head normally shaped, not expanded and hammer-shaped. *Carcharinidae*, p. 27

—Head expanded, hammer-shaped; the eyes at the outer extremities of the head..... *Sphyrnidae*, p. 29

5.—Disk subcircular, no cephalic appendages..... *Dasyatidae*, p. 30

—Disk broad and angular, the outer tips produced into "wings".....6

6.—Head produced into a rostral process; no cephalic appendages. *Myliobatidae*, p. 31

—Head with two long, rather broad, horn-like appendages. *Mobulidae*, p. 32

Key C

1.—Spinous dorsal fin present; small ctenoid scales present. *Aulostomidae*, p. 86

—Spinous dorsal fin absent.....2

2.—Middle rays of caudal fin prolonged into a long filament. Body scaleless, but with bony plates on various parts of the body mostly covered with skin..... *Fistularidae*, p. 87

—Middle rays of caudal fin, when present, not produced into a long filament; body hard, leathery, sometimes tubercular, marked off into segments; shaped either slender and with head in line with body (pipefishes), or robust with head at right angles to body (sea-horses).
Syngnathidae, p. 83

Key D

1.—Sucking disk placed on top of the head and formed of lamellae.
Echeneididae, p. 227
—Sucking disk placed on the belly.....2
2.—Sucking disk formed by the ventral fins alone, the fins of the right and left sides connected together as one fin, with a velum across their base, forming a "cup".....*Gobiidae*, p. 220
—Sucking disk formed only partly by the ventral fins, the fins usually confined to the sides of the disk; dorsal fins composed of soft rays only.
Gobiesocidae, p. 251

Key E[1]

1.—Both jaws equally elongated.....*Belonidae*, p. 63
—Lower jaw only elongated, the upper short.....*Hemirhamphidae*, p. 66

Key F

1.—Dorsal fin single, composed of soft rays only and situated quite far back on the body.....*Exocoetidae*, p. 72
—Dorsal fin composed of spines and rays, the former sometimes very slender.
2
2.—Ventral fins with 1 spine and 5 rays; 3 lowermost rays of the pectoral fins free and separate, the remainder of the fin sometimes quite long; head bony and rough, but without the exceptionally long spines mentioned below. (These fish do not fly, but they have been included here because of the size of the pectoral fins, which are sometimes quite long.)
Triglidae, p. 191
—Ventral rays fewer than 5; the pectoral fins in two parts, the anterior part nearly as long as the head, composed of about 6 rays, the other part produced and reaching nearly to the caudal in adult, shorter in the young; head bony, a long bony process ending in a sharp spine extending from nape to or beyond the dorsal fin; preopercle extending backward as a long spine.....*Cephalacanthidae*, p. 191

Key G

1.—Skin covered with rudimentary scales which are embedded and placed at right angles to each other; mouth terminal, the lower jaw somewhat projecting; teeth in bands on the jaws and vomer.....*Anguillidae*, p. 50
—Scales absent.....2

[1] Some of the flying fishes, *Exocoetidae*, especially the young, occasionally have elongate bills.

2.—Gill openings well developed; tongue present; pectoral fins usually present. 3

—Gill openings very small; pectoral fins absent; tongue absent; skin thick, leathery.....*Muraenidae*, p. 53

3.—Tip of tail with distinct fin rays, the dorsal and anal fins usually confluent around it.....4

—Tip of tail without fin rays, the dorsal and anal fins not extending around it, the tip ending in a hard, horny point.....*Ophichthyidae*, p. 52

4.—Body fairly robust, not worm-like; posterior nostril situated entirely above the upper lip; tongue rather narrow; vomerine teeth well developed; head conical, somewhat pike-like.....*Muraenesocidae*, p. 51

—Body slim and very long, worm-like; the posterior nostril situated in the upper lip.....*Echelidae*, p. 51

Key H

1.—Eyes large and well separated; preopercular margin usually distinct and not hidden by skin and scales.....*Bothidae*, p. 73

—Eyes small, close together; preopercular margin adnate, hidden by skin and scales.....2

2.—Body short and ovate; the eyes and color on the right side...*Achiridae*, p. 76

—Body elongate, more or less lanceolate; the eyes and color on the left side. *Cynoglossidae*, p. 77

Key I

1.—Adipose fin absent; head not lizard-like.....2

—Adipose fin present; mouth large; head lizard-like in shape; body more or less cylindrical, tapering from the head backward...*Synodontidae*, p. 60

2.—A bony plate between the arms of the lower jaw.....3

—No bony plate between the arms of the lower jaw.....4

3.—Scales very large; lateral line decurved; last ray of the dorsal fin elongate. *Megalopidae*, p. 33

—Scales small; lateral line straight; last ray of the dorsal fin not elongate. *Elopidae*, p. 32

4.—Lateral line present; tongue and base of skull inside mouth with patches of coarse blunt teeth.....*Albulidae*, p. 37

—Lateral line wanting; tongue and base of skull without coarse blunt teeth..5

5.—Mouth moderate in size, terminal, usually more or less oblique.....6

—Mouth large, inferior, usually horizontal, the snout overhanging the mouth; mandible long and slender.....*Engraulidae*, p. 45

6.—Belly compressed, usually forming a more or less sharp edge along which are serrae.....*Clupeidae*, p. 39

—Belly rounded, without serrae.....*Dussumieridae*, p. 43

Key J

1.—Lower rays of the pectoral fin free and filamentous.....*Polynemidae*, p. 96

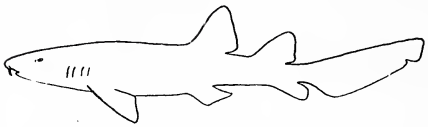
—Lower rays of the pectoral fin not free or filamentous.....2

2.—Lateral line present; teeth very large, unequal; jaws long and strong; head long, pike-like.....*Sphyraenidae*, p. 92
—Lateral line absent; head not pike-like or produced; jaws rather weak....3
3.—Anal fin with a single weak spine; first dorsal fin with 3 to 9 flexible spines. *Atherinidae*, p. 88
—Anal fin with 3 stiff spines (2 in very young); first dorsal with 4 stiff spines. *Mugilidae*, p. 90

ANNOTATED LIST OF FISH OF PORT-AU-PRINCE BAY, HAITI

Family Orectolobidae; Nurse Sharks

Ginglymostoma Muller and Henle, 1837



Nurse Shark
Ginglymostoma cirratum (Bonnaterre)

References: *Squalus cirratus*, Bonnaterre, 1788, Tableau Encyclo. Ichth., p. 7.
Ginglymostoma cirratum, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 29.

Field Characters: A large, blunt-headed shark; a fleshy flap in front of the small mouth with a barbel on each side; two large dorsal fins placed far back; brown, the young sometimes spotted.

Description: A young female measured: Total length 692 mm., length to tail notch 496, depth 87, head to last gill-slit 140, eye 6.

Size and Weight: One young specimen 27.25 inches in total length, weighed 4.25 pounds. The species grows to 10 feet.

Color: Uniform olive brown above, fading to olive buff below.

General Range: Warm seas of the western hemisphere from Carolina to southern Brazil, and on the west coast of Mexico. A straggler to Rhode Island.

Distribution in Port-au-Prince Bay: One young individual taken near shore, over shallow bank.

Method of Capture: Caught in net by native fisherman.

Food: Two six inch parrot fish (*Sparisoma flavescens*) swallowed entire.

Study Materials: Specimens, 1; young female, 692 mm., No. 7094.

Family Galeorhinidae; Dogfish

Galeorhinus Blainville, 1816

Haitian Dogfish

Galeorhinus sp.

Note: I include this genus in the list of Haitian fish from the careful scrutiny I was able to give, on two occasions, to parent sharks of small size swimming

slowly about the schooner. The extremely flattened, elongated head and the two large dorsal fins of equal size insure the certainty of generic identification.

One shark, five feet long, swam past on April 3rd, accompanied by two young, each about a third of her length. On May 4th a smaller dogfish circled the schooner, well under five feet in length, and had with her two young, certainly not over twelve inches in length. (W. B.)

Family Carcharhinidae; True Sharks

Key to Port-au-Prince Bay Genera

A. Small labial fold on upper and lower jaw at angle of mouth..... *Scoliodon*
AA. Labial folds wanting; teeth more or less serrate on both margins of the cusp..... *Carcharhinus*

Scoliodon Muller and Henle, 1837

Sharp-nosed Shark
Scoliodon terrae-novae (Richardson)

References: *Squalus terrae-novae*, Richardson, 1836, Fauna Bor. Amer. III, p. 289.
Scoliodon terrae-novae, Meek and Hildebrand, 1923, Marine fishes of Panama, I, p. 55.

Field Characters: A small-sized shark, reaching a length of three feet; teeth smooth; upper and lower lips with a labial fold extending from the angle of the jaw forward for less than one-third the length of the jaw.

Description: The following measurements were recorded of the largest and smallest specimens taken:

	No. 7141 *Young female*	*No. 7109* *Young male*
Total length	405 mm.	668 mm.
Preoral length	33.5 "	46 "
Length to base of 1st dorsal	135.5 "	198 "
Width at nostrils	35 "	46 "
Interorbital area	35 "	51 "
Snout	37 "	52.8 "
Internostril angle from mouth	16 "	21 "
" " " snout	25 "	34 "
Eye to nostril	13.5 "	19 "
Internarial space	24 "	33.5 "
Eye	10.5 "	13.5 "
Width of mouth	32 "	43 "
Preoral into base of 1st dorsal	1.06	1.1
Width nostrils into preoral	1.05	1
Eye greater than nostril width	Yes	Yes
Teeth in outer row in each jaw	21	23
Upper labial fold		12 mm.

Size and Weight: A 15 inch female weighed 610 grams. A 20 inch male weighed 3 pounds.

Color: Pale shark gray above, turning to white below; dorsals and caudal edged with black, second dorsal and lower lobe of caudal broadly so. Iris greenish silver.

General Range: Labrador to Brazil.

Distribution in Port-au-Prince Bay: Occasionally brought into the market by fishermen.

Abundance: Fairly common.

Method of Capture: Mainly taken in nets by the natives.

Food: Unidentifiable parrot fish.

Young: Three of our specimens, including No. 7141 were of the same brood, the umbilical cord still being in evidence. These were taken April 4th.

Study Material: 6; 405–668 mm. including Nos. 7109, 7141.

Carcharinus Blainville, 1816

Key to Port-au-Prince Bay Species

A. Teeth slightly serrated, similar in form in the two jaws, narrow, claviform, constricted at base; snout rather sharp; fins edged with black. *limbatus*

AA. Teeth in both jaws distinctly serrate in adult, serrae on lower teeth smaller; upper teeth rather broad, lower teeth narrower; snout not very acute; color deep blue gray..... *falciformis*

Spot-fin Ground Shark, Caconeta
Carcharinus limbatus (Müller and Henle)

References: *Carcharias limbatus*, Müller and Henle, 1841, Plagiostomen, 49, Pl. XIX, fig. 9 (Martinique).
Carcharhinus limbatus, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 41.

Note: I include this species on the fact that when I started my deepest dive of sixty feet on March 23, 1927 over the schooner's side, several fathoms below the surface a shark over nine feet in length, attended by a single young about three feet long, passed slowly by me. The only feature which remains in mind is the extensive and intense black tips of at least three fins, the two dorsals and the anal. They appeared much blacker than I have ever observed in sharks of this species after being drawn from the water. (W. B.)

Scythe-shaped Shark
Carcharinus falciformis (Bibron)

References: *Carcharhinus falciformis*, Bibron, 1838, in Müller and Henle's Plagiostomen, p. 47:
Carcharhinus falciformis, Evermann and Marsh, 1902, Fishes of Porto Rico, p. 62.

Field Characters: Large sized blue grey shark. Upper teeth much broader than lower and deeply notched on the outer margin; snout to mouth not greater than width of mouth; no sharp lobe to nasal flap; second dorsal and anal fins subequal.

Description: The female specimen captured showed the following measurements:

Total length	1093 mm.
Length to base of caudal fin	838 "
Snout to first gill opening	213 "
Length of caudal from pit	292 "
Length of pectoral	150 "
Snout to mouth	83 "
Width of mouth	83 "
Snout to origin of dorsal	401 "
Origin of dorsal to caudal pit	448 "

Size and Weight: Reaches a length of 10 feet. Our 43 inch fish weighed 13 pounds.

Color: Dark shark grey.

General Range: West Indies.

Distribution in Port-au-Prince Bay: The small specimens were taken over the deeper fishing reefs.

Method of Capture: Taken on set line by native fishermen.

Food: Two fish hooks and eight inches of line on each were found in the stomach of the young female, together with a small piece of fish, probably bait.

Study Material: Specimens, 2; young female, 3 feet 7 inches long, No. 6940; young male, 3 feet long, No. 7137.

Family Sphyrnidae; Hammerhead Sharks

Sphyrna Rafinesque, 1810

Hammerhead Shark
Sphyrna zygaena (Linnaeus)

References: *Squalus zygaena*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 234.
Cestracion zygaena, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 58.

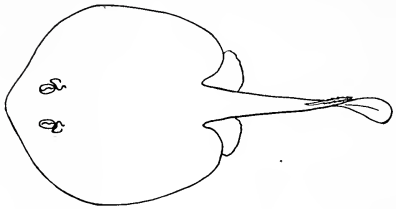
Field Characters: A large shark with the head depressed and greatly expanded from side to side, the eyes being placed on the forward part of the lateral expansions.

Note: No specimens taken. A hammerhead shark, about nine feet long, swam close about the schooner all the afternoon of March 10th. It was pale grey with the posterior edges of the fins black.

Size: The species grows to a length of 17 feet.

Family Dasyatidae; Sting Rays

Urobatis Garman, 1913



Round Sting Ray
Urobatis sloani (Blainville)

References: *Leiobatus sloani*, Blainville, 1816, Bull. Soc. Philom., p. 121.
Urolophus jamaicensis, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 81.

Field Characters: Flattened disk-like ray with rayed caudal fin, the disk ovate, longer than broad and slightly longer than tail; brown sprinkled with yellow or orange dots, sometimes forming ocelli.

Description: Measurements of two specimens:

Length total	304 mm.	145 mm.
Length disk	176 "	76.5 "
Width disk	152 "	76 "
Length caudal spine	41 "	13 "

It can be seen from the measurements that the smaller fish has a disk that is almost round and that the tail is almost as long as the disk. The upper surface of the smaller is nearly smooth.

Size: The largest specimen obtained by us had a disk length of 190 mm. and a total length of 340 mm.

Color: In the larger preserved specimen the round yellow or orange spots are smallest on the mid-line, becoming larger on the periphery of the disk and on the caudal fin. This is also true to a certain extent in the smaller specimen (76.5 disk length) except that on the outer edges of the disk the darker color which surrounds the lighter spots has broken up, so that the color of this part of the fish could be described as a light background with broken reticulations and small spots of dark color.

General Range: West Indies.

Distribution in Port-au-Prince Bay: Found on the bottom, rather widely distributed, especially over muddy and sandy bottoms.

Abundance: Rather common. Seen two or three times a week at the market.

Method of Capture: Taken in wire traps baited with chicken remains and set on the bottom at fifty feet. Also captured by hooks and lines by native fishermen and by small seines along shore.

Food: The 190 mm. ray contained the remains of four shrimps, *Peneus brasiliensis*. The smaller fish contained comminuted bottom detritus.

Size at Maturity: The 190 mm. male was in breeding condition on March 22, 1927.

Study Material: Photographs, 3731, 4126; Specimens, 4; 76.5 to 190 mm. disk length, including Nos. 6853 and 7164.

Family Myliobatidae; Eagle Rays

Aëtobatus Blainville, 1816

Eagle Ray
Aëtobatus narinari (Euphrasen)

References: *Raja narinari*, Euphrasen, 1790, Handl. K. Sven. Vet. Akad., XI, p. 217, pl. X.
Aetobatus narinari, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 89.

Field Characters: Flattened rays with pointed wings; head elevated, compact; tail long and lash-like with two serrated spines at the base; upper surface with numerous, round, whitish spots.

Size and Weight: Grows to 12 feet long, 7.5 feet wide, and an estimated weight of 450 pounds.

Color: A 30-inch specimen is clear green blue grey above, the numerous spots being pearly white, each surrounded by a broad, dark ring; those near the posterior edge of the wings and on the pelvic fins have a large dark center. The spots average 15 mm. in diameter and about the same distance apart; those on the snout merge into bands converging toward center of snout; under surface ivory white, immaculate; pupil vertical, iris silvery.

General Range: Tropical parts of the Atlantic and the eastern Pacific.

Distribution in Port-au-Prince Bay: Seen near surface, over fairly deep fishing reefs.

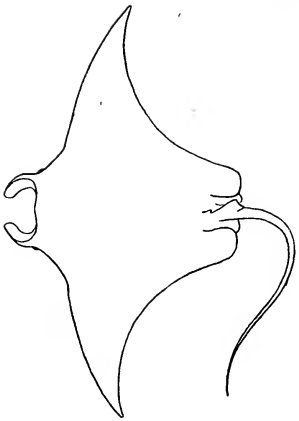
Abundance: Fairly common, according to native fishermen.

Method of Capture: Taken in seines.

Study Material: Photographs, 3919, 4154, 4155, 4156, 4157; Specimens, 3, 300–750 mm., including No. 6953.

Family Mobulidae; Giant Devilfish

Manta Bancroft, 1829



Giant Devil Fish; Great Manta
Manta birostris (Walbaum)

References: *Raja birostris*, Walbaum, 1792, Artedi Piscium, p. 535.
Manta birostris, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 94.

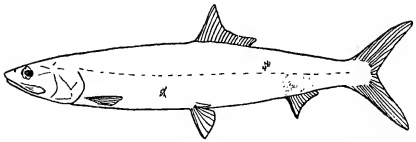
Field Characters: A flattened ray growing to great size; with pointed and curved wings; two large fleshy cephalic fins; a short whip-like tail; black above.

General Range: Tropical waters on both coasts of America, straggling to New York.

Note: No specimen taken, but a medium-sized one observed on January 6, 1927, half way between Port-au-Prince and Gonave Island. On January 12th, one about 6 feet across seen partly cut up at the fish-market.

Family Elopidae; The Ten Pounders

Elops Linnaeus, 1766



Big-eyed Herring
Elops saurus Linnaeus

References: *Elops saurus*, Linnaeus, 1766, Syst. Nat., Ed. XII, p. 518 (Carolina).
Elops saurus, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 175.

Field Characters: A slender, elongate fish with a large normal mouth, a single, soft-rayed dorsal fin in middle of back; very large adipose eyelid; scales small and absent on the head. Uniform bluish above, silvery on sides and below.

Size and Weight: A specimen 10½ inches long weighed 92 grams.

General Range: Atlantic coast from Massachusetts to Brazil.

Abundance: Apparently rather rare, not seen at the market during our stay. A small female seined April 18, 1927.

Food: Our single specimen contained one shrimp, *Peneus brasiliensis*, and the heads of two small fish of its own species.

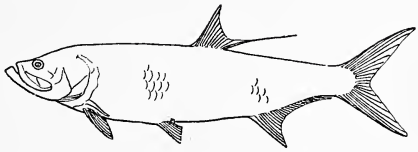
Study Material: Photographs, Specimens, 1; 258 mm., No. 7172.

Family Megalopidae; Tarpons

Tarpon Jordan and Evermann, 1896

Tarpon

Tarpon atlanticus (Cuvier and Valenciennes)



References: *Megalops atlanticus*, Cuvier and Valenciennes, 1846, Hist. Nat. Poiss., XIX, p. 398.

Tarpon atlanticus, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 174.

Field Characters: Large, silvery, compressed fish with a large mouth and undershot lower jaw; a single soft-rayed dorsal fin in middle of back, the last ray of which is long and filamentous; scales very large and heavy.

Dimensions: The measurements of five arbitrarily chosen individuals are given below:

	a	*b*	*c*	*d*	*e*
Length	78 mm.	122 mm.	128 mm.	188 mm.	1060 mm.
Depth	20 "	30 "	33 "	46.5 "	257 "
Head	22 "	30 "	34 "	48 "	239 "
Eye	6 "	9 "	10 "	11 "	43 "
Snout	5.8 "	8 "	8 "	12 "	
Maxillary	13 "	19.5 "	20 "	30 "	148 "
Length pectoral	15 "	25 "	26 "	36 "	
Length last dorsal ray	8 "	22 "	28 "	42 "	287 "
Dorsal rays, number	14	14	14	14	14
Anal rays, number	22	22	22	22	22
Weight	5 grams			65 gr.	36 lbs.

Taking the largest specimen and calling each of its measurements 100% we find that the percentages of size of the smaller individuals *a* and *d* are as follows:

	a	*d*	*e*
Length	7.4%	17.7%	100%
Depth	7.8 "	18 "	100 "
Head	9.2 "	20 "	100 "
Eye	14 "	25.5 "	100 "
Maxillary	8.7 "	20 "	100 "
Length, last dorsal ray.	2.7 "	14.6 "	100 "

It is of interest to observe in this table that the eye is of greater size pro-

portionately and changes least in comparative size,—a character which might be expected in the development of the fish; and that the last dorsal ray is relatively small in smaller fish.

Size and Weight: Three individuals taken during the expedition gave the following weights:

Length	78	mm.	or	3	inches,	weight	5	grams
"	188	"	"	8	"	"	65	"
"	1060	"	"	40	"	"	36	pounds

The world's record for size, at this date, is 8 feet 2 inches long with an estimated weight of 350 pounds.

Color: The thirty-six pound fish had a black dorsal fin with a broad golden edge.

General Range: Atlantic coast, from Massachusetts to Brazil.

Distribution in Port-au-Prince Bay: Adults were rather rare and found mostly near coral reefs and along shore. The young were found in abundance in February in a land-locked lagoon at Source Matelas, approximately 15 miles northwest of Port-au-Prince.

Samples of water from the lagoon where these fishes were captured were submitted to Mr. N. McKaig, Jr., Assistant Chemist of the Service Technique of Haiti. A portion of his preliminary report is given here, "I have started analysis of the water of the Tarpon Lagoon and have found it to be rather interesting. It has a density of 1.0374 and contains 54,000 parts per million total solids, which, as you see, is much denser than ordinary sea water. The hydrogen sulphide content is low, about 5 parts per million in the sample which I received."

Method of Capture: In large seines. Not known to take a hook in Haitian waters according to local fishermen. Two members of our party trolled industriously with various types of tarpon gear and failed to raise a fish. Whether this was the result of its being the wrong time of the year is not known, but as far as we could gather this seems to be the experience of the Haitian sportsmen, also.

The young were taken in small bait seines dragged through the shallow waters of their lagoon.

Eggs: The 40-inch fish contained an estimated 891,000 eggs.

Young: An account of the capture of young individuals of this species has been published by William Beebe in the Bulletin of the New York Zoological Society, September–October, 1927, Vol. XXX, No. 5, page 141, under the title of "A Tarpon Nursery in Haiti." Part of this article is republished in the following paragraphs:—

"About fifteen miles west of Port-au-Prince, Haiti, along the shore of the gulf itself, I located two, interconnected, land-locked lagoons known as Source Matelas.

"The more western of the lagoons was a rounded body of water about one hundred yards across, on a marshy promontory backed by low, rolling hills. These were covered with the usual semi-arid vegetation, consisting of cactus, cereus and acacias. From the waters of the gulf the lagoon is separated only by a narrow dyke built up apparently by the action of the storm waves at high water.

"In mid-January I walked into the mud at the edge of one of the lagoons and out

to the center. There I found half a foot of mud and about eighteen inches of water. This was green and muddy but not slimy. It was impregnated with sulphur and the odor of this element rose strongly from the disturbed mud. A few miles away was a constantly flowing sulphur spring, used to bathe in by the natives, and this lagoon has apparently some connection with the same source of supply. This unprepossessing liquid was filled with innumerable small insects which, upon examination, proved to be water-boatmen (*Corixidae*), both adults, with handsomely variegated, yellow elytra, and young which looked at first glance amazingly like copepods. These have been identified as *Trichocorixa reticulata* (Guerin).

"I saw no signs of fish and was about to return to shore when something nipped my ankle. This happened again, and I called for the seine. We had hardly commenced to draw it when small fish began leaping high to escape it. Closing the net I secured a considerable number, and when we examined our catch on the shore I found thirty-six tarpon, *Tarpon atlanticus* (Cuvier and Valenciennes), ranging from two to eight inches. When I recovered from my first astonishment at seeing these clean-scaled, virile fish living in this sulphurous, stagnant pool, I examined the smallest for any hint of the leptocephalus stage through which it is assumed they must pass early in life. Neither this, nor a later, much more thorough examination showed in these young fish any hint of such phase—even the smallest was as normal and perfectly formed as any six-foot giant of the Florida waters. This may mean only that the leptocephalid characters disappear when the fish are still smaller.

"My next visit to Source Matelas was on January twenty-third, when I made a haul with the seine in the same place and secured a heavy load of tarpon. When we counted our catch on shore, we found one hundred and fifty-four of the young fish, from three to seven inches in length. One individual measured thirteen inches. It was a pure culture of tarpon, except for three small snook, *Centropomus undecimalis* (Bloch). Several times as many tarpon as we took escaped by leaping over the top of the seine as we were pulling it, some of them rising three feet clear of the surface. We threw back all but the few which we wished to keep as specimens.

"My third visit was two months later, after heavy storms had set in, on the twenty-first of March.

"I found the lagoon dyke broken through, and the tide pouring into a three-foot sluiceway. A thorough seining of the first lagoon netted six tarpon, measuring from four and a half to seven inches, together with a two-inch snook. Ultimate hauls failed to secure another fish of any kind. A seine haul in the second lagoon yielded four small mojarras, *Eucinostomus californiensis* (Gill), recent emigrants from the open water outside. The water-boatmen were as abundant, and the sulphur smell quite as strong as ever, in spite of the infiltration of the water from the gulf.

"The most interesting development of this last haul of young tarpon was that when we examined five of the fish in aquariums on the schooner, we found that there was something the matter with their eyes—a grey, translucent film clouding the tissue of the lens or the humor behind it, the aspect being wholly unlike the appearance of the eyes of the fish taken two months before. They seemed to be quite blind. Whether this affliction was connected with their remaining in the lagoon after the hundreds or thousands of their fellows had escaped to the open gulf can be only surmised. It could hardly have interfered with their feeding, as the water-boatmen were present in uncounted millions, and a single scoop with a quart jar would secure large numbers.

"The only other mention of an actual nursery of tarpon is in Evermann and Marsh's "Fishes of Porto Rico," page 80, where we find the following note: "Common about Porto Rico where it evidently breeds, as numerous immature individuals were taken at Hucares and Fajardo. The four examples from Hucares are from 7.5 to 11.5 inches long and were seined in a small brackish pool of dark-colored water, not over five feet deep, in the corner of a mangrove swamp, and at that time (February) entirely separated from the ocean by a narrow strip of land scarcely 25 feet wide. The thirteen others are nearly all very young, of 2.25 to 3.25 inches, collected at Fajardo." A few tarpon, from six to eight inches long, have been taken on the north shore of the Gulf of Mexico in Florida, and L. L. Babcock in his

excellent monograph of the tarpon, records a three-inch specimen taken in a cast net on the coast of Texas. He also gives the world's record tarpon as eight feet, three inches, with an estimated weight of three hundred and fifty pounds. This was taken in a net by Florida fishermen.

"My discovery of young tarpon in a land-locked lagoon in Haiti suggests that the Porto Rican record is not a casual accident, but a usual phenomenon in the life of these fish. On account of the shallowness and the muddiness of the Haitian lagoon, it would be impossible for an adult tarpon of any size to enter it and deposit her eggs. We can only surmise that the eggs are scattered out in the waters of the gulf, sink to the bottom and hatch, and that the young, either as leptocephalids or as very small larval fish, make their way into the lagoon before the season when it becomes cut off from the gulf. Here they live and thrive, with an abundance of food, sheltered from voracious fish and other dangers of the open sea, having to guard only against the keen eyes and sharp beaks of the larger herons, and such unthinkable catastrophes as visiting scientists.

"One of my Haitian fishermen took two good-sized tarpon in his seine not far off shore from Source Matelas. These were thirty-six pounders, more than forty-one inches in length. When diving on Lamentin Reef, several miles across the gulf, I saw a large tarpon again and again. For a number of days in succession this great silver fish would swim toward me on my first submersion, and pass slowly within eight or ten feet, looking me over. When I learned that this would probably happen every time I went down, I devoted all my attention to estimating his exact length. Once he swam past two very tall tube sponges, and I could see distinctly that he overlapped the distance between them in actual body length, not including his tail. I measured this distance and found it six feet, three inches. So even ignoring the slight overlap, he was a full six feet in length of body. He showed no fear, only a gentle curiosity, rolling his great eye about as he passed. His scales reflected the light, even at a depth of twenty-five feet, as a dazzling sheet of bluish silver.

"I could learn of no tarpon being caught on a hook in Haiti, although anglers have made many attempts. The native fishermen were familiar with them, and, as I have said, occasionally found them in their seines.

"The food of the young tarpon consisted entirely of the aquatic hemiptera which filled the waters of the lagoon, a five-inch fish having the remains of sixty-eight of these insects in its stomach. The relative increase in various body measurements from a three-inch, through an eight-inch, to a forty-inch individual, is remarkably uniform, the average of the characters of length, depth, head and eye being 9.6%, and 19.8%, as compared with an arbitrary 100% of the largest fish. The elongated, thread-like, posterior ray of the dorsal fin is developed relatively late in life, the percentages of this character in the same three individuals being 2.7%, 14.6% and 100%. In weight, the relations between the three sizes of fish are tremendously disproportionate. The actual weights are as follows: the three-inch fish, five grams; the eight-inch fish, sixty-five grams; and the forty-inch fish, thirty-six pounds. This makes the percentages:

"Five-inch = .00031% or $\frac{1}{3246}$ of the large fish.

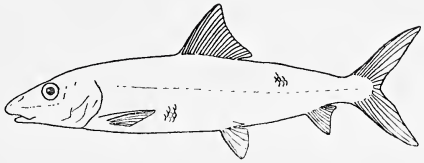
"Eight-inch = .4% or $\frac{1}{250}$ of the large fish."

Study Material: Photographs, 4009, 4018, 4024, 4026, 4010, 4009, 4025; Specimens, 11; 78–1060 mm., all but the largest from Source Matelas; the largest from Port-au-Prince Bay.

Family Albulidae; The Bone Fishes

Albula Gronow, 1763

Bone-fish; Lady Fish
Albula vulpes (Linnaeus)



References: *Esox vulpes*, Linnaeus, 1758, Syst. Nat., Ed. x, p. 313 (Bahamas, based on *Vulpes bahamensis* of Catesby).
Albula vulpes, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 178; Weber, 1913, Fishes Indo Australian Archipelago, II, p. 7.

Field Characters: Adult: Cylindrical fishes with small mouth placed well back of the projecting pig-like snout; a single soft rayed dorsal fin in the middle of the back; scales rather small. Brilliant silver. Leptocephalid larvae: Teeth 30; transparent except for pigment line along ventral surface; dorsal fin 17, anal fin 8.

Size and Weight: Grows to 31 inches and a weight of 14 pounds. Our 17-inch fish weighed a little over 3 pounds.

Color: Brilliant silver, the scales, especially above, with greenish tinge. Top of head greenish. Series of dark lines following the line of the scales, especially prominent above the lateral line. Tips of the dorsal rays, tips of the caudal rays, anterior portion of the anal, and the ventral rays spotted with dusky. A dusky spot at the base of the pectorals superiorly.

General Range: Cosmopolitan in tropical seas.

Distribution in Port-au-Prince Bay: Adults taken occasionally by native fishermen. The leptocephalid larvae were common at night at the surface during our stay. They were attracted to our lights. Adult fishes about a foot in length also seen at night about light, one on April 22nd and two on the 28th.

Abundance: Uncommon. Seen occasionally at the fish market, but not especially useful for food.

Method of Capture: Adults taken in seines; larvae taken in scoop nets at surface.

Food: Bivalve mollusks and small squids formed the food of a 12-inch fish.

Young: *Leptocephalus larva;* From February 26th to April 30th, in the course of thirty-four evenings of study of the positively phototropic surface organisms at the gang-way of the schooner, the larvae of *Albula vulpes* were absent on only two occasions, while on seventeen nights they were very abundant. They swam by slight, lateral undulations and gathered in numbers, swimming around the submerged light.

No radical change or growth was observed during these two months, although one hundred and forty were preserved, and several thousand examined. The extremes of length were 45 and 60 mm.

Description of a Typical Larva taken at 2000 candle power light 9:00 P. M., February 26. *No. 6965*

Length	55 mm.	Length of Pectoral	1.4 mm.
Depth	5.7 "	Length of Ventral	.75 "
Head	4.1 "	Length base dorsal	2.3 "
Snout	1.1 "	Length base anal	1 "
Eye	1 "		

Measurement Percentages of Larvae and Adult stages

	Adult	*Larva No. 6965*
Length	100%	30%
Depth	100%	14%
Snout	100%	5%
Head	100%	.8%
Eye	100%	.9%

There are sixty-four myomeres, the dorsal fin beginning at the fiftieth.

The only pigmentation besides the eye-ball is a very narrow, black line, between the lower edge of the myomeres and the alimentary canal. Anteriorly this is broken into two, short, stitch-like lines to each myomere, but posteriorly the line becomes more connected. There are a few rounded, black pigment cells at the base of the caudal rays, and a scattering of the black stitches along the longest, outer, caudal rays.

The eye-ball is bluish black, with a cap of black pigment, draped in strands like moss or hair over the top of each eye-ball.

The nostrils are very large, double, .4 of a millimeter from the tip of the snout, and occupying .45 of the total length of the snout. The anterior one is round, the posterior one constricted in its lower half.

There are two long, straight, downwardly directed incisors, close together at the symphysis of the upper jaw; then a space, followed by fourteen short teeth, decreasing in length backward, directed almost straight downward. At the point of the lower jaw are two long, needle-like incisors, originating outside and beneath the edge of the jaw, and growing obliquely forward and upward, followed by ten teeth, much longer and more slender than those in the upper jaw, and slanted acutely forward. The upper jaw shows almost no overhang.

The dorsal fin, with the seventeen rays of the adult fish, is well differentiated. The middle rays are the longest, curving rapidly down anteriorly, much less so posteriorly. In front of the dorsal is a short, homogeneous membrane-fin, and behind, another which rises gradually into a low arc and again dies out just in front of the base of the caudal. This fin is granular on the proximal, hyaline on the distal portion.

The anal fin shows the ultimate eight rays. It is close to the caudal, in fact is suspended and extends obliquely out from the body along the outer edge of the hyaline membrane-fin joining the lower caudal rays to the body. The anal fin is immediately preceded by the anus, and anterior to this is a very long, low, hyaline membrane-fin.

The caudal contains twenty-two rays, symmetrically arranged, although the

heterocercal character of this fin is clearly marked. This fin adds 3.4 mm. to the length, making the total 58.4 mm.

The pectorals are well developed, 1.4 mm. in length, and paddle-shaped. The ventrals are much smaller, .75 long, arising at the thirtieth myomere. There is no indication of the axillary scales of the adult.

The vertebrae are clearly distinguishable for the posterior sixteen myomeres, averaging three to a myomere. From the forty-eighth myomere to the base of the urostyle are fifty-two vertebrae, the last six being abruptly narrow, unlike the rest.

Variations: In an individual of 47 mm. the dorsal begins at the fifty-second myomere, but the average is the fiftieth myomere. The extremes of myomeres are 62 and 68.

Extremes of development: In the largest larva taken (No. 7152), with a length of 60 mm., the ventrals are large and distinct, and the anal fin has broken wholly away from the membrane base of the caudal, and lies flat along the body. Although the largest, this is also the most developed, which agrees neither with the figures of Gilbert,[1] nor the description of Meek and Hildebrand.[2]

Study Material: Photographs, 3936; Specimens—adults, 3; 182–390 mm., including Nos. 7009, 7130; leptocephalid stages, 140; 45–60 mm., No. 6965.

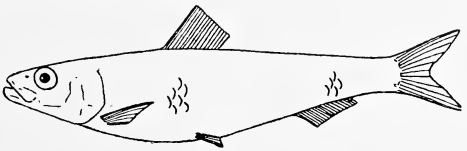
Family Clupeidae; The Herrings

Key to Port-au-Prince Bay Genera

A. Anal fin with less than thirty rays.
B. Last ray of the dorsal fin not prolonged into a long filament.
C. Gill rakers very numerous (105 in our single specimen)..... *Clupanodon*
CC. Gill rakers moderate in number, about 25 to 35..... *Sardinella*
BB. Last ray of the dorsal fin prolonged into a long filament... *Opisthonema*
AA. Anal fin with more than thirty rays; jaws with canines.. *Chirocentrodon*

Clupanodon Lacepede, 1803

False Spanish Sardine
Clupanodon pseudohispanicus (Poey)



References: *Sardinia pseudo-hispanica*, Poey, 1861, Memorias, II, p. 311.
Clupanodon pseudohispanicus, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 180.

Field Characters: Small, compressed silvery fishes with weak scutes along belly, small mouth, weak jaws, and with numerous gill-rakers, in our specimen 105.

[1] In Weber and Beaufort's, 1913, "The Fishes of the Indo-Australian Archipelago," II, p. 7
[2] Meek and Hildebrand, 1923, "The Marine Fishes of Panama," I, p. 179.

Dimensions:

Length	122.5 mm.	Dorsal fin	17
Depth	33 (3.7)	Anal fin	18
Head	30 (4.1)	Scales	50
Eye	7.5 (4)	Scutes	15–13
Snout	8.8 (3.7)	Gill-rakers	105
Maxillary	12 (2.5)		

Discussion: There is considerable likelihood that this represents a new species, but the present lack of knowledge as to exact structural details and comparative osteology of related forms compels us to call it *pseudohispanicus*.

To take the gill-raker count alone we find the following recorded variations:

A—Cuba to Cape Cod[1]	30 to 40 gill-rakers
B—Woods Hole, Mass.	45 "
C—Mass., Cuba, Jamaica	65 "
D—Havana	88 "
E—Dominica	90 "
F—Haiti	105 "

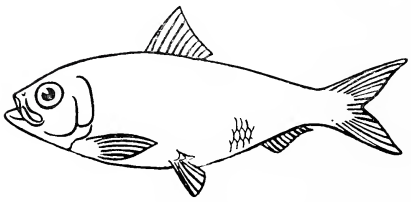
Until re-examination confirms or otherwise explains this extraordinary variation from 30 to 105 gill-rakers, it is useless to try to settle the question of specific identity.

Study Material: Specimens, 1; 122.5 mm., No. 7432.

Sardinella Cuvier and Valenciennes, 1847

Key to Port-au-Prince Bay Species

A. About 25 gill rakers on lower limb of the first gill arch..... *sardina.*
AA. About 32 gill rakers on the lower limb of the first gill arch.. *macrophthalmus.*



Sardine
Sardinella sardina (Poey)

References: *Harengula sardina*, Poey, 1861, Memorias, II, p. 310.
Sardinella sardina, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, page 183.

Field Characters: Small, compressed fishes with adipose eyelid; single, soft-rayed dorsal fin; serrations along belly; small mouth and with about 25 gill rakers. Scales deciduous, those on the sides with vertical striae.

[1] A—Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 424.
B—Kendall and Smith, 1894, Bull. U. S. Fish Com., p. 17.
C—Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 181.
D—One specimen, No. 3377, American Museum.
E—Three specimens, No. 1528, American Museum.
F—One specimen, No. 7432, Haitian Expedition, Zoological Society.

Size and Weight: Grows to eight inches.

Color: Blue above, sides silvery. Alcoholic specimens are amber brown above, larger individuals being silvery on the ventral 3–4 of the body and head. In small fish the silver is confined to the iris and the gill covers.

General Range: Florida and the West Indies to Brazil.

Distribution in Port-au-Prince Bay: In schools along the sandy beaches and at the surface, coming to light at night. Also seen at the surface in daytime, a mile from shore.

Abundance: Common, much more numerous than *Sardinella macrophthalmus*. Seen in the market quite often.

Method of Capture: Small seines along shore and with scoop nets at night.

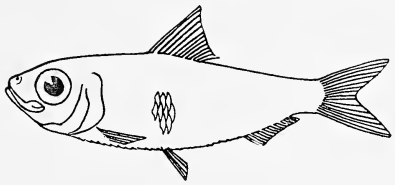
Food: The young fish near shore fed upon red-eyed copepods. A 4½-inch fish taken in a seine off shore had eaten four medium-sized shrimps.

Young: Young almost without pigment, 17 to 25 mm. were taken close in shore and at the surface a mile from land. In the former case they were in the same schools with larger individuals up to 49 mm.

Study Material: Specimens, 82; 17–116 mm., including Nos. 6847, 70 (, 7027, 7043, 7185 and 7192. Port-au-Prince Bay.

Sardine

Sardinella macrophthalmus (Ranzani)



References: *Clupea macrophthalma*, Ranzani, 1842, Nov. Comment. Ac. Sci. Inst. Bonon., V, p. 320.

Sardinella macrophthalmus, Meek and Hildebrand, 1923. Marine Fishes of Panama, I, p. 184.

Field Characters: Small compressed fishes with adipose eyelid; single, soft-rayed dorsal fin; serrations along belly, small mouth and with about 32 gill rakers. Scales fairly firm, not as deciduous as in *sardina*. Scales on sides without evident vertical striae.

Size and Weight: Grows to 6 inches. A 76 mm. individual weighed 7 grams.

General Range: Florida, south to Brazil.

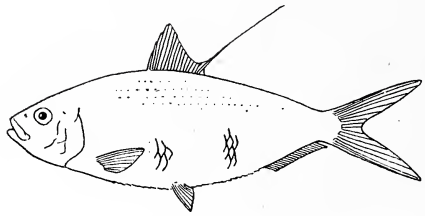
Distribution in Port-au-Prince Bay: Seen and taken mainly at light after dark. Some of the night seine fishermen bring these fish to the market.

Abundance: In schools of hundreds, they often covered the 2000 candlepower submerged light submerged at the gang-way of the schooner, night after night. They were not especially common at the market, however.

Method of Capture: Seines and hand-nets.

Study Material: Specimens, 10; 48–98 mm., including Nos. 7001, 7082, 7150, 7152, 7192, Port-au-Prince Bay.

Opisthonema Gill, 1861



Atlantic Thread Herring
Opisthonema oglinum (Le Seur).

References: *Clupea thrissa*, Broussonet, 1782, Ichthyologia, fasc. 1.
Megalops oglina, Le Seur, 1817, Journ. Ac. Nat. Sci. Phila., I, p. 359.
Opisthonema oglinum, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 187.

Field Characters: Small, compressed, keeled, silvery scale fishes, with toothless mouth, small pectorals and ventrals; last ray of the dorsal fin prolonged into a long filament.

Description: The pectoral fins in many of our specimens do not reach the ventrals and average 1.47 in the head. The stomach is very long and U-shaped.

Color: Silvery bluish-green, darker above, the rows of scales with somewhat indistinct dark streaks. Peritoneum black.

Size and Weight: The weights of three individuals were as follows:

Length	*Weight*
84.5 mm.	9.6 grams
127 "	30.5 "
214 "	201 "

The 214 mm. specimen was the largest seen by us.

General Range: Massachusetts to Brazil.

Distribution in Port-au-Prince Bay: Found widely distributed through the Bay, and at the surface at night.

Abundance: A common species, often seen in the market, but a poor food fish.

Method of Capture: Seines and hand nets.

Food: Small fish, crabs, and shrimps. The smaller fish feed on zoea and other plankton larvae.

Spawning Season: Two adult fish showed signs in March and April of an approaching breeding season.

Study Material: Photographs, 3776; Specimens, 56; 63–214 mm. including 6840, 7131, Port-au-Prince Bay.

Chirocentrodon Gunther, 1868

Spiny-toothed Herringlet
Chirocentrodon taeniatus Gunther

References: *Chirocentrodon taeniatus*, Gunther, 1868, Cat. Fishes Brit. Mus., VII, p. 463.
Chirocentrodon taeniatus, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 435.

Field Characters: Small, elongate, compressed, anchovy-like fishes with single dorsal fin and with strong, canine teeth in both upper and lower jaws.

Dimensions: The measurements of 5 of our specimens are given below:

	a	*b*	*c*	*d*	*e*
Length	74 mm.	74.5 mm.	71 mm.	74 mm.	73 mm.
Depth	16.5 "	17 "	16 "	17 "	16 "
Head	16.5 "	17 "	16 "	18 "	19 "
Eye	5 "	5 "	5 "	6 "	6 "
Snout	5 "	5.5 "	5 "	6 "	5 "
Pectoral fin rays	—	—	11	11	13
Dorsal rays	15	14	15	14	14
Anal rays	40	40	40	40	40
Gill-rakers	13	—	—	—	15

Proportionate Measurements

	a	*b*	*c*	*d*	*e*
Depth into length	4.47	4.3	4.43	4.3	4.6
Head into length	4.47	4.3	4.43	4.1	3.8
Eye into head	3.3	3.4	3.2	3	3.15
Snout into head	3.3	3.4	3.2	3	3.8

Size and Weight: A 74 mm. fish weighed 4.5 grams.

General Range: Jamaica, Haiti.

Distribution in Port-au-Prince Bay: Taken by us only at the surface at night.

Abundance: Rare, seen occasionally in the fish markets.

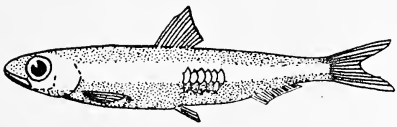
Method of Capture: Taken at light at night, and a few purchased at the markets.

Study Material: Specimens, 6, 63–74 mm., including No. 7102, Port-au-Prince Bay, April 1, 1927.

Family Dussumieridae; Round Herrings

Jenkinsia Jordan and Evermann, 1896

Silver-lined Herringlet
Jenkinsia lamprotaenia Gosse



References: *Clupea lamprotaenia*, Gosse, 1851, Naturalist's Sojourn in Jamaica, p. 291, Plate 1, fig. 2.

Jenkinsia lamprotaenia, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 419.

Jenkinsia stolifera, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 419.

Field Characters: Small, elongate herrings with rounded bellies and with a terminal mouth. Anchovy-like in color and consorting with *Anchoviella epsetus*. Pale green with broad band of silver down the side.

Description: Examination of part of our series of specimens, the majority of which were obtained from one school, reveals a certain amount of variation from the original description,—variation which tends to couple this species with *stolifera*.

The dorsal fin count in our specimens ranges from 11 to 13 and the anal from 14 to 17, both counts within the range of either species. The position of the dorsal fin however, is constantly in front of the middle from the snout to the base of the caudal fin,—a character given for *stolifera*. However, the placing of the fin may not always be a valid character. In Jordan and Evermann's "Fishes of North and Middle America" and in the copied description given by Evermann and Marsh in the "Fishes of Porto Rico," *lamprotaenia* is characterized as having the dorsal fin inserted midway between the snout and the base of the caudal. Metzelaar[1] mentions for this same species that the "Front of the dorsal nearer to base of caudal than to tip of snout,"—a character quite the opposite of that given for either *lamprotaenia* or *stolifera*. However, in the figure given by him, the opposite is true, and the drawing illustrates a fish with the origin of the dorsal conspicuously nearer the snout than the base of the caudal! This figure resembles our specimens very closely, although a few of the Haitian fish have slightly shorter snouts. Considering the variation of the fin counts of our specimens, Metzelaar might very well have called his fish *stolifera*.

The Haitian specimens range in depth from 5.9 to 6.1, approximating closer to *lamprotaenia* in this matter. The size of the eye is also closer to *lamprotaenia*, averaging 2.8 to 3.2 instead of the 2.5 of *stolifera*.

The snout in our specimens might be either species, and the same holds true for the position of the maxillary.

In regard to color, either description would fit our fish. Jordan and Gilbert and Jordan and Evermann (original description of *stolifera* and "Fishes of N. and M. America") mention that *stolifera* has a double row of dots along the back before the dorsal fin and a single row along the back posterior to this. Metzelaar (l. c.) mentions "a triple dot line before, a double one behind the dorsal fin." The latter statement applies more fully to our fish, but the first statement could easily apply to some, as the central line of the three frequently disappears and the 2 rear-most lines approach each other sufficiently close at times to be considered as one.

Jordan and Gilbert in the original description of *stolifera*[2] say that "We

[1] Over Tropisch Atlantische Visschen, 1919, p. 9.

[2] Proc. U. S. Nat. Mus., 1884, p. 25.

should identify our specimens with *Clupea lamprotaenia* Gosse, from Jamaica, were it not for the difference in fin rays."

Taking into consideration the variation and the intermediate position of some of the characters in our fish, we consider *stolifera* to be a synonym of *lamprotaenia*.

Size and Weight: Specimens from 15 to 55 mm. taken.

Color: Pale greenish, translucent, with a wide lateral band of silver. Two or three lines of black pigment dots down back to dorsal, one or two lines posterior to dorsal.

General Range: Key West to Yucatan, Porto Rico, St. Eustatius and Curacao.

Distribution in Port-au-Prince Bay: Found in enormous schools about the outer reefs, especially at Sand Cay.

Abundance: Very abundant, often forming part of the "whitebait" found at the market.

Method of Capture: Seined by native fishermen. Dynamited on reefs.

Enemies: Pelicans take great toll of these as well as of some of the anchovies. Carnivorous fish also feed upon great numbers.

Size at Maturity: Breeding adults were examined, 25 to 50 mm.

Study Material: Specimens, over 1200, including Nos. 7099, 7169, 7262, 7263, 7264, Port-au-Prince Market and Sand Cay, Port-au-Prince Bay.

Family Engraulidae; The Anchovies

Key to Genera of Port-au-Prince Bay

A. Gill membranes not united across the isthmus. Gill rakers relatively few, 12 to 30 ..... *Anchoviella*

AA. Gill membranes broadly united across the isthmus (these membranes very easily torn). Gill rakers numerous 52 to 57. Anal fin moderate, of 20 to 25 rays ..... *Cetengraulis*

Anchoviella Fowler, 1911

Key to Port-au-Prince Bay Species

A. Pectoral fins short, the tips not reaching to the base of the ventral fins.

B. Sides with a distinct silvery band.

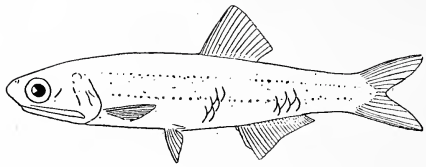
C. Body moderately elongate, depth 4 to 4.75 in the length; eye large, 3.5 in head; gill rakers about ⅔ the eye, about 20 on the lower limb of the first gill arch; dorsal fin 15, anal fin 20 ..... *epsetus*

CC. Body more elongate, the depth about 5.25 to 5.75; eye 4.4 in head; gill rakers as long as eye, about 24 on the lower limb of the first arch; dorsal fin 13, anal 23–24 ..... *choerostoma*

BB. Sides without a distinct silvery band; depth 6 to 7; dorsal rays 12 to 14, anal rays 18–20 ..... *lyolepis*

AA. Pectoral fins very long, the tips of the fins reaching half way between the base of the ventrals and the origin of the anal fin

longipinna new species



Bonnaterre's Anchovy
Anchoviella epsetus (Bonnaterre)

References: *Esox epsetus*, Bonnaterre, 1788, Ichthy., p. 175.
Anchovia browni, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 204, Plate xiv, fig. 1.

Field Characters: Small, elongate, compressed fishes with single, soft-rayed dorsal fin, short pectoral fins and projecting, pig-like snout. Gill membranes not united across the isthmus. Gill rakers about 20. Eye large, 3.5 in head. A silvery lateral band.

Description: The Haitian specimens show a small amount of variation from the published descriptions, but the smallness of our specimens, ranging from 38 to 70 mm. standard length, may account for this. Taking into consideration the various descriptions that have been published, mainly those of Jordan and Evermann,[1] Jordan and Seale,[2] Meek and Hildebrand[3] and Metzelaar[4] the following table can be constructed showing (1) the extreme of variation for the species and (2) the range of variation of the Haitian specimens. From this it can be seen that the variation is fairly small but that a few of the specifications need extending.

	(1)	*2 (Haitian material)*
Head into length	3.4 to 3.75	3.3 to 3.6
Depth into length	4.2 " 4.9	4.87 " 5.04
Eye into head	3.5 " 4.25	3.4 " 3.85
Snout into head	4.6 " 5	5
Dorsal fin rays	12 " 15	15 " 16
Anal fin rays	19 " 23	21 " 23
Gill rakers	16 " 22	18

The Haitian specimens have the pectoral fin almost reaching the ventral as mentioned in Meek and Hildebrand's description, but not as shown in their plate.

Color: The silvery lateral stripe is faint in some of our fish and almost absent in others.

Size and Weight: Grows to 6 inches. A 39 mm. fish weighed 1 gram; a 54 mm. fish weighed 2 grams and a 70 mm. fish weighed 4.5 grams.

General Range: Cape Cod to Uruguay.

Distribution in Port-au-Prince Bay: The small fish are found along shore over shallow beaches and at the surface off shore at night.

Abundance: Common, especially at the market, where it is often seen in great numbers, salted and used as whitebait.

[1] Fishes of North and Middle America, 1896.
[2] Review of the Engraulidae, 1926.
[3] Marine Fishes of Panama, 1923.
[4] Over Tropisch Atlantische Visschen, 1919.

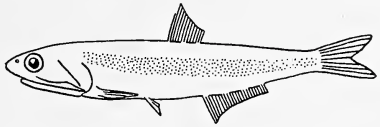
Method of Capture: Seines and scoop nets about submerged lights at night.

Food: Copepods and other entomostracans, shrimps, small worms and miscellaneous debris.

Enemies: Preyed upon by most of the carnivorous fishes. A 2-inch specimen was taken from the stomach of a snapper, *Lutianus griseus*.

Study Material: Colored plate, H41, No. 6845; Specimens, 15, 38–70 mm., including 6845, 6901, 6920, 6997, 7027, Port-au-Prince Bay.

Hog-mouth Fry
Anchoviella choerostoma (Goode)



References: *Engraulis choerostomus*, Goode, 1874, Amer. Journ. Sci., ser. 3, VIII, p. 125.
Stolephorus choerostomus, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 444.

Field Characters: Small, elongate, compressed fish with single, soft-rayed dorsal fin, short pectoral fins and projecting, pig-like snout. Gill membranes not united across the isthmus. Gill rakers about 24. Eye moderate, 4.4 in the head. A silvery lateral band.

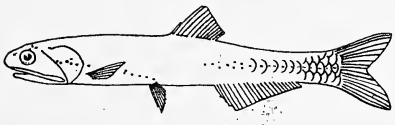
General Range: Bermudas and southward.

Distribution in Port-au-Prince Bay: Taken in shallow water along shore near Bizoton and also in shallow water at Source Matelas.

Abundance: Fairly common, seen in the markets under the same conditions as *epsetus*.

Study Material: Photographs, 4004; Specimens, 34; 34 to 50 mm. including 7266, 7060, Port-au-Prince Bay.

Spot-cheeked Ghost-Fish
Anchoviella lyolepis (Evermann and Marsh)



Reference: *Stolephorus lyolepis*, Evermann and Marsh, 1902, Fishes of Porto Rico, p. 89.

Field Characters: Small, elongate, compressed fishes with single, soft-rayed dorsal fin, short pectoral fins and slightly projecting snouts. Gill membranes not united across the isthmus. No silvery lateral band, but with small black pigment spots, especially conspicuous on top of head, across opercles and at base of tail.

Description: The Haitian specimens have the dorsal fin 13–16 instead of 12–14.

Size: The maximum length is 1¾ inches.

Colors: In life these fish are almost dead-white, rather translucent, and with pigment spots as described by Evermann and Marsh.

General Range: Porto Rico and Haiti.

Distribution in Port-au-Prince Bay: A few taken on some of the shoals, but the great majority found at surface at night, where they came to our lights.

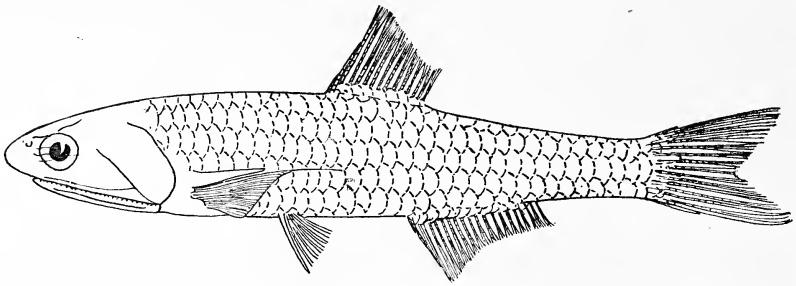
Abundance: One of the commonest of fishes to come to our submerged lamps, and present during all of our stay.

Method of Capture: Seines and hand nets about lights.

Study Material: Photographs, 3937; Specimens, 230; varying in length from 17 to 45 mm., including 7105, 7073, 7097a, 7087, 7046, 7243, 7054, 7152, 7033, 7153b, 7030, 7153c, 7284, 7003, 7073a, 7081, 7097a, 7063, 7087, 7026, 7050a, 7286 and 7005, Port-au-Prince Bay.

Long-pectoralled Anchovy

Anchoviella longipinna new species



Type: No. 7460. Length 65 mm., Bizoton, Haiti, at night, April 1, 1927.

Field Characters: Small, elongate, compressed fishes with single, rayed dorsal fin and projecting pig-like snout. Pectoral fins long, the tips filamentous, reaching half-way between the base of the ventral fins and the origin of the anal fin.

Measurements and Counts of the Type:

Length	65 mm.		Scales about	35, caducous	
Head	18 "	(3.6)	Dorsal fin	14	
Depth	12 "	(5.4)	Anal fin	21	
Eye	4 "	(4.5)	Gill rakers	20	
Snout	4 "	(4.5)			
Pectoral length 19					

Description: Vertebrae: 40 in one specimen.

Body: Elongate, compressed, the greatest depth between the opercle and the dorsal fin; ventral portion of the body but slightly compressed. Depth into length varying from 4.8 to 5.3.

Anterior profile: Very slightly decurved immediately in front of the dorsal fin, thence straight to over the upper angle of the gill opening, then gently decurved to the snout.

Head: Conical, 3.4 to 3.8 in length.

Interorbital: Convex, about equal to diameter of eye.

Eye: Small, 4.2 to 4.7 in head.

Snout: Projecting, conical, but broadly rounded at tip; length approximately equal to diameter of eye, 4.3 to 4.7 in head.

Mouth: Large, slightly oblique, anterior end beginning just before the eye.

Maxillary: Long, not quite extending to the gill openings, its posterior end pointed.

Teeth: Very small, present on jaws, vomer, palatines and pterygoids. No canines.

Preopercular margin: Very oblique, making with the maxillary a V-shaped area, the length of which from eye to tip is less than half the head length.

Opercular margin: Smooth.

Gill rakers: 20 to 21, about ⅔ the eye in length.

Scales: Caducous, about 35.

Dorsal fin: 13 to 15 rays, placed midway or slightly forward of midway between the snout and the base of the caudal fin. The fin arises in one dissected specimen over the 16th vertebrae. Third ray longest, the rays becoming progressively shorter. Last ray longer than preceding one.

Anal fin: 20 to 21 rays, its origin under last ray of the dorsal.

Caudal fin: Forked.

Pectoral fins: Placed low, falcate, the upper ray very long, extending in unbroken specimens, to halfway between the base of the ventral fins and the origin of the anal. The tips in many of our specimens are broken, but clearly show that they extended much further than they now do.

Ventral fins: Short, close together, placed midway between gill opening and origin of anal fin.

Color: (In formalin) Hyaline, the caudal fin dusky. A silvery stripe down sides from upper angle of gill-opening to caudal fin, its margins somewhat indistinct, its width about that of the eye.

Comparison: This fish is very close to *filifera*, described in 1915 from Trinidad by Fowler. It differs in the following particulars: depth slightly less, averaging 4.8 to 5.4; anal fin rays 21 inclusive instead of 24 to 25; snout considerably blunter; scales considerably deeper, possessing only 3 vertical rows plus a half row at the bottom and a half row at the top across the caudal peduncle.

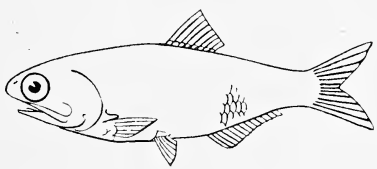
Study Material: Specimens, 11; the type, No. 7460; and 10 paratypes, 52–64 mm., No. 7461,—8 from light, Bizoton, Haiti, and 2 from Port-au-Prince Market, April 1, 1927.

Type Name and Location: *longipinna* in reference to the long pectoral fins.

Type in the collection of the Department of Tropical Research of the New York Zoological Society.

Cetengraulis Gunther, 1868

Whalebone Anchovy
Cetengraulis edentulus (Cuvier)



References: *Engraulis edentulus*, Cuvier, 1829, Regne Animal, ed. 2, II, p. 323.

Cetengraulis edentulus, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 214.

Field Characters: Small compressed fishes with single, soft-rayed dorsal fin, short pectoral fins and projecting pig-like snout. Gill membranes united across the isthmus,—this membrane very easily broken and not visible until the opercles are gently pried open.

Size and Weight: Our largest specimen measured 103 mm. The species grows half again as large. A 98 mm. fish weighed 18 grams.

Color: Caudal fin yellow with dusky edges. Iris golden. Dorsal greenish yellow.

General Range: Atlantic Coast of tropical America.

Distribution in Port-au-Prince Bay: Fairly common in the open Bay.

Abundance: Common, often seen in the markets.

Method of Capture: Mostly by seining by the native fishermen.

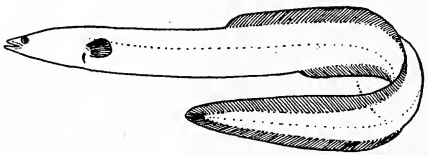
Food: Copepods and other planktonic animals. Considerable amount of sand found in the stomachs of 2 fish taken from the stomach of *Scomberomorus maculatus*.

Enemies: Two 100 mm. individuals found in the stomach of a Mackerel (*Scomberomorus maculatus*).

Study Material: Photographs, 3900; Specimens, 22; 85–103 mm., including 6868, 7292, Port-au-Prince Bay.

Family Anguillidae; True Eels

Anguilla Shaw, 1803



Common Eel

Anguilla rostrata (LeSueur)

References: *Muraena rostrata*, Le Sueur, 1817, Journ. Acad. Nat. Sci. Phila., I, p. 81, (New York).

Anguilla chrysypa, Evermann and Marsh, 1902, Fishes of Porto Rico, p. 68, plate I.

Field Characters: Elongate eels with rather large mouth, the lower jaw projecting; pectoral fins well developed; skin covered with rudimentary embedded scales, placed at right angles to each other (often difficult to see without magnifying glass); dorsal fin continuous with the anal around the tail.

Size and Weight: Grows to 4 or 5 feet. Our 186 mm. fish weighed 8 grams.

General Range: Atlantic Slope of North America from southern Canada to Panama, West Indies.

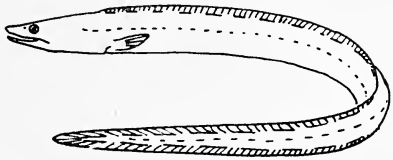
Distribution in Port-au-Prince Bay: Found by us only at Source Mariani, a small fresh-water pond a little over a mile from the sea, connected with the ocean by a small rocky stream.

ABUNDANCE: Rare, only one seen. Not observed at the markets.
STUDY MATERIAL: Specimens, 1; 186 mm., No. 7178.

Family MURAENESOCIDAE; PIKE-EELS

Muraenesox McClelland, 1844

Pike-Headed Eel
Muraenesox savanna (Cuvier)



REFERENCES: *Muraena savanna*, Cuvier, 1829, Regne Animal, Ed. 2, II, p. 350.
Muraenesox savanna, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 143.
FIELD CHARACTERS: Medium sized eels without scales and with well developed pectoral fins; dorsal and anal fins confluent around the tail; lower jaw shorter than upper; tongue narrow, mostly attached to the floor of the mouth; vomerine teeth large, in three series, the central ones enlarged.
SIZE AND WEIGHT: A 28-inch eel weighed 1.25 pounds.
COLOR: Silvery gray above, silvery white below; dorsal fin dull fleshy bordered with black; anal fin bordered with black.
GENERAL RANGE: West Indies to Brazil
ABUNDANCE: Uncommon, but seen occasionally at the market.
METHOD OF CAPTURE: Seines and spears.
FOOD: The alimentary canal contained the remains of three engraulids.
EGGS: The ovary in the 720 mm. specimen is 173 mm. long, and extends 30 mm. back of the vent. The very numerous eggs are round and average .3 mm. in diameter.
STUDY MATERIAL: Specimens, 2; 720–733 mm., including No. 6969.

Family ECHELIDAE; WORM-EELS

Ahlia Jordan and Davis, 1892

Worm-eel
Ahlia egmontis (Jordan)

REFERENCES: *Myrophis egmontis*, Jordan, 1884, Proc. Acad. Nat. Sciences, Phil. XXXVI, p. 44.
Ahlia egmontis, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 370.
FIELD CHARACTERS: Small, very elongate, worm-like eels with dorsal fin

beginning behind anal fin; posterior nostril placed at edge of mouth; the anterior nostril in a large tube.

Description: Twenty-one fish, 50 to 145 mm. long are grouped under this species. They agree with the figure given by Bean (Proc. U. S. Nat. Mus., XXVI, p. 963), but in general they are considerably slimmer. The anterior nostril is very large, almost doubled by an infolded pointed septum, the nostrils of each side of the head connected by a thin velum. The nostrils lie one on each side of the lower jaw.

Size and Weight: Grows to fifteen inches.

Color: Brownish green, the head finely speckled with black dots, becoming larger and rounder on posterior sides of head, and smaller and more dot-like on body.

General Range: Florida, Glover Reef, Swan Island, Haiti and Barbados.

Occurrence in Port-au-Prince Bay: Many specimens taken and seen at light at surface at night. Not otherwise seen.

Abundance: Fairly common.

Method of Capture: Scoop net about submerged lamps.

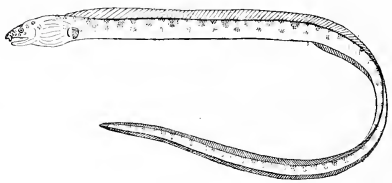
Study Material: Photographs, 3939, 3943; Specimens, 21; 50–145 mm., including Nos. 6998, 7088, 7097d, 7125, 7185, 7192, 7242, 7243.

Family Ophichthyidae; Snake Eels

Myrichthys Girard, 1859

Key to Port-au-Prince Bay Species

A. Dark spots on body on a paler background.....*oculatus*
AA. Pale spots on body on a dark background .....*acuminatus*



Black-spotted Snake Eel
Myrichthys oculatus (Kaup)

References: *Pisoodonophis oculatus*, Kaup, 1856, Cat. Apod. Fish Brit. Mus. p. 22. (Curacao).
Myrichthys oculatus, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 376.

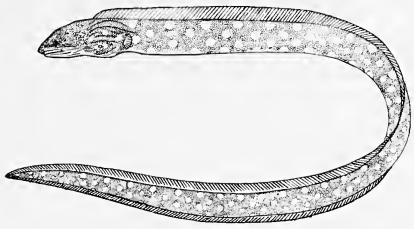
Field Characters: Medium sized elongate, more or less cylindrical eels with sharp-pointed finless tail; teeth blunt; dorsal fin beginning on the head before the gill opening; a series of 35 or more dark spots on paler background; white below.

Size and Weight: Our 28-inch fish weighed 160 grams.

General Range: Cuba to Brazil, also Cape Verde and Canary Islands.

Distribution in Port-au-Prince Bay: Our single specimen was taken at the surface, coming to light over a depth of 40 feet of water.

Abundance: Apparently rather rare, not seen at the markets.
Method of Capture: Hand nets at side of schooner.
Study Material: Specimens, 1; 730 mm., No. 6978.



Yellow-spotted Snake Eel
Myrichthys acuminatus (Gronow)

References: *Muraena acuminata,* Gronow, 1854, Fishes Brit. Mus. p. 21.
Myrichthys acuminatus, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 376.

Field Characters: Medium sized, elongate cylindrical eels with sharp-pointed finless tail; teeth blunt; dorsal fin beginning on head before gill opening; two series of round, whitish blotches on each side of body; head with small whitish blotches.

Description: Our specimen in life had a series of conspicuous horizontal creases, especially common along the middle of the sides of the trunk, and a series of vertical creases on the sides extending up to the base of the dorsal fin but not extending below the middle of the sides. The combination of these two series of creases formed a series of small square or rectangular areas. These creases may be an aid to easy movement, and the presence of the horizontal creases may be helpful when especially large prey has been swallowed.

Color: The white spots mentioned in Jordan and Evermann "on the sides," are present also all over the crown.

General Range: West Indies north to the Florida Keys.

Distribution in Port-au-Prince Bay: Found by us on shallow reefs along shore.

Abundance: Rare.

Method of Capture: Taken by means of spears.

Study Material: Specimens, 1; 740 mm., No. 6905.

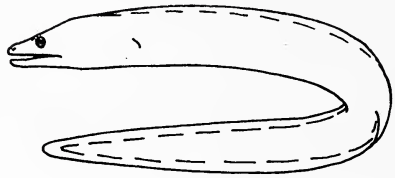
Family Muraenidae; Moray Eels

Gymnothorax Bloch, 1795

Key to Port-au-Prince Bay Species

A. Color more or less uniform, not conspicuously mottled or reticulated with white or light yellow.
B. Body plain dark brown, lower parts somewhat paler; teeth on anterior part of jaws more or less distinctly in two series ..... *funebris*
BB. Body brownish, mottled with dark brown or purplish spots; teeth uniserial ..... *vicinus*

AA. Brownish to purplish brown, conspicuously mottled and reticulated with white or light yellow.....*moringa*



Olive-green Moray Eel
Gymnothorax funebris Ranzani

REFERENCES: *Gymnothorax funebris*, Ranzani, 1840, Novi Comment. Ac. Sci. Inst. Bonon., IV, p. 76.
Gymnothorax funebris, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 163.

FIELD CHARACTERS: Medium to large eels without pectoral fins and with very small gill openings; plain olive green or olive brown.

SIZE AND WEIGHT: Our largest specimen, 41 inches long, weighed 3.5 pounds.

GENERAL RANGE: Florida to Brazil. Also recorded from the Cape Verde Islands.

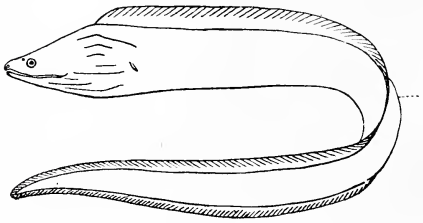
DISTRIBUTION IN PORT-AU-PRINCE BAY: Found generally on reefs.

ABUNDANCE: Fairly common; often seen in the markets.

METHOD OF CAPTURE: Usually by spearing. Often taken in traps.

HABITS: These eels have astonishing viability. One taken out of water one evening was able to move and snap the next morning.

STUDY MATERIAL: Specimens, 2; 800–1040 mm. including No. 7048.



Purple-mouthed Moray Eel
Gymnothorax vicinus (Castelnau)

REFERENCES: *Murenophis vicina*, Castelnau, 1855. Anim. Nouv. Rares Amer. Sud, p. 81, Plate XLII, fig. 4.
Gymnothorax vicinus, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 164.

FIELD CHARACTERS: Medium sized eels without pectoral fins and with very small gill openings; brownish mottled with darker brown or purplish spots; anal fin with a pale edge.

GENERAL RANGE: Cuba to Brazil.

DISTRIBUTION IN PORT-AU-PRINCE BAY: Found by us only over the shallower reefs.

ABUNDANCE: Uncommon; seen rarely in the markets.

METHODS OF CAPTURE: Grains and tra

Food: One specimen contained a 6-inch *Rhomboplites aurorubens*, a 5-inch *Cetengraulis edentulus* and two 3-inch Yellow-tails, *Ocyurus chrysurus*.

Study Material: Specimens, 3; 573–600 mm., including No. 6903.

Common Spotted Moray Eel; Hamlet

Gymnothorax moringa (Cuvier)

References: *Muraena moringa*, Cuvier 1829, Regne Animal, Ed. 2, II, p. 352.

Gymnothorax moringa, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 166.

Field Characters: Medium sized eels without pectoral fins and with very small gill openings; brown or purplish brown with spots and reticulations of white or pale yellow.

Size and Weight: A 24-inch eel weighed half a pound.

Color: Field notes were made on color twice, in both cases the lighter color being considered as the ground color, which is the opposite of the usual color descriptions.

A 610 mm. eel was described as follows: Pale yellowish white, mottled and marbled everywhere with raw umber; head with a pinkish white sheen; dorsal fin viridine green; anal fin edged with white; iris silvery white near pupil, mottled toward outer rim with dark brown.

A second eel, somewhat larger, was described thus: General ground color between ivory yellow and colonial buff, becoming whitish on the head and brightest on the dorsal fin. Spots of cameo brown covering the entire body, these being divided into two distinct sizes, the larger being irregular in shape, the smaller more regular.

The variation in color and pattern is enormous.

General Range: Florida to Brazil; Also recorded from St. Helena.

Distribution in Port-au-Prince Bay: Widely distributed over the coral reefs.

Abundance: Common, the commonest eel seen on the reefs, usually seen hiding between clumps of coral. Often seen in the markets.

Method of Capture: Spearing and traps.

Food: Small fish; one eel had swallowed a small trigger fish (*Monacanthus oppositus*).

Study Material: Color Plate, H9, No. 6889; Photographs, 3783, 3784, 3833, 3834, 3860; Specimens, 11; 400–720 mm., including Nos. 6889, 6924.

Leptocephalid Larvae

During the expedition collections were constantly made at night, by the use of dip nets about submerged lights. As a result of this fishing, and in addition to the various juvenile fishes which resembled their adult forms, a

number of young fishes were captured which are wholly unlike their parents. All of these fish in life were transparent, or at least translucent.

The vast majority of these larvae were Lizard-fish (*Synodus foetens*), Snake-fish (*Trachinocephalus myops*), and Lady-fish (*Albula vulpes*), especially the first and third; the remaining ones being typical eel Leptocephalids. The first three mentioned species have been treated under their respective headings, but for ease of identification they have been included in the following key. The eel Leptocephalids have been placed under the Leptocephalus form that they most closely resemble, with notes as to how they differ.

Key to Leptocephalid-larval stages

A. Larval stages with small vertical fins, the dorsal with 11 to 17 rays, the anal with 8 to 11.
B. Dorsal rays 17, anal rays 8. No conspicuous, black, circular spots along sides..... *Albula vulpes*
BB. Dorsal rays 11 to 14, anal rays 11 to 16. Lower sides with six conspicuous black circular spots on lower sides, these spots on the gut.
C. Head long, flattened, lizard-like, coming to a rather sharp point. Eye small, shorter than snout..... *Synodus foetens*
CC. Head shorter, compressed; eye large, longer than snout. *Trachinocephalus myops*
AA. Larval stages with elongate dorsal and anal fins, the dorsal at least half the length.
D. Pectoral fins absent; 142 myomeres; origin of dorsal fin far in advance of anal..... *Leptocephalus latus*
DD. Pectoral fins present.
E. Myomeres 140; dorsal beginning very slightly in advance of anal; tail rather sharp, the dorsal and anal not continued around it, each of these fins expanded just before caudal; a series of conspicuous wide spaced black dots along alimentary canal... *Leptocephalus mucronatus*
EE. Myomeres 120 to 126.
F. Myomeres 125–126.
G. Myomeres 125; dorsal fin beginning slightly in advance of anal; anterior nostril in a tube, posterior nostril very small; eye large, 4.7 in head *Leptocephalus michael-sarsi*
GG. Myomeres 126; dorsal fin beginning far in advance of anal, near the head; anterior nostril in tube, posterior very large, eye small, 6.8 in head..... *Leptocephalus microphthalmus* new species
FF. Myomeres 120; dorsal fin beginning slightly in advance of the anal; nostrils remote, the anterior not in a tube..... *Leptocephalus rex*

Leptocephalus latus **Eigenmann and Kennedy**

REFERENCES: *Leptocephalus latus*, Eigenmann and Kennedy, Bull. U. S. Fish Comm., XXI, 1901, p. 87, figs. 6, 6a, 6b.

DESCRIPTION: A single leptocephalus 83 mm. long, is referred to *latus*. It is intermediate in some ways between *latus* and *gilli*, possessing a head shaped

like *latus,* and with the caudal region shaped more like *gilli;* it also differs in the relations of the myomeres.

No. 7081, 83 mm. Port au Prince Bay at light, March 19, 1927. Body very thin and elevated, widened rather suddenly at the nape, reaching its maximum height before the middle of body, and maintaining the same height for more than ⅓ the length; tail rounded, but not quite as broad as shown for *latus;* depth 6; head small, 20 in length, lower jaw slightly shorter than upper with a series of 10–11 long fang-like teeth in lower jaw; 12 similar forward pointing teeth in upper jaw; eye 2.1 in snout, 6.7 in head; nostrils remote, pectorals not developed; a series of very small pigment spots at base of dorsal and anal rays, and a few dots obliquely on back of head; myomeres 91 + 51, total 142.

The relation of the caudal and abdominal myomeres is considerably different from *latus,* a character which possibly may be assigned to movement of the anus with growth, but in most other characters the fish is fairly close to Eigenmann's description of that species.

Study Material: Specimen, 1; 83 mm., No. 7081, March 19, 1927.

Leptocephalus mucronatus Eigenmann and Kennedy

References: *Leptocephalus mucronatus,* Eigenmann and Kennedy, Bull. U. S. Fish Comm., XXI, p. 90, figs. 11, 11a, and 11b.

Description: Two larvae, 73.5 and 82 mm. long, agree with this form, the longer one especially. Our field notes about this specimen record prominent black marks on each myomere below the lateral line, a character agreeing with Eigenmann and Kennedy's description. In the preserved fish these spots are practically absent, and would never have been noticed except for the field description.

No. 7146, 82 mm. Surface at light, Port-au-Prince Bay, April 4, 1927. Elongate, band-shaped, the body tapering in its anterior fourth, tapering more abruptly posteriorly, depth 11 in length; head rather short, 17.5 in length; eye small, 5.5 in head; snout about 4.7 in head; nostrils closer together than described by Eigenmann and Kennedy; teeth large, strong, triangular; two long slender canines project downward from tip of upper jaw beyond tip of lower; myomeres 61 + 79, total 140; dorsal fin beginning 39 mm. from snout; anal fin 39 mm. from snout; dorsal with 236 rays and anal with 220 rays.

A series of pigment lines down each myacomma a short distance from middle bend; a black dot at base of each dorsal and anal ray; a series of relatively larger spots along alimentary canal, a larger one above and a smaller one below.

This specimen differs somewhat in size of head, snout and eye from *mucronatus,* but agrees fairly well in myomere count, and excellently in form, especially the peculiarly shaped tail, and in pigmentation.

The second specimen, No. 7198, 73.5 mm. surface at light, Port-au-Prince Bay, April 22, 1927, is slightly older and more robust, the depth being 18 in the length. It possesses the same myomere count, peculiar form of posterior dorsal and anal fins, and pigmentation. It differs from the preceeding specimen in having the anterior nostril in a short tube.

Study Material: Specimens, 2; No. 7146, April 4, 1927 and No. 7198, April 22, 1927.

Leptocephalus michael-sarsi Lea

REFERENCES: *Leptocephalus michael-sarsi,* Lea, Muraenoid Larvae, Rep. Sci. Results Michael Sars North Atlantic Deep Sea Expedition, Vol. III, Part 1, p. 28.

DESCRIPTION: Two specimens, 65 and 68 mm. long are placed under this species. Both are considerably further advanced than the single specimen (99 mm.) upon which Lea based his description. They agree in all essential characters, those in which they differ being easily laid to difference in age.

No. 7032, 68 mm., surface, Port-au-Prince Bay at light, March 10, 1927.

Rather robust in form, partly metamorphosed from the flattened ribbon-like form, the depth 14.8 into the length, the body tapering slightly toward the tail. Head conical, fairly robust, 9.7 in total length, the dorsal profile evenly curved; lower jaw shorter than upper, the upper slightly decurved over the lower; anterior nostril in a tube at edge of upper jaw; posterior nostril small, .1 mm. in diameter, anterior to but below the middle of eye; eye fairly large, 4.7 in head length. Myomeres 54 + 71, total 125; dorsal fin beginning a few segments in front of anal.

A lateral line of chromatophores just beneath the central angle of the myomeres, the color cells roughly on alternate muscle segments. Three small black spots (2 in *michael-sarsi* of Lea) on gut anterior to pectoral fins; a row of black dots with large interpsaces along alimentary canal, more marked anteriorly; small black spots at base of dorsal, caudal and anal rays.

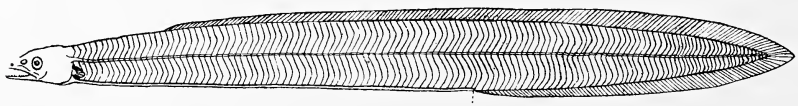
No. 7390, 65 mm. Surface at light. Port-au-Prince Bay, February 15, 1927.

This specimen does not differ in any essential way. Its coloration is not quite as distinct as the others, and the three spots on the anterior part of the gut are absent, a fact which may be laid to preservative, as the specimen is a reddish brown instead of light yellow typical of most preserved leptocephalids.

Lea's specimen of *michael-sarsi* came from 48° 2′ N. and 39° 55′ W., West of Flemish Cap in the North Atlantic, a long distance from Haiti, but the agreement of characters which change but little with age, is such that we have little hesitation in identifying our specimens as this form.

STUDY MATERIAL: Specimens, 2; 65 and 68 mm., Nos. 7032, 7390.

Leptocephalus microphthalmus sp. nov.



TYPE: No. 7080, 74 mm. Surface at light, March 19, 1927.

DESCRIPTION: Body elongate, flattened, moderately deep, depth 11.8; dorsal and anal fins rather wide, especially posteriorly; head rather small, conical, 14.5 in length, the lower jaw projecting beyond upper (specimen damaged, so that lower jaw may possibly be equal to upper); eye small, 6.8 in head, its vertical diameter greater than its horizontal; snout rather short, a little less than 3 in head; anterior nostril in a short tube, near upper lip; posterior nostril very large, almost half the horizontal diameter of the eye in width,

and situated anterior to middle of eye; 13 teeth in side of lower jaw,—anterior 8 large, the remaining 5 very small.

Myomeres 65 + 61, total 126; dorsal fin rays, 250, the fin arising at the 18th myomere from the head; anal fin rays 165; pectoral rays 16.

Gut with anlage of liver at 13th myomere from head; from this point onward back to anus a row of small round chromotophores along ventral surface.

Transparent, with a very short vertical pigmented line on each myocomma below central bend of myomere. Dorsal and anal fin posteriorly with a black spot at the base of each ray, these spots faint and most noticeable at posterior end of anal. Small black spots along gut.

Measurements and Counts:

Total length	74	mm.
Depth	6.3	"
Head	5.1	"
Eye	.75	"
Posterior nostril diameter	.32	"
Snout	1.6	"
Pectoral fin length	2	"
Snout to origin of dorsal	13	"
Snout to anus	44	"

Comparison: This species runs close to *michael-sarsi*, but specimens of practically equal size differ strikingly in size of posterior nostrils and in relative proportions of the eye and somewhat in color.

Study Material: Specimen 7080. Surface at light, March 19, 1927.

Leptocephalus rex Eigenmann and Kennedy

References: *Leptocephalus rex*, Eigenmann and Kennedy, Bull. U. S. Fish Comm., XXI, 1901, p. 86, figs. 3, 3a, 3b.

Description: One specimen is placed under *rex*, agreeing in possessing about 120 myomeres, in the relative proportions and relations of the dorsal and anal fins, form and color, but differing in depth and size of head. Eigenmann and Kennedy in their paper mentioned above were not certain as to whether their *amphioxus* and *rex* were not the same. The Haitian specimen possesses some characters of both.

No. 7003, 87 mm. long. Taken at light, Port-au-Prince Bay, March 6, 1927.

Depth 14.7; head 11; form rather robust, not especially compressed, the head having taken on its adult form, (like illustration of *rex*); snout rounded, lower jaw very slightly shorter than upper; teeth very small; tail long and pointed; dorsal beginning slightly in front of anal; caudal rounded, the continuation of the dorsal and anal fins intermediate in shape between *rex* and *amphioxus*. Small black pigment dots at base of dorsal and anal, most conspicuous near caudal, becoming less marked as they progress forward, those of the anal more marked than those of the caudal. No other pigment spots apparent.

Study Material: Photograph, 3940; Specimen, 1; 87 mm., No. 7003, March 6, 1927.

Family Synodontidae; The Lizard Fishes

Key to Port-au-Prince Bay Genera

A. Head rather long, flattened, triangular; snout depressed, longer than eye. *Synodus*

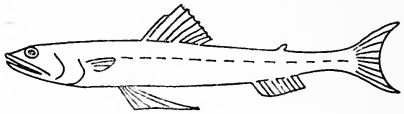
AA. Head compressed; snout short, not depressed, shorter than eye. *Trachinocephalus*

Synodus Scopoli, 1777

Key to Port-au-Prince Bay Species

A. Scales larger, 48 to 52 in the lateral line.....*intermedius*

AA. Scales smaller, 58 to 63 in the lateral line.....*foetens*



Agassiz's Lizard-fish

Synodus intermedius Agassiz

References: *Synodus intermedius*, Agassiz, 1829, in Spix, Pisc. Brazil, p. 81.
Synodus intermedius, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 217.

Field Characters: Elongate fish with single soft-rayed dorsal fin and small adipose fin, and with flattened, scaled lizard-like head; 48 to 52 scales in the lateral line. Greenish with 8 cross bands of darker, sometimes with indistinct bands between them.

Size and Weight: Grows to 15 inches. A 225 mm. fish weighed 129 grams.

General Range: North Carolina to Brazil.

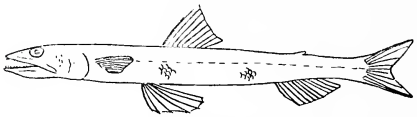
Distribution in Port-au-Prince Bay: Found generally along shore.

Abundance: Fairly common, and often brought to the markets, where it is one of the poorer food fish.

Method of Capture: Mostly with seines.

Food: A carnivorous species. Our food records mention fish, especially engraulids and atherinids, and shrimps.

Study Material: Photograph, 4121; Specimens, 6; 216–262 mm., including No. 6860, Port-au-Prince Bay, 1927.



Lizard-fish; Galliwasp; Lagarto

Synodus foetens (Linnaeus)

References: *Salmo foetens*, Linnaeus, 1776, Syst. Nat. Ed., XII, p. 513.
Synodus foetens, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 220.

Field Characters: Adults: elongate fish with flattened lizard-like head and with single soft dorsal and small adipose fin; scales 58 to 63; greenish, pale below; Young; elongate, cylindrical, translucent, with 6 black spots on the gut showing through to outside, a blackish patch on the sides at base of caudal fin, continued forward on the lateral line, but not continued onto the dorsal surface.

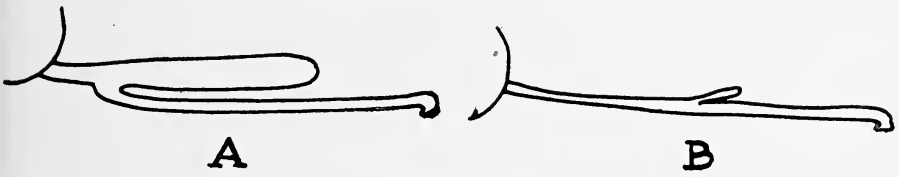
Description: The single adult taken agrees completely with the published descriptions. Two hundred young specimens, 22 to 41 mm., the majority near the larger size, agree very well with Nichol's description and figure of young *Synodus foetens* (Bull. Amer. Mus. Nat. Hist. XXX, 1911, p. 278). Our fish differ in being slightly deeper, about 10½ instead of 11½, as stated by Nichols. However, his figure when measured, has the same depth as our fish, and is identical with our specimens of similar size. The Haitian fishes of 40 mm., and some of slightly shorter length have the scales well defined, but practically invisible until the fishes are partly dried.

The teeth in a 41 mm. fish are as follows:

Lower jaw: Four sharp incisors in front followed by two long, curved canines. Following these four groups of three teeth each, each group somewhat separate from the rest, the first and second in each group somewhat longer than the others.

Upper jaw: Teeth much more irregular. About 24 on each side, in two rows, the larger in the outer row. Posterior third of jaw has only a single row of teeth.

The proportionate size and placing of the stomach diverticulum in a 40 mm. and the 155 mm. fish is shown in the following diagram.



Synodus foetens

Relative size of stomach diverticulum in adult and young.

A. 155 mm. standard length. B. 40 mm. standard length.

The curved line at the left hand side of the diagram represents the opercle; the right hand portion of the diagram represents the anus.

The stomach in the larvae is lined with circular folds, broken only at the bottom. These are deep and close together, each .43 mm. deep and 10–12 to the millimeter. The height of the gut, following along the curve of the side, is 1.35 mm.

Size: Grows to about 12 inches.

Color: Larvae;—Body, translucent white with six pairs of conspicuous, round black spots along the ventral side;—one near the posterior edge of the opercle, one beneath the posterior edge of the pectoral, one half way between insertion and tip of ventral, one at half the length of the ventral beyond the tip of the ventral, one-half way between last mentioned spot and the anus. The position of the second, third and fourth may be shifted considerably forward in relation to the fins. These black pigment spots lie between the gut and the peritoneum, and they are considerably more adhesive to the outer layer of tissue. The spots are upright, broad ellipses with solid edges.

A slightly older fish, 41 mm., is described as follows:

Upper surfaces and upper sides of head with small chromatophores, these color cells extending on the back and sides of the fish, those on the sides in the

form of diamond shaped figures with the axis on the lateral line. Small blotches of chromatophores on the sides between and above the diamond-shaped patches. Chromatophores of the upper side of the body forming vague cross bands. A dark bar on the sides at the base of the lower caudal rays, continued forward slightly along the lateral line. The black spots of the slightly younger larvae still show through the sides.

General Range: North Carolina to Brazil.

Distribution in Port-au-Prince Bay: Seen along shore. The young found at the surface at night.

Abundance: Adults uncommon. Young very common.

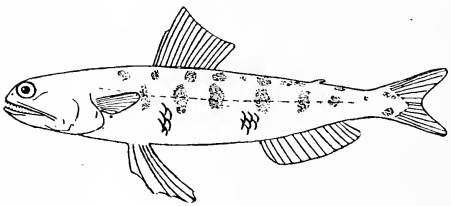
Method of Capture: The small specimens were taken mainly with scoop nets as they came to the submerged lights at the side of the schooner. Adults taken with seine.

Food: The young individuals are exceedingly voracious, devouring their own brothers and cousins and anything else animal approaching their way. A 35 mm. fish ate a 20 mm. fish af the same species, 11.8 of the 20 mm. fish remaining well forward in the alimentary canal and undigested. A 41 mm. fish had swallowed a 31 mm. specimen of his own kind.

Breeding: The young were first taken by us on February 28th, and they were present about the schooner in almost the same numbers and differing only slightly in size up to April 30, 1927.

Study Material: Photograph, 3942; Specimens, 201; 22–155 mm., including Nos. 6967, 6995, 7003, 7004, 7007, 7026, 7029, 7046, 7050, 7054, 7063, 7073, 7074, 7081, 7087, 7097, 7107, 7125, 7126, 7152, 7153, 7243 and 7285. February 28 to April 30, 1927, Port-au-Prince Bay.

Trachinocephalus Gill, 1861



Snake-fish

Trachinocephalus myops (Forster)

References: *Salmo myops*, Forster, MS., Bloch and Schneider, 1801, Syst. Ichth., p. 421.

Trachinocephalus myops, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 222.

Field Characters: Medium sized fishes with dorsal fin composed of rays only and a small adipose fin; head short, blunt, compressed, the snout shorter than the eye.

Description: Three small fish resembling young *Synodus foetens* in general appearance and color, are assigned to this species. When compared with *foetens* they differ most noticeably in the shape of the head, and size and position of the eye.

Size: Grows to 9 inches.

Color: The young specimens were translucent with six black spots on the gut (similar to *Synodus foetens*), and one similar spot at the posterior base of the anal. Blackish spots and pattern on other parts of the body as follows:—top of head with scattered chromatophores; a line of chromatophores along middle of sides; a series at the base of the dorsal; 2 spots at upper base of the pectoral; a large spot at base of the adipose fin; a series of spots at base of posterior anal rays; a large blotch at base of caudal, extending upward and forward slightly on the upper surfaces.

General Range: Widely distributed in tropical seas.

Distribution in Port-au-Prince Bay: Young found at surface only at night.

Abundance: Rare.

Method of Capture: Scoop nets at night.

Study Material: Photographs, 3942; Specimens, 3; 36–38 mm., including 6995, 7125 and 7126, Port-au-Prince Bay.

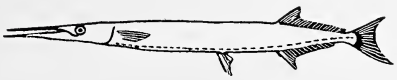
Family Belonidae;* The Needlefishes

Key to Port-au-Prince Bay Genera

A. Body moderately compressed, the depth not greatly exceeding the width. *Strongylura*

AA. Body very strongly compressed, more or less ribbon-shaped; the depth more than twice the width..... *Ablennes*

Strongylura Van Hasselt, 1824



Needlefish; Houndfish; Guardfish

Srongylura raphidoma (Ranzani)

References: *Belone raphidoma*, Ranzani, 1842, Nov. Comm. Ac. Nat. Sci. Inst. Bonon., V, p. 359, pl. 37, fig. 1.

Tylosurus raphidoma, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 226.

Field Characters: Very elongate and slender fishes, with jaws produced into a long, slender beak; a band of minute teeth and a series of large, wide-set teeth; scales small and thin; lateral line low and fold-like; dorsal and anal opposite and long, elevated anteriorly; gill rakers obsolete; greenish above, silvery below; bones green.

Description: The needlefish we took in Haiti are typical of the present species and the only point of interest worth mentioning is a comparative table of characters from young to adult.

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* There is a species of gar living in Etang Saumatre, the inland brackish lake of Haiti. Although we plainly saw two fish about a foot long, we were unable to capture them.

Specimen	*a*	*b*	*c*	*d*
Length	30 mm.	50 mm.	166 mm.	740 mm.
	4%	7%	22%	100%
Depth	1.7 mm.	3 mm.	9 mm.	44 mm.
	4%	7%	20%	100%
Head	6.8 mm.	12 mm.	53 mm.	220 mm.
	3%	5%	24%	100%
Eye	1.5 mm.	2 mm.	6 mm.	22 mm.
	7%	10%	27%	100%
Snout	3 mm.	6.3 mm.	32.5 mm.	120 mm.
	2.5%	5%	27%	100%
Average	4%	7%	24%	100%

We see from this that the length, depth and head increase from juvenile to adult rather regularly. The snout is, at first, by far the least developed, being only two and one half percent of the arbitrarily chosen adult; the eye, as is usual in almost all young vertebrates, is ahead of the rest, showing as seven percent in the smallest youngster. In the 166 mm. individual, the eye has slowed down and the snout caught up, and we find all five characters averaging twenty-four percent of those of the full-grown needlefish.

The variation in the dorsal and anal rays is not great, being from 22 to 23 in the former, and 20 to 23 in the latter fin.

Size and Weight: Known to reach a length of 5 feet. Our largest captured specimen weighed 3¾ pounds and was 33 inches in length. We saw several which were well over four feet long.

Color: Adult: The back is dark green, the sides and belly silvery; on some individuals there are two or three black lines down the back and a silvery band along the sides; the dermal keel on the caudal peduncle is black and the fins dusky.

Young: A typical young of fifty mm. exhibits an inverted pattern very unusual among fishes, being light brown above and brownish black below. After death the pigment of both dorsal and ventral surfaces concentrated into a multiplicity of minute, round, black dots. The pectorals, ventrals, caudal and the anterior portions of the vertical fins are hyaline, but the posterior three-fourths of the anal are slightly spotted, and the dorsal solidly blackened. The lower half of the caudal peduncle is conspicuously black, and the large, lappet-like, jaw flap of skin which is such a consistently juvenile character in this and related families, is jet black.

General Range: From North Carolina to Brazil.

Distribution in Port-au-Prince Bay: The young and occasionally the adults are seen swimming singly at the surface in full sunlight. A few may be seen almost every day in the market. One of medium size was taken at the surface light.

Abundance: Uncommon. Always seen singly.

Method of Capture: The young were scooped up in hand nets. Adults taken with hook and line and in the seines of the native fishermen.

Food: Fish remains were found in several stomachs but too comminuted to be recognized. The beak and teeth of needlefish are too delicate to be used

in the capture of very large fish, and it is probable that they feed chiefly on the vast schools of small fish which swarm at the surface.

Proportion of Sexes: Of eight adult individuals one was a male, and seven were females.

Size at Maturity: In no individual smaller than 24 inches were the gonads well developed.

Spawning Season: In March and April the ovaries were well developed, indicating spawning in the next month or two. In these females the ovary averaged about thirty per cent of the length of the fish, and fifty percent of its depth.

Eggs: The eggs were packed closely together in the elongated ovary. In a fish taken in mid-March they measured from one, to two and one quarter mm. in diameter.

Young: Two young fish, 30 and 50 mm. in length, were taken on the 20th and the 11th of March respectively, and at least half a dozen others seen swimming at the surface. All were a mile or more from shore.

General Habits: The young must in some way be adapted, by the inverted pattern already described, for concealment at the surface. The eyesight is much more acute than that of the other young fish living under similar conditions, and it was exceedingly difficult to take them with hand nets. In flight, they darted off with short irregular spurts, and never sought shelter beneath the stray strands of sargassum weed or floating debris. The juvenile, fleshy flap extends along the entire length of the lower jaw and on each side near the symphysis is abruptly enlarged into a wide lappet. It is less deeply pigmented in the smaller specimen. In both young fish the teeth are well developed, both the small and the larger series. In addition to the short beak, the most distinctive character of these immature fish is the total absence of any forked appearance of the caudal fin. Instead, it is quite regularly rounded.

Even in needlefish which have reached a length of over six inches the dermal jaw flap is still fully developed, shaped as described in the above paragraph. In the fish of this age the inverted coloration has given place to the more usual pattern of the adult.

Study Material: Color Plates, H548, No. 7195a; Photograph, 4127; Specimens, 11; 30–840 mm., including numbers 6865, 6880, 7051, 7158, 7195a, 7260, 7287.

Ablennes Jordan and Fordice, 1886

Ribbon Needlefish
Ablennes hians (Cuvier and Valenciennes)

References: *Belone hians*, Cuvier and Valenciennes, 1846, Hist. Nat. Poiss., XVIII, p. 432.
Ablennes hians, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 231.

Field Characters: Similar to *Strongylurus* but with the body compressed into a band or ribbon shape.

Description: Our specimen is typical except that it has one more dorsal ray than has heretofore been recorded.

Length	654 mm.	Interorbital	18 mm.
Depth	44 "	Postorbital	38 "
Width	20 "	Pectoral length	64 "
Head	185 "	Dorsal rays	26
Eye	19 "	Anal rays	27
Snout	129 "		
Beak	111 "		

$\frac{L}{D}$ 14.9 $\frac{L}{H}$ 3.5 $\frac{H}{E}$ 9.7 $\frac{H}{S}$ 1.43 $\frac{H}{B}$ 1.65

Size and Weight: The species is known to reach a length of 3 feet. Our specimen was 25¾ inches or 654 mm. in length, and weighed 320 grams.

General Range: From Massachusetts to Brazil. Also recorded from the Cape Verde Islands.

Occurrence in Port-au-Prince Bay: One specimen taken in seine by native fishermen.

Study Material: Specimen, 1; 654 mm., No. 7134.

Family Hemirhamphidae; The Half-beaks

Key to Port-au-Prince Bay Genera

A. Body moderately compressed; pectoral fins moderate; shore fishes.
B. Sides of the body vertical; ventral fins inserted much nearer the base of the caudal than the gill opening..... *Hemirhamphus*
BB. Sides of body not quite vertical, more or less convex; ventral fins inserted further forward, usually at a point about midway between base of caudal and gill opening..... *Hyporhamphus*
A. Body slender and compressed, more or less band-like; pectoral fins very long, more than ¼ the length of the body; ventral fins very short, inserted posteriorly; pelagic species..... *Euleptorhamphus*

Hemirhamphus Cuvier, 1817

Orange-tailed Half-beak; Ballyhoo; Baloa

Hemirhamphus brasiliensis (Linnaeus)

References: *Esox brasiliensis*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 314. *Hemirhamphus brasiliensis*, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 234.

Field Characters: Small, elongate fishes with lower jaw prolonged into a long beak; sides vertical; ventral fins inserted nearer base of caudal than gill openings. Upper lobe of caudal fin orange.

Description: Our specimens are typical in almost every respect. The following table illustrates the relative progress of 6 characters from young to adult.

	A		*B*		*C*		*D*	
Length...	35 mm.	16%	38.5 mm.	18%	145 mm.	67%	215 mm.	100%
Depth....	3.8 "	10	5 "	14	25 "	70	36 "	100
Head.....	7.8 "	16	9 "	18	35.2 "	73	48.5 "	100
Eye.....	2.3 "	17	2.6 "	19	9.5 "	70	13.5 "	100
Snout....	1.6 "	10	2.4 "	14	11 "	67	16.5 "	100
Beak.....	10.3 "	17	13.5 "	23	41.5 "	72	58 "	100
Average...	14.3%		17.6%		70%		100%	

The head of the 145 mm. fish is slightly longer than is usually described for this species, averaging 4.1 times into the length instead of 4.35 to 4.63. The specimen agrees, however, in all other characters.

The smaller examples are less deep than in typical measurements given Meek & Hildebrand, the depth into the length being 9.2 in a 35 mm. fish and 7.7 in a 38.5 mm. specimen, and in these the eye is slightly larger,—3.4 and 3.46 in the head, respectively.

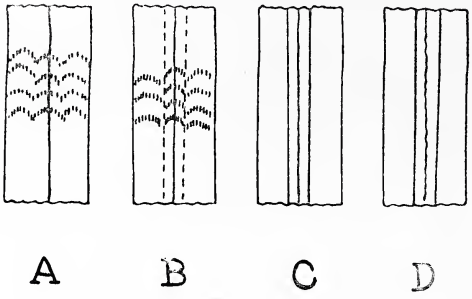
Size and Weight: This species is said to reach a length of 15 inches. Our largest example measured 215 mm. in length.

Color: This species is conspicuous among the Haitian half-beaks because of the orange upper lobe of the caudal fin.

Adults: Dusky greenish-brown above, silvery on the sides and below. A dark streak along the sides from the upper angle of the gill opening to the base of the caudal, wider and more diffuse posteriorly. Median line of the back with three, dark, narrow lines, often difficult to see, the central one often diffuse. Upper lobe of the caudal fin orange, the lower dusky.

Smaller fish from 35 to 47 mm. in length (alcoholic specimens) have the pigment distributed as follows: Top of head, snout and lower jaw densely covered with chromatophores; the opercles with only a few scattered pigment cells. Edges of the scales on the dorsal surfaces as far down as the center of the sides, densely pigmented. A dark band on the sides beginning at the upper angle of the gill-opening, continuing to the caudal fin, becoming wider and denser posteriorly. Belly and under surfaces with a median narrow band of chromatophores extending from the isthmus to the caudal fin, most intense immediately before and between the ventrals, splitting in two at the anus and continuing as a line of spots on either side of the anal fin to the caudal. A small black spot on the body at the base of the ventral fin, anteriorly and superiorly. Three dark patches on the middle of the sides, two between the anal and dorsal fin, and one above the ventrals. There is a trace of another spot before this one, but it is not sufficiently developed in any of our specimens to be certain as to its actual existence. A few scattered chromatophores are found on the lower sides. Membranes of the posterior part of the dorsal and anal fins blackish. Lower lobe of the caudal dusky. Other fins plain.

The changes in the distribution of the pigment on the dorsal surface is somewhat simpler than in *Hyporhamphus unifasciatus*, although this may be because we lack specimens of *Hemirhamphus* as small as those of the other species. Three characters only are present, and their changes may be shown in the following diagram:



Hemirhamphus brasiliensis

Changes in pigmentation of the dorsal surface with growth.
A.—35 mm. specimen. C.—47 mm. specimen.
B.—40 mm. specimen. D.—185 to 215 mm. specimens.
Symbols same as those used under *Hyporhamphus unifasciatus*.

1. Median line.

Present in all individuals, in varying degrees of strength; in some of the larger specimens being wider and more diffuse than in others.

2. Submedian lines.

These appear in our fish of 40 mm. length as a series of dots, which in the 47 mm. specimen have become continuous lines. They are present in all larger specimens.

3. Pigmented scale edges.

These are present and are very conspicuous in our small specimens of 35 to 47 mm. In the older fish the general darkening of the upper surface has completely submerged these patterns.

General Range: Florida south to Bahia, Brazil.

Occurrence in Port-au-Prince Bay: A few at surface light at night.

Abundance: Rather rare compared with *Hyporhamphus unifasciatus*. We took nine individuals.

Method of Capture: Natives take them in seines at night. All of ours were taken as they came to submerged lights.

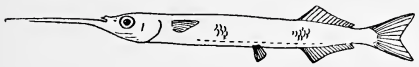
Food: The stomach of a 215 mm. specimen contained the usual quantity of comminuted algae, also considerable woody tissue of land plants, 2 or 3 blades of grass and several insects, a spider and a small hymenopteron. There was also the remains of a half-digested small fish.

A second individual had eaten large quantities of half-decayed bits of *Thalassia* leaves.

In a third fish, 50 mm. long was a mass of similar material, *Thallasia* and bits of tissue of land plants all quite decolorized.

Study Material: Photographs, 3773; Specimens, 9 (6 small, 3 large); including Nos. 6803, 7043 (2), 7050 (2), 7087a (2),—(2). Port-au-Prince Bay.

Hyporhamphus Gill, 1859



Half-beak; Balao; Balaju; Bally-hoo
Hyporhamphus unifasciatus (Ranzani)

References: *Hemirhamphus unifasciatus*, Ranzani, 1842, Novi. Comment. Ac. Sci. Inst. Bonon., V, p. 326.
Hyporhamphus unifasciatus, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 237, Plate XVI, fig. 1.

Field Characters: Small, elongate fishes with lower jaw prolonged into a long beak. Sides convex. Ventral fins inserted midway between base of caudal and gill opening.

Description: The 28 specimens taken all conform typically to the descriptions of *unifasciatus*. The extremes in size in our collection are 15 and 147 mm. and the comparative development of six characters is shown in the following table:

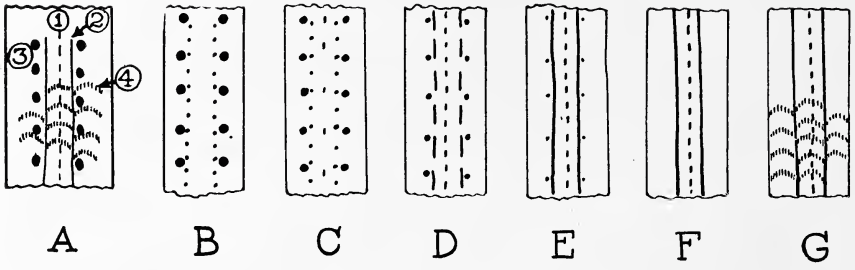
	A		*B*		*C*		*D*	
Length...	15.5 mm.	10%	26 mm.	18%	78 mm.	53%	147 mm.	100%
Depth....	1.3 "	8	2.5 "	10	8.5 "	37	23 "	100
Head.....	3 "	9	5 "	15	16 "	50	33 "	100
Eye.....	.95 "	12	1.7 "	22	4.0 "	53	7.5 "	100
Snout....	.65 "	6	1.3 "	12	5.7 "	52	11 "	100
Beak.....	2 "	8.3	7.8 "	32	20 "	83	24 "	100
Average...	8.6%		18%		55%		100%	

In the smallest fish the snout is least developed, the eye as usual being the most advanced. In specimen C, which is half the length of the adult, the general average of all six characters is 55%, yet the depth still lags, being only 37%, while compensation is found in the beak which has forged ahead to 83%.

Size and Weight: Our largest specimen measured 147 mm. and weighed 27 grams. Grows to a foot.

Color: Pale green above, silvery below and on sides. Upper surface of head and mandible blackish, the tip of the latter red. Sides with a plumbeous stripe, widest posteriorly, bordered above with black,—this line present at all ages down to 15.5 mm. long. Back with dusky punctulations following the edges of the scales. The pattern of the dorsal surface varies with age, and the component parts of the pattern and their appearance and disappearance are given below.

In connection with the dorsal pigmentation four characters may be distinguished, as shown in diagram. These characters are similar to a certain extent to those found on *Hemirhamphus brasiliensis*, but they also differ considerably.



Hyporhamphus unifasciatus

Changes with growth in the pigmentation of the dorsal surface.

A.—Artificial diagram showing all the elements present. 1, median dorsal line, 2, sub-median dorsal lines, 3, lateral dorsal spots, 4, pigmented scale edges.

B.—Dorsal surface of 15.5 mm. specimen.

C.—19 mm. specimen.

D.—32 mm. specimen.

E.—52 mm. specimen.

F.—95 mm. specimen.

G.—147 mm. specimen.

Taken one by one the characters appear or disappear with age as follows:

1. Median dorsal line of chromatophores.

In a 15.5 mm. fish this line is absent. Faint indications appear in a 19 mm. fish, the chromatophores being very small and wide apart. In a 28 mm. specimen the chromatophores have increased in number and are consequently closer together. They continue their existence in much the same way in larger specimens, although in a 147 fish they are masked to a considerable extent by the encroaching pigmented scale edges.

2. The sub-median dorsal lines.

These are present in 15.5 mm. and 19 mm. fish as a series of unconnected pigment dots. In 32 mm. specimens these pigment dots have become elongate dashes, and at 52 mm. standard length the dashes have consolidated and the continuous double dorsal stripes so conspicuous in the adult, are developed.

3. Lateral spots.

These spots are present in specimens up to 95 mm. and it is possible that they may persist in larger fish. In the very young they are enormous, apparently formed of a single chromatophore, and dwarfing the chromatophores of the beginning sub-median dorsal lines. With age they become relatively smaller and in practically all of our 85 and 95 mm. specimens they have disappeared entirely. In the smallest specimens these chromatophores join posteriorly to form the black spot on the upper surface of the caudal peduncle.

4. Pigmented scale edges.

In our series these do not appear until 95 mm. standard length has been attained. They are then especially prominent on the rows of scales just outside the submedian line. In still larger specimens they attain greater prominence and form, next to the submedian dorsal lines, the most conspicuous feature of the dorsal coloration of the adult.

General Range: Rhode Island to Brazil.

Occurrence in Port-au-Prince Bay: Many seen in the markets. Common about our surface lights at night. Medium-sized half-beaks occasionally seen in shallow water near shore, and one small one was taken at the surface in full daylight two miles from shore.

Method of Capture: The native fishermen take these in seines at night. Our specimens were captured with hand nets at the gangway at night.

Food: Stomach of a medium sized fish filled with a fine, white, flocculent substance, amorphous except under high power microscope, where remains of partly broken down cells of algae can be made out. We have never seen this species feeding, but both the structure of its jaws and beak and the character of the food indicate a surface feeder.

Size at Maturity: Female 147 mm. in length (March 5th) had ripe ovaries.

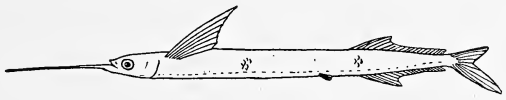
Spawning Season: The ripe condition of the 147 mm. fish taken on March 5th, would indicate that the spawning season was approaching. The two ovaries were 70 mm. long by 7, the largest eggs measuring 1 mm. in diameter.

General Habits: Those which came to our light were wary, and always on guard, and it was not easy to take them with a hand net. None were ever seen to feed; they swam slowly along near the surface, occasionally making a flying leap out of the water at the approach of danger.

Study Material: Specimens, Total number 28, divided as follows,—14, 15 to 70 mm. including 6996 (2), 7006 (2), 7043, 7050 (2), 7087a (3), 7113 (2), 7183 and 7288. 12, medium sized, up to 100 mm., including 7153d, 7243,—(8). 2, large, up to 147 mm.

Euleptorhamphus Gill, 1859

Flying Half-beak
Euleptorhamphus velox Poey



References: *Euleptorhamphus velox*, Poey, 1867, Synopsis, 383.
Euleptorhamphus velox, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 724.

Field Characters: Slender, compressed, band-like fishes with lower jaw extended into a long beak; pectoral fins very long, more than one quarter the length of the body.

Note: En route to Gonave Island on January 6, I positively identified this species of which 30 or 40 kept rising ahead of the mine-sweeper in which I made the trip. In the afternoon of the same day a pair was seen through the water-glass, as I waded shoulder deep in an outer reef off Point á Galets, Gonave, and both broke water and flew some distance at the approach of a motor boat.

I distinguished every character in the case of the latter pair, but never again saw the species in Haiti. (W. B.)

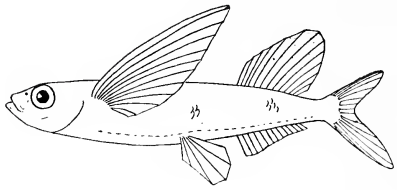
Family Exocoetidae; the Flying-Fishes

Key to Port-au-Prince Bay Genera

A. Pectoral fins moderate, not reaching beyond middle of base of dorsal fin; base of anal about equal to base of dorsal.....*Parexocoetus*

AA. Pectoral fins long, usually reaching beyond base of dorsal fin, sometimes nearly to base of caudal; ventral fins long, reaching past middle of base of anal; anal fin short, its base shorter than dorsal fin base.....*Cypselurus*

Parexocoetus Bleeker, 1866



Short-winged Flyingfish
Parexocoetus mesogaster (Bloch)

References: *Exocoetus mesogaster*, Bloch, 1795, Ichthyologia, p. 399.
Parexocoetus mesogaster, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 728.

Field Characters: Transparent-winged flying-fish; body coppery blue above, silvery below; pectorals reaching half way to end of dorsal, anal equal in length to dorsal; snout short and blunt.

Size and Weight: Reaches 7 inches in length. Our specimen measured 104 mm. and weighed 14.5 grams.

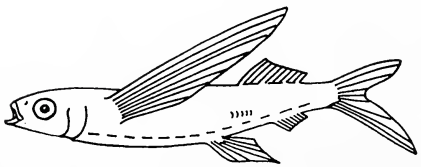
Color: Blue above with iridescent lights changing constantly to copper, green and orange; silvery white below, shading to steely purple.

General Range: Cosmopolitan in tropical seas.

Occurrence in Port-au-Prince Bay: Seen now and then flying about the Bay. A single specimen taken at the surface light at night on April 20th.

Study Material: Colored Plate, H101, No. 7186; Specimens, 1; 104 mm. No. 7186, Port-au-Prince Bay.

Cypselurus Swainson, 1839



Dark-winged Flyingfish
Cypselurus bahiensis (Ranzani)

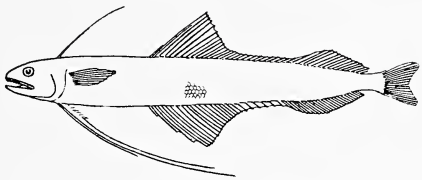
References: *Exocoetus bahiensis*, Ranzani, 1842, Novi. Comment. Ac. Sci. Insti. Bonon. V, p. 362, Pl. XXXVIII.
Exocoetus bahiensis, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 739.

Field Characters: Flying-fish with dusky and brown spotted pectoral fins.
General Range: Tropical seas.
Note: No specimen of this flying-fish was taken, but numerous individuals and schools with dusky and brown spotted pectorals were seen flying above the water of the Bay, all of which undoubtedly belonged to this genus, and very probably to the species *bahiensis*.

Family Bregmacerotidae

Bregmaceros Thompson, 1840

Unicorn Fish
Bregmaceros atlanticus Goode and Bean



References: *Bregmaceros atlanticus*, Goode and Bean, 1886, Bull. Mus. Comp. Zool., XII, No. 5, p. 165.
Bregmaceros atlanticus, Jordan and Evermann, 1898, Fishes of No. and Mid. America, III, p. 2527.

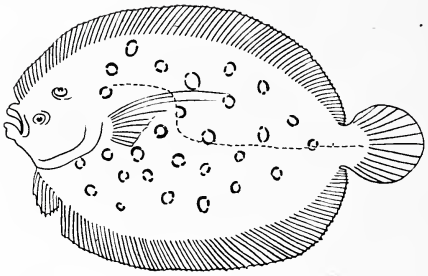
Field Characters: Very small flesh-colored fish, pigmented above and sometimes on fins; long dorsal and anal fins with undulatory outlines, of forty or more rays each; single elongated spine on head; pelvics with three, very long, flat, separate rays.
Size and Weight: The longest specimen recorded measures 46 mm.
General Range: Atlantic Ocean near the West Indies.
Occurrence in Port-au-Prince Bay: Six specimens taken at night, at the surface, at light.
Enemies: One taken from the stomach of *Caranx latus*.
Study Material: Colored Plate, H56; Photograph, 3938; Specimens, 6; 25 to 40 mm., including Nos. 7000, 7030, 7055, 7064, and 7289.

Family Bothidae; Flounders

Key to Port-au-Prince Bay Genera

A. Lateral line with a distinct arch in front; interorbital space broad; scales small, 75 to 100 or more..... *Platophrys*
AA. Lateral line without a prominent arch in front.
B. Teeth in upper jaw biserial, in lower uniserial; gill-rakers short... *Syacium*
BB. Teeth in both jaws uniserial; maxillary more than ⅓ length of head; gill rakers slender, of moderate length..... *Citharichthys*

Platophrys Swainson, 1810



Peacock Flounder
Platophrys lunatus (Linnaeus)

References: *Pleuronectes lunatus*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 269.
Platophrys lunatus, Jordan and Evermann, 1898, Fishes of North and Middle America, III, p. 2665.

Field Characters: Medium-sized flounders with eyes and color on left side; both pectoral fins present, that of the left side usually filamentous in the male; vomer toothless; lateral line with a strong arch in front; interorbital space very broad; snout projecting, prominent; dark olive, with many rings, curved spots and small round dots of sky blue on body.

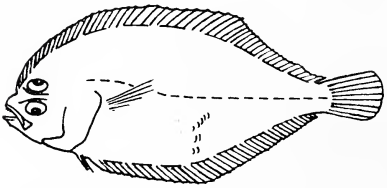
Size and Weight: Reaches a length of 18 inches. Our 250 mm. specimen weighed 288 grams.

General Range: Florida and West Indies.

Occurrence in Port-au-Prince Bay: Two specimens obtained from market.

Study Material: Color Plate, H113, No. 7239; Specimens, 2; 171 and 250 mm., Nos. 7726, 7239.

Syacium Ranzani, 1842



Transparent Turbot
Syacium micrurum Ranzani

References: *Syacium micrurum*, Ranzani, 1842, Novi Comment. Ak. Sci. Inst. Bonon., V, p. 20.
Syacium micrurum, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 981.

Field Characters: Small, elliptical flounders with ventral fin of eyed side inserted on abdominal ridge; lateral line nearly straight; maxillary equal to or greater than ⅓ length of head; teeth in upper jaw biserial; 60 to 68 scales in lateral line; brownish.

Size and Weight: Reaches a length of 175 mm.

Color: Adult, brownish with irregular dark blotches and a few ocelli, ringed with grey and black, fins with numerous dark spots. Young, quite transparent.

General Range: Key West, to West Indies and Rio Janeiro, Brazil.

Occurrence in Port-au-Prince Bay: Three inch specimen seined by native, smaller one taken at night at surface light.

Young: On the night of March 31st took a small turbot of 23 mm. at the gang-way submerged light. When first seen, and later when examined under the microscope in the laboratory tent, it was absolutely transparent, even bone being perfectly clear and distinct. Only the phosphorescent-like reflective gleam from the two eyes was visible, together with the backing of the eye balls, and six red pigment cells on the gills and anterior dorsal rays. In preservative, the fins have remained clear, but the body is pale opaque yellow. In this specimen the head is relatively small, going into the length five times, instead of the adult average of 3.8. (W. B.)

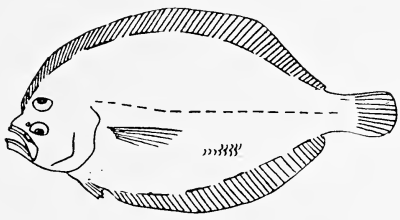
Study Material: Specimens, 2; 23 and 68.5 mm. Nos. 6990 and 7127. Port-au-Prince Bay.

Citharichthys Bleeker, 1862

Key to Port-au-Prince Bay Species

A. Eye larger, 3½ to 4½ in head; whitish blotches and ocelli present...*uhleri*
AA. Eye smaller, 5 to 6 in head; no whitish blotches and ocelli present. *spilopterus*

Uhler's Whiff
Citharichthys uhleri Jordan



References: *Citharichthys uhleri*, Jordan and Goss, 1889, Rep. U. S. Fish Comm., p. 275.
Citharichthys uhleri, Jordan and Evermann, 1898, Fishes of North and Middle America, III, p. 2684.

Field Characters: Small, oblong flounders with eyes and color on left side; vomer toothless; lateral line without arch in front; teeth in jaws uniserial; maxillary more than ⅓ of head; gill rakers slender; eye 3⅓ to 4½ in head; dorsal rays 68, anal rays 52; brown with large ocelli on body and tail.

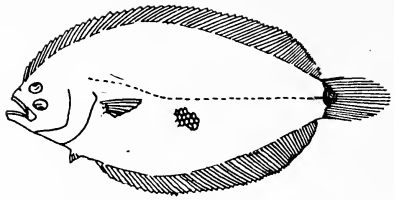
Size and Weight: A 123 mm. specimen weighed 28 grams.

Color: Greenish brown, with numerous large ocelli, pale edged with dark brown centers; a large very distinct ocellus in the center of the caudal rays. Iris bright yellow.

General Range: Haiti.

Occurrence in Port-au-Prince Bay: Rarely taken in seines by native fisherman.

Study Material: Specimens, 2; 99 and 123 mm. No. 6850.



Spot-finned Whiff
Citharichthys spilopterus Günther

Reference: *Citharichthys spilopterus*, Günther, 1862, Cat. Fish. Brit. Mus., IV, p. 421.
Citharichthys spilopterus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 988.

Field Characters: Small oblong flounders with eyes and color on left side; vomer toothless; lateral line without arch in front; teeth in jaws uniserial; maxillary more than ⅓ length of head; gill rakers slender; eye 5 to 6 in head, 45 to 48 scales in lateral line; olive brown, with darker spots and blotches.

Description: Differs from the type description in having the eyes somewhat closer together, and the depth into the length is 2.3 instead of "nearly two."

Size and Weight: Our 133 mm. specimen weighed 37 grams.

General Range: New Jersey, and the West Indies to Brazil.

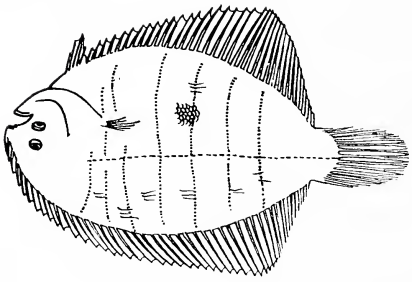
Occurrence in Port-au-Prince Bay: On the bottom in rather shallow water where the native fishermen take them in their seines.

Abundance: Apparently not rare as we obtained eleven specimens.

Study Material: Photograph, 3777; Specimens, 11; 72–133 mm. No. 6837.

Family Achiridae; Soles

Achirus Lacepede, 1803



Lineated Sole
Achirus lineatus (Linné)

References: *Pleuronectes lineatus*, Linné, 1758, Syst. Nat., Ed. X, p. 268.
Achirus lineatus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 998.

Field Characters: Small, ovate, scaled soles with caudal fin free from dorsal and anal; eyes and color on right side of body; brown to greyish, with about eight narrow, vertical blackish cross streaks, and often with large blackish blotches.

Size and Weight: Grows to a length of 8 inches. Our 96 mm. specimen weighed 32 grams.

Color: Variable, plain dark brown, or mottled or showing six to eight narrow, dark cross lines.

General Range: Florida Keys and West Indies, to Uruguay.

Occurrence in Port-au-Prince Bay: Adults living on bottom, the young coming to the surface at night.

Abundance: Not rare, fourteen taken by us.

Method of Capture: Seined by native fisherman, and taken in hand nets at surface.

Young: On several nights I caught young soles of this species, near the surface, at our submerged light. They swam slowly along and when at the surface elevated the encircling ring of vertical fins, and depressed the body, and in this cupped shape floated with no apparent movement of fins or body. The tips of all the rays could be seen breaking the surface film, but I could see no difference in the level of the enclosed water and that outside. These specimens measured from 17.5 to 25 mm.

The color change in these young soles was more extreme than in any fish I have ever seen. One taken on April 5th was dark green when dipped up, but in a glass dish under full electric light lost all color except a broad fin border of mottled greenish brown. When this individual undulated to the surface and cupped itself, the effect was of a circular ribbon of dark color, surrounding an area of absolute transparency, showing only dimly a network of fine bones. This specimen had only a single eye although in orientation it was quite adult. In past years I have caught 6 or 8 soles and flounders which had each lost an eye, and as this has always been the peripatetic one, it appears as if the astonishing shift through muscle and skull is not accomplished without a certain amount of weakening.

A second baby sole taken at night had a considerable amount of brilliant torquoise blue on the fins. This one likewise became transparent in the light of the laboratory, with the exception of six large, dusky, round spots, three on each side, with a scattering of black pin-pricks of dots. The blue was of the same character as that on the fins of the young, surface-swimming *Halieutichthys*, an interesting fact because of the bottom living nature of the adult fish in each case. (W. B.)

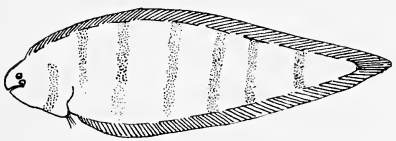
Study Material: Colored Plate, H18, H125a, No. 7190; Photograph, 3962; Specimens, 14; 17.5–96 mm., including Nos. 6841, 7021, 7204, and 7243. Port-au-Prince Bay.

Family Cynoglossidae; Tongue-Fishes

Symphurus Rafinesque, 1810

Tongue Fish

Symphurus plagusia (Bloch and Schneider)



References: *Pleuronectes plagusia,* Bloch and Schneider, 1801, Syst. Ichth., p. 162.

Symphurus plagusia, Meek and Hildebrand, 1928, Marine Fishes Panama, III, p. 1005.

Field Characters: Small, elongate, lanceolate soles, with dorsal and anal fins confluent around tail; eyes and color on left side of body; brownish, somewhat mottled.

Description: The two specimens show somewhat intermediate characters between *plagusia* and *plagiusa,* as follows: No. 7257 is *plagiusa* in dorsal ray and in scale count, while 7116 is close to it in anal ray count. In color and all other characters both are typical *plagusia.* It is probable that the two forms will prove to be one species.

Size and Weight: Our 142 mm. specimen weighed 21 grams.

Color: Brown with 6 to 7 black cross-bars, vertical fins dusky or black.

General Range: West Indies to Uruguay.

Occurrence in Port-au-Prince Bay: Seined by native fisherman near a pebbly beach.

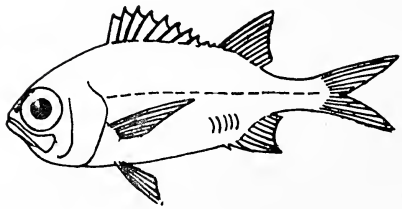
Study Material: Specimens, 2; 91 and 142 mm. Nos. 7116, 7257.

Family Holocentridae; the Squirrel-Fishes

Key to Port-au-Prince Bay Genera

A. Lower jaw short, the chin not entering the dorsal profile.
B. No large, preopercular spine, gill rakers long and slender, 21 to 23 on lower limb of first arch.....*Myripristis*
BB. A large preopercular spine; gill rakers rather long and slender, 8 to 15 developed on lower limb of first arch.....*Holocentrus*
AA. Lower jaw long, more than half the length of the head; chin projecting considerably beyond upper jaw. Gill rakers short, thick-set, about 9 developed on lower limb of first gill-arch.....*Flammeo**

Myripristis Cuvier, 1829



Candil; Frere-Jacque
Myripristis jacobus Cuvier and Valenciennes

References: *Myripristis jacobus,* Cuvier and Valenciennes, 1829, Hist. Nat. Poiss., III, p. 162.

Myripristis jacobus, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 294.

Field Characters: Small, chunky, compressed, large-eyed, scarlet fish without a preopercular spine; with a deep crimson bar across upper half of opercle, extending down and back across base of pectoral.

* The genus *Flammes* merges with *Holocentrus* and is no longer considered valid.

DESCRIPTION:

Length 125 mm.
Depth 50 (2.5)
Head 42 (3)
Eye 19 (2.2)
Snout 8 (5.2)
Lateral Line Scales 34
Dorsal : X–I–14
Anal : IV–12

SIZE AND WEIGHT: Reaches 12 inches in length; our five-inch specimen weighed 74.5 grams.

COLOR: In life: Scarlet, paling to silvery below; a deep crimson bar across upper half of opercle, and down and back across base of pectoral fin; dorsal fin deep scarlet on distal three-fourths of first two webs, becoming a broad edge on the rest; remainder of webs silvery; ventral fins white; all others deep rose, anterior ray of dorsal and anal and outer caudal rays white, iris scarlet, shot with silvery on outer edge.

GENERAL RANGE: West Indies to Brazil.

OCCURRENCE IN PORT-AU-PRINCE BAY: Found on reefs; rare.

METHOD OF CAPTURE: Taken in trap baited with crab meat at Bizoton Reef.

SIZE AT MATURITY: In breeding condition when five inches long.

SPAWNING SEASON: Female breeding on March 23rd.

EGGS: Ovary 30 x 10 mm. Eggs .68 mm., each containing a single oil globule.

STUDY MATERIAL: Specimen, 1; 125 mm. No. 7092.

Holocentrus Gronow, 1763

Key to Port-au-Prince Bay Species

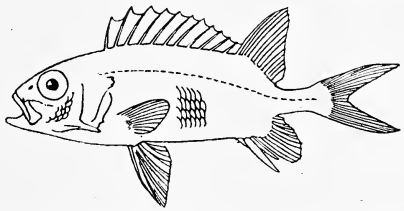
A. Thirteen to fifteen gill-rakers developed on lower limb of first gill arch. *ascensionis*

AA. Eight to nine gill-rakers developed on lower limb of first gill arch.

B. Black spot confined to the membranes between first and third or first and fourth dorsal spines..... *coruscus*

BB. Membranes of dorsal fin black in front of each spine, pale behind, the black not extending to the base or to the tip between the first and second and the second and third spines..... *vexillarius*

Common Squirrel-fish; Cartinau
Holocentrus ascensionis (Osbeck)



REFERENCES: *Perca ascensionis,* Osbeck, 1765, Reise nach Ostindien und China, p. 388.

Holocentrus ascensions, Meek and Hildebrand 1923, Marine Fishes of Panama, I, p. 297.

Field Characters: Small to medium-sized, oblong, compressed fishes, with very large eyes, long spine on preopercle; scales strongly serrate; upper lobe of caudal much longer than lower; anterior rays of soft dorsal much elevated; reddish above, with bluish reflections and brownish stripes between the scales; head bright red, iris scarlet.

Description: Our series of specimens agrees with the published descriptions of this species.

Size and Weight: Grows to 2 feet. A 156 mm. fish weighed 85 grams.

General Range: From Florida to Brazil, and known from the Eastern Atlantic.

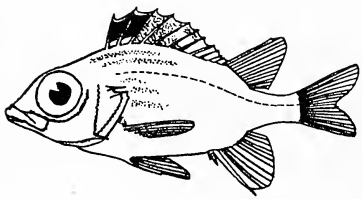
Occurrence in Port-au-Prince Bay: Widely distributed over reefs.

Abundance: A common species, often seen in the markets, but not of great food value.

Method of Capture: Seines, hooks and lines and in traps. Many were taken with the two latter methods, from the schooner anchorage in 40 to 60 feet of water on muddy bottom. A 56 mm. fish was strongly attracted to a red selenium bulb submerged over the side.

General Habits: These fish were easily frightened while we were diving. One medium-sized fish had appropriated a small box-like depression in the upper part of a piece of coral, in which it had coiled itself, and was quietly resting.

Study Material: Color Plate, H21, No. 6877; Photographs, 3761, 4012; Specimens, 12; 56–156 mm., No. 6877.



Shining Squirrel-fish
Holocentrus coruscus Poey

References: *Holocentrum coruscum*, Poey, 1860, Memorias, II, p. 158.
Holocentrus coruscus, Jordan and Evermann, 1896, The Fishes of Middle and North America, I, p. 851.

Field Characters: Small, short and thick, compressed fishes with large eye and a long spine on preopercle; an intense black spot on membrane between 1st and 3rd or 1st and 4th dorsal spine.

Description: Three specimens are assigned to this species, their respective lengths being 30, 32 and 85 mm. All three agree in possessing the black spot on the anterior part of the spinous dorsal fin, although in preserved coloration the two small fish are bright silvery, while the larger one is dull yellow, a condition most likely brought about by differences in preservative, the former being in alcohol and the latter in formalin.

The measurements of the three are as follows:

Specimen number	*7149B*	*7149A*	*7291*
Length, actual mm.	30 mm.	32 mm.	85 mm.
Depth	9 (3.3)	10 (3.2)	30 (2.8)
Head	10 (3)	11.2 (2.8)	30 (2.8)
Eye	4 (2.5)	3.7 (3)	12.5 (2.4)
Snout	2.5 (4)	3 (3.7)	7 (4.3)
Scales	41	40	41
Gill-rakers, developed	8	9	8–9
Dorsal fin	XI–1–12	XI–1–12	XI–1–13
Anal fin	IV–9	IV–8	IV–8½

Although there is an appreciable amount of variation between certain proportions it is believed that all three fish are of the same species. The longer head and snout measurements in the smaller specimens is due to the projecting snout characteristic of young Holocentrids.

Size and Weight: Our 85 mm. specimen weighed 16 grams.

Color: The following description was made of the 32 mm. fish; Upper surfaces above a line from the center of the eye to middle of caudal peduncle, reddish with a coppery tinge. Remainder of sides silvery with a slight reddish tinge. A series of horizontal, bluish stripes as follows: one from head to base of 4th dorsal spine; one from head to base of last dorsal ray; two from upper edge of opercle to tail; a stripe above and a stripe from below the pectoral fin toward the tail, these bands merging together above the last rays of the anal fin; one band from isthmus below pectoral to above base of anal. A yellowish, rather broad band, along the lateral line from opercle to tail. Upper sides with brownish punctations. Sides and lower surfaces with small red spots. Spinous dorsal pinkish red at base, above which is a rather irregular white band, surmounted by a pinkish band which, in the posterior part of the fin extends to the outer edge. On the membrane between the first five spines the outer edge is white. Membranes immediately in front of the spines, heavily punctate with black, the punctuation more sparse on rest of membranes,—resembling *vexillarius* to a slight degree in this way. A large, intense black spot on membranes between the first and second, second and third, and on the anterior half of space between third and fourth dorsal spines. Pectoral, ventral and anal fins hyaline. Soft dorsal hyaline, the rays reddish. Center of each caudal lobe reddish.

The coloration of the smaller specimen was the same with the exception that the black spot on the anterior portion of the spinous dorsal was confined to the space between the first and third spines, and the reddish tinge was continued to the outer border of the anterior membranes of the dorsal fin.

General Range: West Indies.

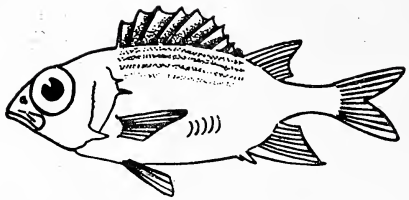
Occurrence in Port-au-Prince Bay: On reefs, and young found near surface at night.

Abundance: Rare, not seen on reefs during expedition.

Method of Capture: Small ones taken with scoop-nets as they came to our light at night.

Food: The largest specimen had eaten a shrimp.

Study Material: Specimens, 3; 30, 32 and 85 mm., Nos. 7149b, 7149a and 7291.



Black-barred Squirrel-fish
Holocentrus vexillarius Poey

REFERENCES: *Holocentrum vexillarium*, Poey, 1860, Memorias, II, p. 158.
Holocentrus vexillarius, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 299.

FIELD CHARACTERS: Small, rather short, compressed fishes with a long spine on preopercle. Dark stripes along rows of scales; membrane in front of each dorsal spine black, and pale behind.

DESCRIPTION: Our specimens agree very well with the long description given by Meek and Hildebrand.

SIZE AND WEIGHT: Our specimens are all of about the same size, the largest measuring 100 mm. and weighing 31 grams.

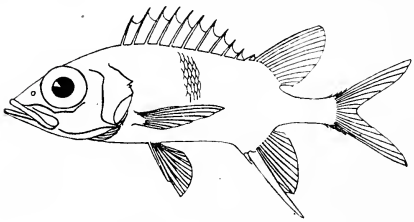
GENERAL RANGE: Cuba, Porto Rico and Panama.

OCCURRENCE IN PORT-AU-PRINCE BAY: Found on small reefs.

METHOD OF CAPTURE: Taken by us only with dynamite.

STUDY MATERIAL: Specimens, 7; 60–100 mm., Nos. 7332, 7321.

Flammeo Jordan and Evermann, 1898



Large-mouthed Squirrel-fish; Marian
Flammeo marianus (Cuvier and Valenciennes)

REFERENCES: *Holocentrum marianum*, Cuvier and Valenciennes, 1829, Hist. Nat. Poiss., III, p. 219.
Holocentrus marianus, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 852; Part III, 1898, pages 2842 and 2871.

FIELD CHARACTERS: Small, rather deep, compressed, red fishes with projecting chin, large lower jaw and projecting spine on preopercle; spinous dorsal fin with two rows of orange spots; caudal with a deep red bar.

SIZE AND WEIGHT: Grows to at least 170 mm. Our 130 mm. specimen weighed 52 grams.

COLOR: In life, bright red becoming white below, with narrow, yellowish stripes between the rows of scales, the stripes above the lateral line alternately large and small. Upper part of soft dorsal and anterior part of anal rays pinkish. Membrane of spinous dorsal pale bluish-white with irregular orange

spots on upper portion of anterior part of fin. Smaller spots of similar color but paler on basal portion of anterior rays. Caudal fin with a broad bar of deep red, the posterior part of the lobes pale pink.

General Range: West Indies.

Occurrence in Port-au-Prince Bay: Taken near reef by native fishermen.

Abundance: Rare, only two specimens seen or taken, one of these at market.

Eggs: The larger fish contained numbers of undeveloped eggs, measuring .3 mm. in diameter.

Study Material: Specimens, 2; 85–130 mm., Nos. 7100 and 7320.

Family Syngnathidae; the Pipe-Fishes

Key to Port-au-Prince Bay Genera

A. Head shaped like horse; tail prehensile; body robust.....*Hippocampus*
AA. Body elongate; tail not prehensile.
B. Dorsal fin with 40 to 43 rays.....*Doryrhamphus*
BB. Dorsal fin with fewer than 30 rays.....*Syngnathus*

Hippocampus Rafinesque, 1810; The Seahorses

Dotted Seahorse
Hippocampus punctulatus Guichenot

References: *Hippocampus punctulatus*, Guichenot, 1853, in Sagra, Hist. Phys. Polit. Nat. Cuba, IV, Pt. II, p. 174, Pl. V, fig. 2.
Hippocampus punctulatus, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 255.

Field Characters: Head shaped like that of horse, at right angles to the body; tail prehensile.

Description: Our specimens are typical in every way. Both have 17 dorsal rays.

Size and Weight: Our 128 mm. seahorse weighed 9 grams.

General Range: Tropical Atlantic from America to Africa.

Occurrence in Port-au-Prince Bay: Taken rarely in Sargassum weed which the tide brought into the Bay. One small and one large one collected.

Study Material: Specimens, 2; 19–128 mm., including Nos. 6846 and 7195. Port-au-Prince Bay. Sargassum weed.

Doryrhamphus Kaup, 1856

Lineated Pipe-fish
Doryrhamphus lineatus (Valenciennes)

REFERENCES: *Doryichthys lineatus*, Valenciennes, 1856, MS. in Kaup, Cat. Lophobr. Fish, 59.
Doryrhamphus lineatus, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 261.

FIELD CHARACTERS: Small, elongate pipe-fishes with long snout; tail shorter than trunk; approximately 40 rays in the dorsal fin.

DESCRIPTION: Our specimens are typical except that the tail fin in specimens up to 80 mm. in length, is longer and not shorter than the post-orbital portion of the head, as shown in the following table:

Length of Specimen in mm.	63.5 mm.	73	76	80	85	142
Length of Post-Orbital Part of Head	3.9 "	4.2	5	5	6.3	9
Length of Caudal Fin	6.9 "	5.2	5.9	6	5.5	5.3

GENERAL RANGE: Shores of tropical Atlantic.

OCCURRENCE IN PORT-AU-PRINCE BAY: Of the 11 specimens 3 were taken in a brackish creek at Bizoton and the others at light, from March 5th to April 30th.

STUDY MATERIAL: Specimens: 11; 63 to 147 mm., including numbers 6977 (3) brackish creek, Bizoton; 6996 (3), 7125 (2), 7153d (1), 7243, and 27261, all from light, Port-au-Prince Bay.

Syngnathus Linnaeus, 1758

Key to Port-au-Prince Bay Species

A. Dorsal longer, with 26 to 30 rays.
B. Head and snout 6.1 to 6.6 in length; depth (in Haitian specimens) about 22 or less ..... *mackayi*
BB. Head and snout 7.5 to 8.5 in length; the depth (in Haitian specimens) 25 to 37 in length ..... *rousseau*
AA. Dorsal shorter, 22 to 24 rays, on ½ + 5 or 0 + 6 rings ..... *elucens*

Mackay's Pipefish
Syngnathus mackayi (Swain and Meek)

REFERENCES: *Siphostoma mackayi*, Swain and Meek, 1884, Proc. U. S. Nat. Mus., VII, p. 239.
Syngnathus mackayi, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 257.

FIELD CHARACTERS: Small elongate pipe fishes with 26 to 30 dorsal rays: depth 16 to 22; head and snout very long, 6.1 to 6.6 in length.

DESCRIPTION: Various discrepancies were encountered in the descriptions of

this fish and of the two following species, when the accounts, mainly of Jordan and Evermann, Evermann and Marsh, and Meek and Hildebrand, in addition to the original description of each species, were considered. However, when all the descriptions were merged and the extreme proportions and characters combined, our specimens fall within the limits of these species.

General Range: Florida to Panama.

Occurrence in Port-au-Prince Bay: All of our specimens were taken from Sargassum weed in late April, 1927.

Abundance: Common in sea-weed.

Method of Capture: Taken by searching through sea-weed grappled from surface.

Study Material: Photograph, 4225; Specimens, 7; 77–130 mm., including Nos. 7210 and 7245, Port-au-Prince Bay. April, 1927.

Rousseau's Pipefish

Syngnathus rousseau Kaup

References: *Syngnathus rousseau*, Kaup, 1856, Cat. Lophob. Fish, p. 40.
Syngnathus rousseau, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 258.

Field Characters: Small, very elongate pipe-fishes with 26 to 29 dorsal rays; head and snout 7.5 to 8.5 in length; both sexes very slender, the depth 25 to 37, usually, in Haitian specimens, over 30.

General Range: West Indies.

Occurrence in Port-au-Prince Bay: Our largest fish was taken close inshore over muddy bottom. Smaller fish (55–67 mm.) were present at night at the surface from Feb. 26 to April 20th, 1927.

Abundance: Fairly common, several specimens were to be seen every night.

Method of Capture: Traps and by means of scoop nets at submerged lights.

Breeding: The male captured February 23, was carrying eggs.

Study Material: Specimens, 9; 55–167 mm., including Nos. 6936, 6963, 7063, 7125, 7153d, 7185, 7300, Port-au-Prince Bay.

Poey's Pipe-fish

Syngnathus elucens Poey

References: *Syngnathus elucens*, Poey, 1867, Synopsis, p. 443.
Syngnathus elucens, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 768.

Field Characters: Small pipefish with short dorsal fin, containing 22 to 24 rays; dorsal fin occupying the first six caudal rings or occasionally extending on the last or the two last body rings.

Description: Five small fish, 32 to 35 mm. long, differ considerably from the other Haitian pipe-fishes, and appear to agree more closely with *elucens* than any other described species. They have been compared with a 66 mm. fish from the collections of the Museum of Natural History, identified as this species, and our fish differ in no essential details.

The Haitian fish have 22 (2 spec.) to 24 (3 spec.) dorsal rays, as opposed to 24 or 25 as described for *elucens*. The dorsal fin in 3 Haitian fish is on 0 + 6 rings and in the two others it is on 1 + 5.

Proportions of these five fish are given below:

	7192a	*7192b*	*7301a*	*7301b*	*6963*
Length	35 mm.	32 mm.	32.5 mm.	32.5 mm.	33 mm.
Depth in Length	23	24	23	23	22
Head in Length	7	7.1	7.2	7	7.5
Snout in Head	2.6	2.6	2.5	2.6	2.7
Post-orbital in Head	2.5	2.3	2.3	2.4	2.46
Eye in Head	5.8	5	5.9	5.2	5.7
Tail in Length	1.6	1.7	1.7	1.7	1.7
Dorsal Rays	22	24	24	22	24
Dorsal Rings	17+32	17+30	16+33	17+32	16+31
Pectoral Length into Head	7.1	7.1	7	6.5	6.7

General Range: Florida, Cuba and Haiti.

Occurrence in Port-au-Prince Bay: Found by us only at surface at night.

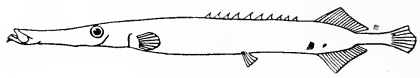
Abundance: Uncommon, 5 specimens seen and taken.

Method of Capture: Scoop nets as the fish came to light.

Study Material: Specimens, 5; 32–55 mm., including Nos. 7192a, 7192b, 7301a, 7301b, 6963. February 26–April 4th, 1927.

Family Aulostomidae; the Trumpet-Fish

Aulostomus Lacépède, 1803



Trumpet-fish

Aulostomus maculatus Valenciennes

References: *Aulostoma maculatum*, Valenciennes, about 1845, in Cuvier, Illust. Poiss., plate 92, fig. 2.

Aulostomus maculatus, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 754.

Field Characters: Elongate, somewhat compressed fishes, with mouth at end of very long head and snout, scales present; dorsal fin over anal and of same size; preceded by 8–11 spinous finlets.

Description: Three specimens showed unusual variability in several characters. The spinous dorsal rays number from 8 to 11, and the anal rays 24 to 28. The arrangement of the silvery body lines agrees with *maculatus*, but in general body color and in the greater relative length of the postorbital part of the head, specimen C approaches the unique individual known as *cinereus*. It appears probable that this is only a variation of *maculatus*. In comparative measurements the only point of interest is the unusually large size of the eye in the smaller specimens, contrary to Günther's statement. (Cat. Fishes British Museum, Vol. III, p. 536).

	A ♀		*B* ♀		*C* ♀	
Length	362 mm.	62%	440 mm.	76%	578 mm.	100%
Depth	29– "	59.5	35– "	71.5	49– "	100
Head	120– "	62.5	147– "	77	191– "	100
Eye	11 "	73.5	14– "	93.5	15 "	100
Snout	81– "	62.5	98– "	75.5	130 "	100
Interorbital	6.5 "	56.5	9 "	78	11.5 "	100
Postorbital	28.2 "	57	36.5 "	74	49.5 "	100
Weight in grams	90	26	160	47	341	100
Average of above eight characters	62%		78%		100%	
Dorsal	X–27		XI–26		IX–26½	
Anal	28		24½		28	

Size and Weight: Our largest trumpet-fish measured 22.5 inches or 578 mm. and weighed 341 grams.

General Range: Caribbean Sea, north to southern Florida.

Distribution in Port-au-Prince Bay: Observed over reefs, slowly moving in and out among the coral.

Abundance: Uncommon; rarely brought to the markets.

Method of Capture: Taken by native fishermen in nets, and speared by us on the reefs.

Food: The stomach contents of three individuals with their respective length are as follows:

(a) 578 mm. long, contained a 51 mm. *Engraulid;* and a *Pomacentrus.* The measurements of the latter are quite enormous, when the small mouth of the trumpet-fish is considered. The fish measured 71 mm. long with a depth of 29 mm. and a width of 17 mm. It had been swallowed tail first.

The size of the demoiselle and the fact that it had been swallowed tail first, make it likely that it had been swallowed after being killed by one of our dynamite explosions.

(b) 440 mm., contained comminuted fish remains.

(c) 362 mm., contained an *Engraulid.*

Breeding: The ovaries measured as follows:

(a) 578 mm. in length = 97 × 10 × 8 mm. = the length of the ovary being 16% of the fish's length.

(b) 440 mm. in length = 82 × 11 × 7 mm. = 18% of the length

(c) 362 mm. in length = 88 × 12 × 8 = 24% of the length.

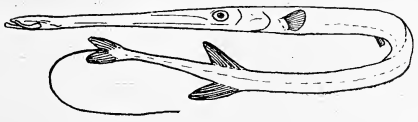
Study Material: Specimens, 4; 362–578 mm., including No. 6941.

Family Fistulariidae; the Cornet-Fishes

Fistularia Linnaeus, 1758

Cornet-fish

Fistularia tabacaria Linnaeus



References: *Fistularia tabacaria*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 312.
Fistularia tabacaria, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 250.

Field Characters: Elongate fishes with small mouth at end of very long snout and head; body without scales; no small finlets on dorsal surface before dorsal fin.

General Range: West Indies and neighboring seas, straggling occasionally to Massachusetts.

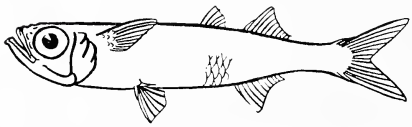
Note: This species was not taken during the expedition, but individuals belonging unmistakably to the species were seen while diving, once at Sand Cay and twice on Lamentin Reef. One of the latter was observed while close to a large *Aulostomus maculatus*, and the differences between the two genera were easily ascertained.

Family Atherinidae; the Silversides

Key to Port-au-Prince Bay Genera

A. Upper edge of mandibular rami straight or nearly so.....*Hepsetia*
AA. Upper edge of mandibular rami sharply curved posteriorly..*Atherina*

Hepsetia Bonaparte, 1837



Broad-headed Silverside
Hepsetia stipes (Müller and Troschel)

References: *Atherina stipes*, Müller and Troschel, 1848, in Schomburgk, Hist. Barbados, p. 671.
Atherina stipes, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 264.
Hepsetia stipes, Jordan and Hubbs, 1919, Monographic Review of the Family Atherinidae, Studies in Ichthyology, Stanford University Series, p. 34.

Field Characters: Small elongate fishes with two separate, small dorsal fins; greenish with a narrow silvery line down middle of sides. Interorbital space wide. Scales 36 to 38.

Size and Weight: Grows to less than 3 inches. A fish 45 mm. long weighed 2 grams.

General Range: West Indies; shores of Western Atlantic from Florida to Panama.

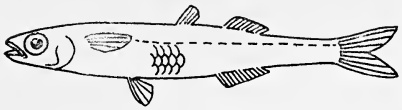
Distribution in Port-au-Prince Bay: Taken only at surface at night with submerged light alongside schooner.

Method of Capture: Scoop-nets at gangway of schooner, with light.

Food: Plankton, mainly entomostracans.

Study Material: Specimens, 21; 15 to 44 mm., including Nos. 6997, 6999, 7027, 7050, 7054, 7087a, 7097d, 7125.

Slender Silverside
Atherina harringtonensis araea (Jordan and Gilbert)



References: *Atherina araea*, Jordan and Gilbert, 1884, Proc. U. S. Nat. Mus., VII, p. 27.
Atherina harringtonensis araea, Jordan and Hubbs, 1919, Monographic Review of the Family Atherinidae, Stanford University Publ., University Series, p. 39, Plate III, fig. 9.
Atherina araea, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 264.

Field Characters: Small elongate fish with two separate small dorsal fins; greenish with a silvery line down middle of sides. Interorbital space not very wide, scales 42 to 45. The general appearance in the water seen from above, shows the back of molten silver; the head and the back from the second dorsal to the caudal turquoise green; sides silver with a greenish tinge, a patch of green at base of pectoral; head bluish; eye cold silvery white.

Description: Our specimens are quite typical and show a decided average of difference from a series of Bermuda *harringtonensis harringtonensis* taken by the senior author in September, 1927.

General Range: Florida and West Indies, south to Panama.

Occurrence in Port-au-Prince Bay: Widely distributed surface fish, near reefs and the shore line. The distribution of the 164 specimens taken was 99 dynamited, 53 caught at the surface light at night and 12 taken at surface near Sand Cay.

Abundance: In enormous schools of hundreds of thousands near the surface.

Method of Capture: The fishes formed an abundant component of the so called "white bait" in the markets, taken by the native fishermen in seines. We secured many when we were dynamiting for large fish.

Food: Plankton, and floating dead organisms such as ants.

Enemies: Mackerel and many other large carnivorous fish took heavy toll from the great schools of silversides, while the pelicans pursued them mercilessly whenever they leaped out of the water.

Eggs: Eggs were bursting from a female taken on March 11th at surface light at nine o'clock. The ovaries contained 163 large eggs about 1 mm. in diameter, and about 400 averaging .4 mm. in diameter. The large eggs were clear, with a small dark nucleus surrounded by a few, small fat-cells, while the surface of the egg was covered with a maze of numerous, fine, hair-like lines.

General Habits: As our motor-boat passed through one of the large schools, the appearance was of concentrated silvery motes sliding over the water, seldom sinking unless frightened, more than a few inches beneath the surface. The schools extended sometimes for a mile or more. They were closely associated with equal numbers of *Jenkinsia lamprotaenia*.

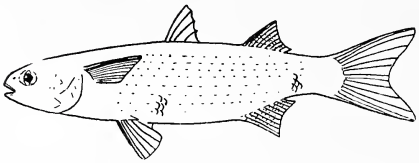
Study Material: Specimens, 164; including Nos. 6985, 6999, 7027, 7027a, 7087a, 7113, 7150, 7153b, 7183, 7192, 7192a, 7243, 7265, 7302, 7303.

Family Mugilidae; the Mullets

Key to the the Haitian Genera

A. Palatine teeth absent.....*Mugil*
AA. Palatine teeth present.....*Agonostomus*

Mugil Linnaeus, 1758



White Mullet; Blue-back Mullet; Liza Blanco

Mugil curema Cuvier and Valenciennes

References: *Mugil curema*, Cuvier and Valenciennes, 1836, Hist. Nat. Poiss., XI, p. 87.

Mugil curema, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 279.

Field Characters: Elongate, cylindrical, round-headed fishes with large adipose eyelids; small mouth with minute teeth. Two dorsal fins, the first of 4 spines, the second of 1 spine and 8 rays; anal fin with 3 spines and 9 rays; young similar with 2 anal spines and 10 rays.

Description: Our specimens fall within the limits of description of typical *curema*, except that we find a maximum count of 43 lateral scales in one large specimen.

Ontogentic Character Averages.

	A	*B*	*C*	*D*	*E*	*F*
Length of Specimen in mm.	7.7	21.5	115	158	196	418
Length	1.8%	5.1%	27%	38%	47%	100%
Depth	2.3	5.5	35	44	60	100
Head	2	6	31	47	49	100
Eye	3	7	34	53	53	100
Snout	1.7	6	31	43	50	100
Interorbital	2	6	29	40	42	100
Average	2%	6%	31%	44%	50%	100%
Weight in grams			32	95	165	1020
Average			3%	9.3%	16%	100%

Size and Weight: In a land-locked pool, the source of the Mariani, we secured our largest specimens of this species. They measure respectively 418 and 420 mm. and weigh 2¼ pounds each.

Color: A 7 mm. specimen shows a reversed coloration, the dorsal surface of the head and body showing only a scattering of pigment dots. This probably is connected with their life at the surface.

General Range: Both coasts of America from Cape Cod to Brazil, and the Gulf of California to Chili; also found in West Africa.

Occurrence in Port-au-Prince Bay: Only found at surface light and in inland pools and streams.

Abundance: Querimanna stage common about surface light; larger ones fairly common in streams. Abundant in market.

Method of Capture: Hand-nets at surface light, and seines in fresh-water pools.

Food: Mud, decayed vegetation and bottom debris in the freshwater individuals.

Study Material: Colored Plate, H34, No. 6909; Photograph, 3901; Specimens, 155; from 7 to 420 mm. in length, of which 18 were taken in a fresh-water pool at the source of Mariani: Nos. 7176, 7177, 7307, 7308, 7309, 7310. 136 were in the Querimanna stage, taken at the submerged light; Nos. 6909, 6929, 6930, 6984, 6997, 7010, 7020, 7027, 7043b, 7081, 7185, 7304, 7305, 7306.

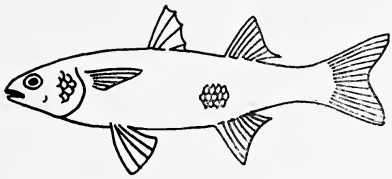
Agonostomus Bennett, 1830

Key to Haitian Species

A. Upper lip very little if at all thickened, body rather robust and deep. *monticola*

AA. Upper lip thick anteriorly, much wider than the lateral portions, body elongate and rather slender ..... *microps*

Yellow-tailed Fresh-water Mullet
Agonostomus monticola (Bancroft)



References: *Mugil monticola*, Bancroft, 1836, Cuvier's Animal Kingdom, (ed. Griffith), p. 367, t. 36.

Agonostomus monticola, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 819, fig. 347.

Field Characters: Small to medium-sized, elongate, somewhat compressed, but robust fishes with small teeth on the palate, and with two separate dorsal fins, the first of four spines. Upper lip thin, not conspicuously thickened anteriorly. Caudal fin yellow, with a conspicuous black spot on the side of the caudal peduncle.

Description: In a great many of the Haitian specimens the interorbital space is almost flat; but these fish grade into those with typical convex interorbital spaces. It is very likely that *percoides* is the same as *monticola*.

Size and Weight: Grows to 9 inches. A 150 mm. fish weighed 82 grams.

Color: Sides greenish, becoming dark brown above and white below, the edges of the scales on the upper sides with dark edges. A dark irregular bar through the eye across opercles to base of pectoral fin. Axil black. An intense black spot on the caudal peduncle, in some specimens shaped like a triangle, the longest point of which is directed toward the tail. Caudal yellowish, especially intense on the base of the lobes. Ventral, anal and soft dorsal fins yellowish, the latter with very small black spots at the base. Spinous dorsal yellowish and orange at base, pale distally, and with a few black spots at base. First dorsal spine black.

General Range: Fresh water streams of the West Indies and the east coast of Mexico.

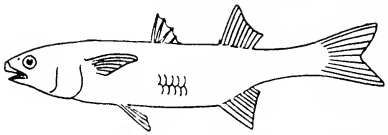
Occurrence in Haiti: Found widely distributed in fresh-water streams. Found by us in sea-ward flowing streams of the Cul-de-Sac Plain and at Source Mariani.

Abundance: A common species. In the Grand Riviere they were by far the most abundant species, far out-numbering the cichlids and poecilids.

Method of Capture: Seining.

Food: An omnivorous feeder; seeds, berries, insects and mites found in the stomachs of three fish examined.

Study Material: Color Plate, H54; Specimens, 49; 43–188 mm., including Nos. 6972 and 6989, Grand Riviere and Source Mariani.



Thick-lipped Fresh-water Mullet
Agonostomus microps Günther

References: *Agonostomus microps*, Günther, 1861, Cat. Fish British Museum, III, p. 462.
Agonostomus microps, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 820.

Field Characters: Small to medium, elongate, compressed fishes with small teeth on the palate, and with two separate dorsal fins, the anterior of four spines. Upper lip thickened anteriorly.

Description: Our single 180 mm. fish agrees with the description given by Gunther, with the exception that it posseşses a slightly larger eye, 4.9 instead of 6 as mentioned by Gunther, or 6½ as stated by Jordan and Evermann for a male. As Gunther's specimen was 12 inches long and ours a little over 7, the discrepancy may possibly be laid to size.

Size and Weight: Grows to 12 inches. Our 180 mm. fish weighed 71 grams.

General Range: Dominica, St. Vincent, Venezuela, Haiti.

Occurrence in Haiti: Known to us from a single specimen from the Grand Riviere, Cul-de-Sac Plain.

Abundance: Rare.

Study Material: Specimen, 1; 180 mm., No. 7459.

Family Sphyraenidae; the Barracudas

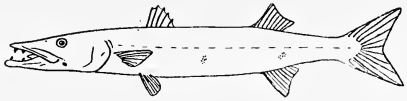
Sphyraena Klein, 1778

Key to Port-au-Prince Bay Species

A. Ventral fins inserted in advance of dorsal; pectorals reaching beyond base of ventrals.
B. Scales large, 79 to 85 in a lateral series..... *barracuda*
BB. Scales smaller, 118 to 130..... *guachancho*

AA. Ventral fins inserted directly under origin of spinous dorsal, much nearer base of last anal ray than tip of lower jaw; pectoral fins failing to reach base of ventrals. Scales 123 to 130 in a lateral series.....*picudilla*

Great Barracuda
Sphyraena barracuda (Walbaum)



References: *Esox barracuda*, Walbaum, 1792, Artedi Piscium, III, p. 94, (after Catesby).
Sphyraena barracuda, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 283.

Field Characters: Medium to large, elongate, cylindrical and slightly compressed fishes with long snout and projecting lower jaw; mouth with large, pointed, wide-set teeth; pectoral fins overlapping ventral fins; scales large, 79 to 85 in a lateral series.

Description: Our specimens are typical in every way of this species.

Ontogenetic Characters

Specimen Numbers	*7185*	*6809*	*7315*	*7314*	*7110*
Actual Length, mm.	25.5	106	210	454	705
Length	3.6%	15%	30%	64%	100%
Depth	3.8	16	36	65	100
Head	5.3	19	35	70	100
Eye	6.4	23	46	78	100
Snout	5.1	18	32	67	100
Average	4.8%	18%	36%	69%	100%
Weight in grams		8	70	794	2495
Average		.32%	2.8%	33%	100%

Size and Weight: Reaches a length of at least 5 feet 3 inches and a weight of 54 pounds; unauthenticated reports of 10 foot specimens. Our 705 mm. specimen weighed 5½ pounds.

Color: Young:—Five preserved fish, 20 to 26.5 mm. had the following disposition of pigment:

1.—A broad lateral band extending through the eye from snout to the tail, narrowed anteriorly, about ½ width of eye at posterior edge of the eye, becoming wider posteriorly and spreading over the entire upper and lower surfaces beyond the anal and soft dorsal fin. When viewed without a lens this band tends to break up into a series of spots, six in number from the pectorals to the caudal fin.

2.—A series of six dark blotches along dorsal surface, which when viewed through a low power microscope, merge, into a broad band.

3.—Upper surface of head and anterior portion of lower mandible covered with chromotophores.

4.—Spines of first dorsal fin spotted, other fins clear.

It is possible that smaller fish than those in our collection may possess a complete lateral band, which is here shown breaking up into the spots characteristic of fishes of medium size (100–200 mm.).

General Range: West Indies to Brazil, north to South Carolina and Bermuda. Rarely straggles as far north as Woods Hole.

Occurrence in Port-au-Prince Bay: Widely distributed near surface and over reefs; small ones taken close to shore over weed-covered bottom, both at Bizoton and at Source Matelas. Three foot fish photographed under water, 15 feet deep, on Sand Cay. Large specimens, estimated at 5 feet and over, circled about our schooner at least half a dozen times.

Abundance: A common species; small and medium sized individuals often seen in the market.

Method of Capture: Caught on hook and line and in seines, and in hand-net at surface light.

Food: Stomach contents of 3 individuals as follows:

1—200 mm. specimen had eaten a 55 mm. *Scarus croicensis.*

2—400 mm. specimen had eaten an 80 mm. *Chloroscombrus chrysurus.*

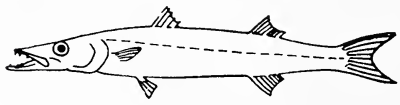
3—697 mm. specimen had eaten a 70 mm. *Ocyurus chrysurus,* the *Ocyurus* in turn, having swallowed three anchovies.

Size at Maturity: A ♂, 705 mm. long (No. 7110) was in full breeding condition on March 28, with testes 140 x 10 mm.; a 400 mm. individual was also in breeding condition, with testes 120 x 14 mm.

Young: Five young individuals, from 20 to 26 mm. were taken from March 6th to May 8th. Three were taken at the surface light at night and two scooped from the surface several miles from land in full daylight.

General Habits: Like the gars, large sized barracudas now and then swam around the schooner for an hour or two at a time, apparently in the hope of picking up a dead fish or other refuse.

Study Material: Specimens, 12; of which five were under 26 mm., 7006, 7185, 7230, and 7271; five were 175 mm., 6809; two, 465 and 705 mm., Nos. 7110, 7314.



Guachancho Barracuda

Sphyraena guachancho Cuvier and Valenciennes

References: *Sphyraena guachancho,* Cuvier and Valenciennes, 1829, Hist. Nat. Poiss., III, p. 342.

Sphyraena guachancho, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 285.

Field Characters: Medium sized, elongate, cylindrical and slightly compressed fishes with long snout and projecting lower jaw; mouth with large teeth; pectoral fins overlapping ventrals; scales small, 118 to 130 in a lateral series.

Size and Weight: Known to reach a length of two feet.

General Range: Florida and West Indies south to Panama.

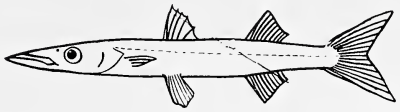
Occurrence in Port-au-Prince Bay: Occasionally seen at the surface and over reefs.

Abundance: Rarely seen alive but common in the market.

Food: Small fish, including remains of Atherinids and Pomacentrids.

Study Material: Specimens, 7; four averaging 200 mm., and three averaging 325, Nos. 7311, 7312, 7313.

Picudilla Barracuda
Sphyraena picudilla Poey



References: *Sphyraena picudilla*, Poey, 1860, Memorias, II, p. 162.
Sphyraena picudilla, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 287.

Field Characters: Medium-sized, elongate, slightly compressed fishes, with long snout and projecting lower jaw; teeth large and wide set; pectoral fins not overlapping the ventral fins; scales small, 123 to 130 in lateral series.

Description: Adult specimens taken are typical of the species.

A specimen 33 mm. long has the posterior lateral line scales keeled, forming a carangid-like keel along the sides of the caudal peduncle. It possessed a black, cutaneous flap at the tip of the lower jaw. Both of these characters are mentioned by Nichols and Breder (Zoologica, IX, Number I) as having appeared in a specimen of *Sphyraena borealis*, 2⅜ inches total length, from Sandy Hook.

Meek and Hildebrand (Marine Fishes of Panama, 1923, Part I, p. 288) state of *picudilla*, that "The species is very closely related to *Sphyraena borealis* from which it is probably not distinct." and "A larger series must be secured before their true relationship can be established."

The presence of the lateral keel in these two young fishes is an additional character tending to unite the two species.

Color: The 33 mm. fish, Number 7194, in its preserved condition, differs considerably in color pattern from similar sized specimens of *Sphyraena barracuda.*

The most noticeable character in *picudilla* is the dark lateral band, which in this species is much narrower than in *barracuda* and extends from the tail about half way to the gill-openings. The upper posterior part of the head is densely pigmented, and pigment is found in the other parts of the body as follows: 7 quadrate patches on the dorsal surface, the three posterior patches being duplicated on the ventral surface, the center of each patch less dense; upper surface of snout, more densely toward the tip; tip of lower jaw, especially the black cutaneous portion; basal part of dorsal spines and posterior part of soft dorsal with small black spots; anal fin, small blackish spots more abundant on basal half of fin; other fins plain.

General Range: West Indies south to Bahia.

Occurrence in Port-au-Prince Bay: Obtained now and then near reefs.

Abundance: Less common than the other two species of the genus.

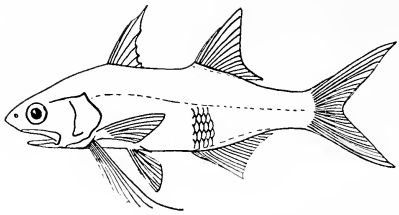
Food: Small fish and shrimps.

Size at Maturity: A female of 335 mm. had ovaries 115 x 10 mm.

Study Material: Specimens, 5; four of which are medium, 149 to 335 mm., No. 6810; one small, 33 mm., No. 7194.

Family Polynemidae; the Threadfins

Polynemus Linnaeus



Seven-fingered Threadfin; Barbudo
Polynemus virginicus Linnaeus

References: *Polynemus virginicus,* Linnaeus, 1758, Syst. Nat., Ed. X, p. 317.
Polynemus virginicus, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 289.

Field Characters: Small fishes with small scales, two separated dorsal fins and a projecting pig-like snout; seven thread-like filaments arising from just in front of the pectoral fin; scales 53 to 61.

Description: Ontogenetic Characters.

Specimen Number	*7163*	*7006*	*6835*
Actual Length, mm.	23	35	113
Length	20%	31%	100%
Depth	17	30	100
Head	22	33	100
Eye	24	36	100
Snout	27	39	100
Average	22%	34%	100%

Size and Weight: Grows to a foot in length. Our largest specimen was 113 mm. in length and weighed 28 grams.

General Range: Florida, West Indies, Panama and possibly from Brazil.

Occurrence in Port-au-Prince Bay: Found at the surface both by day and night. Larger ones around coral. Nine small specimens taken near floating sargassum weed in daytime, and 21 small ones at surface light in evening from Feb. 27 the April 21.

Abundance: Not common. Usually seen singly.

Method of Capture: Taken at surface with hand net. A few seen in market taken with other fish in seines.

Young: Found occasionally among floating Sargassum weed, and taken now and then at submerged light in the evening.

Study Material: Specimens, 34; of which 30 are small, from 23–35 mm., Nos. 6984, 6997, 7006, 7027, 7097c, 7163, 7183, 7192, 7192a, 7195d, and 4, 100–113 mm.

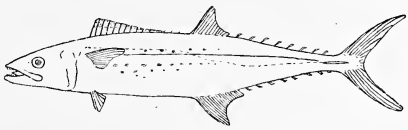
Family Scombridae; Mackerels

Scomberomorus Lacépède, 1802

Key to Port-au-Prince Bay Species

A. Pectoral fins scaled; sides with bronzy longitudinal bar and spots...*regalis*
AA. Pectoral fins naked; sides with bronzy spots only.....*maculatus*

King Mackerel, Painted Mackerel
Scomberomorus regalis (Bloch)



References: *Scomber regalis*, Bloch, 1795, Ichthyol., Plate CCCXXXIII.
Scomberomorus regalis, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 323.

Field Characters: Medium-sized, elongate, compressed fishes, with slender spines in first dorsal fin; second dorsal and anal fin followed by a series of finlets. Pectoral fins scaled. Bluish above, silvery below with a longitudinal golden-brown band on middle of sides; spots above and below this.

Description: All our specimens agree with the descriptions given for species.

Size and Weight: Grows to 6 feet and 20 pounds weight.

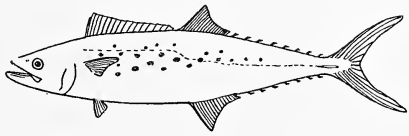
General Range: Massachusetts to Brazil.

Distribution in Port-au-Prince Bay: Rather widely distributed over the bay.

Food: A carnivorous species feeding upon anchovies and small snappers.

Study Material: Specimens, 5; Nos. 6976, 7019, and 7145.

Spanish Mackerel, Cazard
Scomberomorus maculatus (Mitchill)



References: *Scomber maculatus*, Mitchill, 1815, Trans. Lit. and Phil. Soc., N. Y., I, p. 426 (New York).
Scomberomorus maculatus, Meek and Hildebrand, 1923, Marine Fishes of Panama, Part I, p. 324

Field Characters: Medium-sized, elongate, compressed fishes with slender spines in first dorsal fin; second dorsal and anal fins followed by a series of finlets; pectoral fins naked; bluish above, silvery below, sides with elliptical bronzy spots.

Description: Our specimens are typical of the species.

Size and Weight: Grows to a length of 3½ feet and a weight of 10 pounds. The largest specimen taken during the expedition measured 745 mm. and weighed 9½ pounds. A 280 mm. fish weighed 234 grams.

Coloration: A fish 170 mm. long, had the anterior half of the spinous dorsal, the distal ⅔ of the soft dorsal, the caudal and edge of pectoral black;

posterior half of spinous dorsal whitish; proximal third of soft dorsal, and all of pectoral except edge yellow.

A 255 mm. fish was recorded as follows: bluish above, silvery below. Membrane of dorsal spines, tip of 2nd dorsal lobe, and posterior part of pectoral fins blackish. Anal fin whitish. Caudal dusky, especially so on anterior rays of upper lobe. The spots on the sides of the body are almost invisible and disappear entirely when the fish became dry.

General Range: Atlantic coast from Maine to Brazil and West Indies. Also on Pacific coast from Cortez Banks to the Galapagos Islands.

Occurrence in Port-au-Prince Bay: Widely distributed in many localities in the bay. Seen occasionally while diving over reefs.

Abundance: A common fish, often seen in the markets, and one of the fishes most often brought to our table. An excellent food fish.

Method of Capture: Seines and hooks and lines.

Food: The stomach contents of about a third of our specimens contained fish, a number of them being identified as Anchovies *Anchoviella epsetus* and *Cetengraulis edentulus*. The major number of our specimens were taken in the early morning hours, from midnight to 3 or 4 o'clock. This may account for their empty stomachs, as it is possible that they do not feed at night.

Parasites: Nematodes and trematodes(D. T. R. 27190) especially the first, were taken in the alimentary tract of a number of specimens. Encysted worms, were found in the liver (D. T. R. 27189, 27108) and parasitic isopods were found on the outer surfaces (D. T. R. 27186). A small fish had the marks of some boring parasite just beneath the thin skin. The meanderings ran back and forth, across and under the lateral line, like the marks of a bark-boring beetle or leaf-mining caterpillar.

Study Material: Photographs, 3963, 3965; Specimens, 25; 85–730 mm., Nos. 6832, 6879, 6975, 7028 and 7096. One hundred or more additional fish were examined in the field.

Family Thunnidae; Tunnies

Key to Port-au-Prince Bay Genera

A. Scales present on anterior part of body only, forming a corselet, and along the lateral line; palatine teeth wanting.

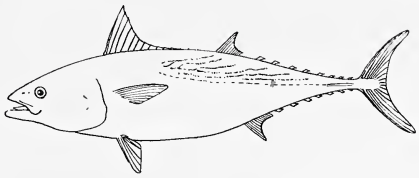
B. Spinous and soft dorsal fins close together, the former of 15 to 16 spines. *Gymnosarda*

BB. Spinous dorsal not close to soft dorsal, the space between equal to about ⅕ of the length of the head; first dorsal with 9 to 11 spines.....*Auxis*

AA. Body covered with scales, sometimes very small or rudimentary, forming a corslelet or not, palatine teeth present. Teeth on jaws small, conical, curved inward, body robust, slightly or not at all compressed. *Parathunnus*

Gymnosarda Gill, 1862

Little Tunny
Gymnosarda alletterata (Rafinesque)



REFERENCES: *Scomber alletteratus,* Rafinesque 1810, Carrateri, etc., p. 46.
Gymnosarda alletterata, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 311.

FIELD CHARACTERS: Elongate, robust, fusiform, slightly compressed fishes; scales present on anterior part of body only, forming a corselet; dorsal fins close together, the first of 15 to 16 spines, a series of finlets following the dorsal and anal fins. Bluish above, silvery below; sides above lateral line with black, oblique lines or spots.

DESCRIPTION: Our single specimen was typical.

SIZE AND WEIGHT: A 496 mm. fish weighed 3.75 pounds.

GENERAL RANGE: A pelagic species known from all warm seas.

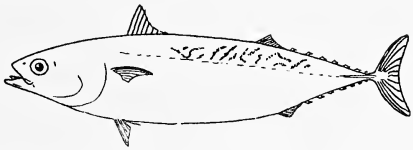
ABUNDANCE: Uncommon.

METHOD OF CAPTURE: Taken in seines by Greek fishermen.

STUDY MATERIAL: Specimen, 1; 496 mm., No. 7053.

Auxis Cuvier, 1829

Frigate Mackerel
Auxis thazard (Lacépède)



REFERENCES: *Scomber thazard,* Lacepede, 1802, Hist. Nat. Poiss., III, 9.
Auxis thazard, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 313.

FIELD CHARACTERS: Small to medium, fusiform-shaped fishes; scales present on body in the form of a corselet close to the head, and along the lateral line; remainder of body naked; spinous and soft dorsal fins widely separated, the first with 9 to 11 spines, a series of finlets following the dorsal and anal fins.

DESCRIPTION: Our single specimen was typical, with the exception that it had 11 dorsal spines instead of 9 or 10,—the last one being exceedingly small and difficult to find.

SIZE AND WEIGHT: A 395 mm. fish weighed 2 pounds.

GENERAL RANGE: Known from all warm seas.

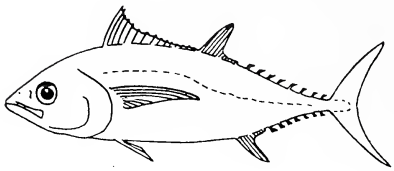
OCCURRENCE IN PORT-AU-PRINCE BAY: Found offshore in the Bay.

ABUNDANCE: Seldom seen in the fish markets. About fifteen observed,—the result of one day's fishing of a Greek fisherman. It is interesting to note that this species and the other Bonito-like fishes, *Gymnosarda* and *Parathunnus,* are

seldom seen in the fish markets where most of the fishing was done by negroes. The Greek fishermen, of which there is a small colony in Port-au-Prince, specialize in the capture of these fishes,—an interesting carrying over of the customs of their homeland.

Study Material: Specimen, 1; 395 mm., No. 7052.

Parathunnus Kishinouye, 1923



Deep-bodied Tunny
Parathunnus obesus (Lowe)

References: *Thynnus obesus*, Lowe, Trans. Zool. Soc. London, III, 1849, p. 4.

Field Characters: Large robust fishes with pointed snout and large eye; body covered with scales: soft dorsal fin followed by a series of finlets; pectoral fin quite long, extending to the end of the spinous dorsal fin, 3.8 in the length; teeth, on jaws, small, conical, curved slightly inward.

Description: Our single specimen is placed under this species with very little hesitation. It agrees very well with Lowe's description, and falls within the genus *Parathunnus* as described by Jordan and Evermann (Occasional Papers of the Cal. Acad. of Sciences) although we have not been able to examine some of the internal characters mentioned by these authors and Kishinouye. As the finlets were not yellow in life and *obesus* is described from the Atlantic, we consider our specimen to be this species, and not *sibi* as Cunningham (1910) mentions. Mr. John T. Nichols has seen our fish and considers that we are quite justified in assigning it to this species.

Size and Weight: Reaches a length of 5 feet. Our 620 mm. fish weighed 12 pounds.

General Range: Atlantic, known from Madeira, St. Helena and Haiti.

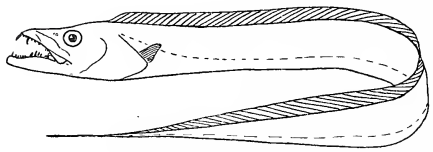
Abundance: Uncommon.

Food: Carnivorous, the stomach contents mainly shrimps and small fish, among the latter, anchovies and small snappers, *Rhomboplites aurorubens*.

Study Material: Specimen, 1; 620 mm., No. 7037.

Family Trichiuridae; the Cutlass-Fishes

Trichiurus Linnaeus, 1758



Cutlass-fish
Trichiurus lepturus Linnaeus

References: *Trichiurus lepturus*, Linnaeus, 1758, Syst. Nat. Ed. X, p. 246.
Trichiurus lepturus, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 328.

Field Characters: Elongate, compressed, band-like, bright silvery fishes with slender tail tapering to a point; no caudal fin; teeth on jaws strong and unequal, the lower jaw projecting beyond the upper. No ventral fins.

Size and Weight: Grows to 34 inches. A 500 mm. fish weighed 79.5 grams.

General Range: Widely distributed in warm seas.

Occurrence in Port-au-Prince Bay: Often brought into the market by fishermen. Not otherwise seen by us.

Abundance: Uncommon, two or three specimens a week brought into the markets.

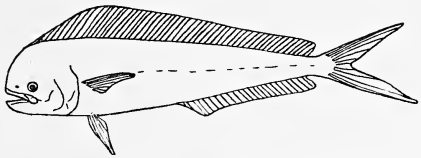
Study Material: Specimens, 5; 345–500 mm., No. 6943.

Family Coryphaenidae; Dolphins

Coryphaena Linnaeus, 1758

Dolphin

Coryphaena hippurus Linnaeus



References: *Coryphaena hippurus*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 261; (open seas).

Coryphaena hippurus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 406.

Field Characters: Large, compressed, elongate, tapering fishes with very long high dorsal fin beginning on the nape, entirely of flexible spines or jointless rays; brilliantly colored, blues, yellows, and greens.

Size and Weight: Grows to 6 feet. A 34-lb. specimen is the largest of its species to be caught by hook and line. A 325 mm. fish weighed 3.25 pounds and one of 645 mm. weighed 5 pounds.

General Range: Atlantic and Pacific.

Occurrence in Port-au-Prince Bay: Occasionally seen accompanying ships in the Gulf. Observed at the market about once a week. It is not valued very highly for food. The 3.25 pound fish sold for 40 cents gold and the 5 pound fish for 30 cents, an apparent contradiction but very likely the result of bargaining.

Abundance: Uncommon.

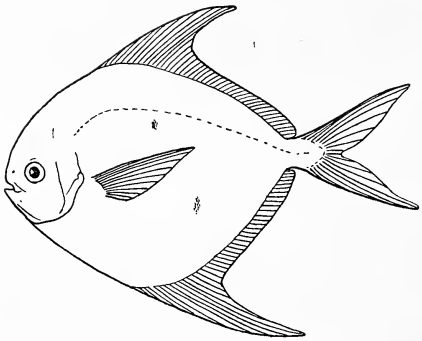
Breeding: In the 645 mm., 5 pound fish, captured on March 23rd, 1927, the ovaries measured 175 by 30 mm., and weighed 96 grams. The estimated number of eggs was 500,000, about one-third of the mass averaging .85 mm. in diameter, while the remainder averaged from .17 to .28 in diameter.

Food: Vertebral column of a small unidentified fish, 1 *Rhomboplites aurorubens*, and a small piece of sea-weed.

Study Material: Specimens, 2; 325–645 mm., No. 694.

Family Stromateidae; the Harvest-Fishes

Peprilus Cuvier, 1829



Harvest-fish
Peprilus paru (Linnaeus)

References: *Stromateus paru,* Linnaeus, 1758, Syst. Nat., Ed. X, p. 248.
Peprilus paru, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 411.

Field Characters: Small, compressed, small scaled, deep, silvery-blue fishes without ventral fins. Snout very short and steep, pug-nosed; anterior portions of dorsal and anal fins long, falcate.

Description: Many of the Haitian fish have the anal fin with 38 to 40 rays.

Size and Weight: Grows to 8.5 inches. A 182 mm. fish weighed 205 grams.

General Range: Cape Cod to West Indies and Brazil.

Occurrence in Port-au-Prince Bay: Not seen by us over the coral reefs, but taken by seine fishermen along shore.

Abundance: Rather common, practically always to be seen in the fish markets.

Method of Capture: Older fish taken by seine fishermen. Our smaller fish were taken with larger numbers of bumpers (*Chloroscombrus chrysurus*) under jelly-fish. One 29.2 mm. fish was taken while swimming free at light. Whether it had temporarily emerged from its coelenterate host was not ascertained.

Size at Maturity: A seven inch male was in full breeding condition with testicles 20 x 5 mm.

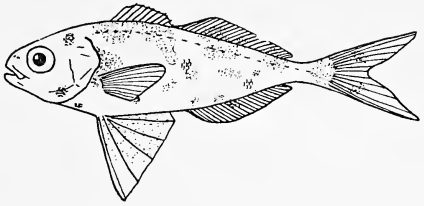
Food: The pharyngeal teeth of this species apparently are sufficiently strong to chew up the food to such an extent that by the time it has reached the stomach it is almost of the consistency of mucus. Incidently in all of our specimens large quantities of mucus was present. In examining the teeth in the pharynx we found considerable sand, intermixed with minute crustaceans and comminuted vegetable matter. Two specimens contained a single spine of a Porcupine fish (*Diodon hystrix*), and others contained animal tissue too far gone to identify.

Study Material: Specimens, 24; 22–182 mm., including Nos. 6859, 7182, 7185 and 7193.

Family Nomeidae; Portuguese Man-of-War Fish

Nomeus Cuvier, 1817

Portuguese Man-of-War Fish
Nomeus gronovii (Gmelin)



References: *Gobius gronovii*, Gmelin, 1789, Syst. Nat., I, p. 1205.
Nomeus gronovii, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 408.

Field Characters: Small, symmetrically shaped fishes with forked tail; ventral fins comparatively very large and black; conspicuously marked with dark cross bands.

Note: This fish was seen by us while diving. It was swimming close to the surface near a small patch of Sargasso weed. (W. B.).

Size: Grows to 6 or 8 inches.

General Range: Tropical parts of the Atlantic and Pacific.

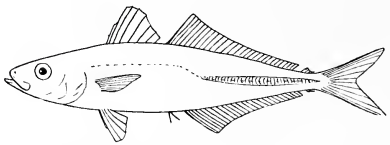
Family Carangidae; the Cavallas

Key to Port-au-Prince Bay Genera

A. Lateral line armed in some part with bony scutes. (Very weak and occasionally wanting in *Chloroscombrus*.)
B. Dorsal and anal each with a single detached finlet.....*Decapterus*
BB. Dorsal and anal without finlets.
C. Shoulder girdle with a deep furrow near its juncture with the isthmus and with a fleshy projection above it; eye large.....*Selar*
CC. Shoulder girdle normal, not as above; eye of normal size.
D. Teeth uneven, in one or a few series, persistent; villiform teeth usually present on vomer, palatines and tongue, deciduous or wanting in some species.....*Caranx*
DD. Teeth, if present, small and even, in a single series, or in villiform bands on the jaws.
E. The back much elevated; the dorsal outline more strongly curved than the ventral.
F. Snout well in advance of the forehead; anterior profile convex; anterior rays of the second dorsal and anal filamentous.....*Alectis*
FF. Snout scarcely in advance of forehead; anterior profile nearly vertical; soft dorsal and anal low, never falcate, the anterior rays not produced in filaments.....*Vomer*
EE. Back little elevated; ventral outline much more strongly curved than the dorsal; lateral line with a few very weak bony scutes or none. *Chloroscombrus*

AA. Lateral line entirely unarmed.
G. Second dorsal and anal fins equal in length, both longer than the abdomen.
H. Body deep, ovate; premaxillaries protractile; 2nd dorsal and anal fins anteriorly elevated, falcate.
I. Body very closely compressed, the outline everywhere trenchant; preorbital extremely deep; maxillary broad, with a well developed supplemental bone.....*Selene*
II. Body less closely compressed; abdomen never trenchant; preorbital very narrow; maxillary narrow, without a distinct supplemental bone. *Trachinotus*
HH. Body oblong; premaxillaries not protractile, except in very young; maxillary narrow, without a supplemental bone; second dorsal and anal fins low, never falcate.....*Oligoplites*
GG. Anal fin much shorter than second dorsal, its base shorter than the abdomen; 1st dorsal with 3 or 4 low stiff spines.....*Naucrates*

Decapterus Bleeker, 1851



Round Scad; Round Robin; Cigarfish; Quia-quia
Decapterus punctatus (Agassiz)

References: *Caranx punctatus*, Agassiz in Spix, Pisc. Brazil. 1831, p. 108, Plate LVIa, fig. 2.
Decapterus punctatus, Meek and Hildebrand, Marine Fishes of Panama, II, 1925, p. 334.

Field Characters: Small, elongate, slightly compressed or fusiform fishes with minute teeth, long dorsal and anal fins, each followed by a single detached finlet.

Description: The specimens in the collection agree with the descriptions published, except that the smaller fish are considerably compressed and by no means fusiform. The widths of these specimens are contained about twice in the depth. Larger specimens in the American Museum of Natural History are almost fusiform. The two smallest individuals also have a larger head, it being contained 3.4 and 3.5 in the length. Teeth are present on the tongue of the large specimen.

Size and Weight: Grows to 1 foot. Our 95 mm. fish weighed 15 grams.

Color: One of the larger fish has 12 small black spots on the anterior portion of the lateral line, these being absent on the smaller fish. Jordan and Evermann mention these spots in their key to the species of the genus *Decapterus* but not in their description.

General Range: Known from Cape Cod to Brazil.

Abundance: This species seems to be rather rare about Port-au-Prince. It was seldom seen in the markets.

Method of Capture: The larger specimens were taken with hook and line, while the smaller were scooped up from beneath floating Sargasso weed.

Evermann and Marsh in "The Fishes of Porto Rico" mention young about 2 inches in length taken in a beam trawl at 220 fathoms. Judging from our small specimens taken under Sargasso weed by us, this record is questionable. As a beam trawl was used, the specimens may have been taken at almost any depth and could very likely have come from the surface.

Some of our other small specimens were taken at light at night.

Food: The 95 mm. specimen had fed copiously upon planktonic organisms, namely small copepods, and numerous zoea and ostracods. The small fish contained no food.

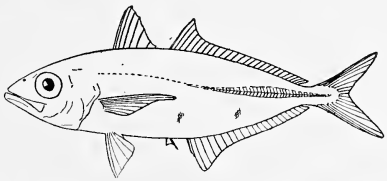
Enemies: A 6 mm. nematode in the alimentary canal of the 95 mm. fish.

Study Material: Specimens, 6; 33–95 mm., Nos. 7027, 7167, 7195.

Selar Bleeker, 1851

Large-eyed Selar Goggle-eyed Scad

Selar crumenophthalmus (Bloch)



References: *Scomber crumenophthalmus*, Bloch, 1793, Naturg. Ausl. Fische, VII, p. 77, Plate CCCXLIII.

Selar crumenophthalmus, Meek and Hildebrand, Marine Fishes of Panama, II, 1925, p. 335.

Field Characters: Small, elongate, little compressed carangids, with very large eye and well developed adipose eyelids; a deep furrow on the shoulder girdle near the isthmus and a fleshy projection above the furrow. Silvery, highly iridescent.

Description: Our specimens are typical in every respect.

Size and Weight: Grows to 2 feet. Our two specimens are as follows:

Length	*Weight*
175 mm.	104 grams
178 "	109 "

Color: Highly iridescent. Upper parts sage green shading into lighter green with a narrow band of calliste green on the middle of the sides. Lower parts opalescent, iridescent silver. Breast in front of the ventrals light rhodamine purple shading into blue violet and venice green. Opercles opalescent, blue violet, venice green and rhodamine purple predominating. Eye opalescent. Dorsal fin rays pale green yellow. Caudal pale green yellow edged with black. Pectorals, anal and ventral fins pearly white.

General Range: Known from most tropical seas.

Occurrence in Port-au-Prince Bay: Seen only beneath our schooner from 10 to 15 feet beneath the surface, where they came to feed upon worms, fish and other creatures that had been attracted to our lights.

Abundance: Not uncommon at light, but seen nowhere else. Not seen at the markets.

Method of Capture: Taken only by hook and line, the hook being baited with small silvery fish.

Food: Fed entirely upon small fish of various kinds and polychaete worms.

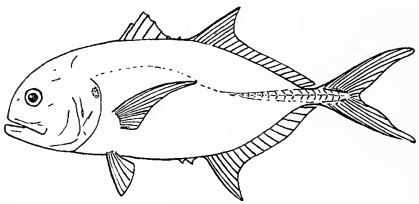
General Habits: As mentioned above this fish was found only about our lights, where they took great delight in preying upon any living organism that they could capture. They took a hook readily, and were easily brought to the surface when captured.

Study Material: Specimens, 2; 175 and 178 mm., No. 7191.

Caranx Lacepede, 1802

Key to Port-au-Prince Bay Species

A. Gill rakers 13 to 18 exclusive of rudiments, on the lower limb of the first arch.
B. Breast naked, with only a small triangular patch of scales in front of the ventrals; a large opercular spot present..... *hippos*
BB. Breast covered with small scales; opercular spot present or wanting.
C. Second dorsal and anal fins scarcely elevated anteriorly, the fins completely covered with minute scales; no opercular spots; lateral scutes 22 to 35..... *bartholomaei*
CC. Second dorsal and anal fin moderately or strongly developed anteriorly, only the elevated portions of the fins with minute scales; lateral scutes 35 to 38..... *latus*
AA. Gill rakers 24 to 32 exclusive of rudiments, on the lower limb of the first arch.
D. Second dorsal and anal fins long, the former with 27 or 28 rays, the latter with 23 or 24; lateral scutes 30 to 35; gill rakers 30 to 32..... *ruber*
DD. Second dorsal and anal shorter, the former with 22 to 25 rays; the latter with 19 to 24; lateral scutes 38 to 52; body moderately deep, 2.8 to 3 in length; gill rakers 24 or 25..... *crysos*



Common Jack-fish; Crevalle Toro; Horse Crevalle; Cavally
Caranx hippos (Linnaeus)

References: *Scomber hippos*, Linnaeus, 1766, Syst. Nat. Ed., XII, p. 494.
Caranx hippos, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 350.

Field Characters: Large, robust, compressed fishes, with short, deep head and blunt snout and with strong enlarged scutes along the posterior sides; breast naked; upper profile very strongly convex, lower slightly curved anteriorly. Bluish green above, sides with a brassy lustre, a large, very distinct

black spot on opercle; dorsal and caudal fins dusky; axil of pectoral fin black, lower rays of pectoral with a black blotch, indistinct or wanting in the young.

General Range: Tropical Atlantic and Pacific.

Abundance: Fairly common. Large specimens are often seen at the market places.

Method of Capture: Taken by us during airplane bombing practice, and with hook and line.

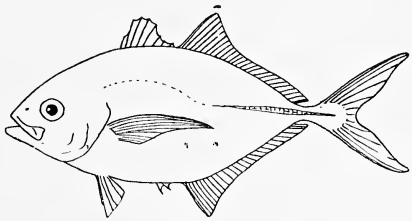
Food: Small fish, consisting mainly of young *Lutianus aya* and *Rhomboplites aurorubens*.

Breeding: In a 520 mm. fish, taken on March 11, 1927, the eggs were well-developed, and the ovary measured 110 by 60 mm.

Study Material: Photograph, 3751; Specimen, 1, 520 mm.

Yellow Jack

Caranx bartholomaei Cuvier and Valenciennes



References: *Caranx bartholamaei*, Cuvier and Valenciennes, 1833, Hist. Nat. Poiss., IX, p. 100.

Caranx bartholamaei, Meek and Hildebrand, Marine Fishes of Panama, 1925, II, p. 351.

Field Characters: Small, rather deep, compressed fishes with weak scutes along the posterior sides and with upper and lower profile almost evenly convex, the upper slightly more so; head short and blunt. Bluish green above, sides silvery, in the young strongly reticulated with gold.

Size and Weight: Grows to 15 inches. A 65 mm. fish weighed 5.25 grams.

Color: All of the smaller specimens observed by us, and especially those smaller than 75 mm. were strongly reticulated on the sides with irregularly-shaped patches of gold.

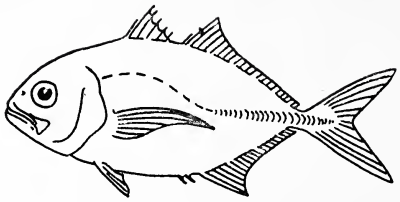
General Range: North Carolina to Panama.

Occurrence in Port-au-Prince Bay: This species is found all over the Bay in quite widely differing situations. It was found on the reefs and inshore in shallow water, on or near the bottom in 50 to 60 feet, and also at the surface at light at night.

Abundance: A common species, seen always while diving, and, although small and not of much value from a food stand-point, often seen in the market.

Method of Capture: Seines, dynamite, traps and hook and line; also taken at light.

Study Material: Specimens 15; 52–121 mm., Nos. 6959, 7154 and 7015.



Horse-eye Jack
Caranx latus Agassiz

References: *Caranx latus*, Agassiz, in Spix, Pisc. Brazil, 1831, p. 105.
Caranx latus, Meek and Hildebrand, Marine Fishes of Panama, II, 1925, p. 354.

Field Characters: Elongate, compressed, rather deep fishes with enlarged scutes along the posterior part of the sides, and with steeply descending forehead. Lobe of soft dorsal fin blackish, other fins pale, caudal yellowish or dusky.

Description: Most of our specimens have had 36 lateral scutes.

Size and Weight: Grows to 22 inches. Weights and measurements of three of our specimens are as follows:

Length	*Weight*
115 mm.	42 grams
158 "	103 "
238 "	320 "

General Range: Occurring in all tropical seas.

Occurrence in Port-au-Prince Bay: We have taken this species practically everywhere in the Bay,—at the surface, among coral heads on the reefs, and—especially the smaller individuals, along shore in shallow water.

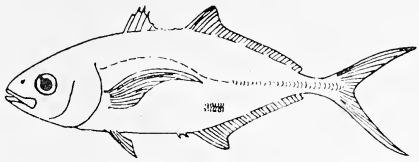
Method of Capture: Seines, hooks and lines, dynamite, and by scoop-nets at night at the surface.

Food: When these fish came to light they usually gorged themselves upon the many animals of this fruitful source of sustenance. One small specimen that we captured after its sojourn about the light, contained 33 small fish, including 2 full grown anchovies, 10 anchovy larvae, 8 leptocephalid eel larvae, in addition to 6 trigger-fish (*Monacanthus*), 2 puffers (*Spheroides testudineus*) and 6 Bumpers (*Chloroscombrus chrysurus*). This list was duplicated with variations in many other fish taken under the same conditions. While it may not be significant, none of our specimens contained worms, although they were as abundant as the fish under our lights.

General Habits: When these voracious attendants came about our submerged lamps they practically always remained from 6 to 15 feet beneath the surface, making quick darts up to the vicinity of the lights to capture food.

Study Material: Specimens, 27; 72–280 mm., Nos. 6851, 7013.

Blue-striped Cavalla; Carbonero; Cibi Mancho
Caranx ruber (Bloch)



References: *Scomber ruber*, Bloch, 1793, Naturg. Ausl. Fische, VII, 75, Plate 342.
Caranx ruber, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 357.

Field Characters: Elongate, compressed fish with long tapering head and with enlarged keeled plates along the posterior middle of the sides; upper profile evenly convex, lower outline only slightly curved in front of anal. Bluish and silvery with a brilliant blue line on sides just beneath the dorsal fin. Lower lobe of caudal fin with a black bar.

Color: Bluish olive, silvery below, scarcely yellowish in life; a stripe of brilliant clear blue just below the dorsal fin, which disappears rapidly after death. Dorsal yellowish gray, other fins dusky olive. Caudal fin vinaceous tawny with a distinct blackish band extending along the lower lobe.

General Range: West Indies; North Carolina, Bahamas and southward to Cozumel.

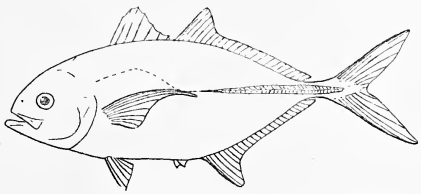
Occurrence in Port-au-Prince Bay: Found generally over reefs and in deeper water.

Abundance: Common, seen in markets in fair numbers practically every day. This was by far the commonest species of its genus seen while diving on the reefs. Schools of 10 to 20 often swam about the divers, their blue dorsal line making them exceptionally conspicuous as it reflected the sunlight from above.

Method of Capture: Taken by hook and line, in seines and by dynamite.

Study Material: Color Plate, H123; Specimens, 15; 77 to 275 mm., No. 7016.

Golden Jack; Hard-tailed Jack; Runner, Jurel, Yellow Mackerel, Caran
Caranx crysos (Mitchill)



References: *Scomber crysos*, Mitchill, 1815, Trans. Lit. and Phil. Soc., N. Y., I, p. 424.
Caranx crysos, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 358.

Field Characters: Elongate, rather slender, compressed short-headed and short-snouted fishes with rather strong scutes along the posterior middle sides; upper and lower profile evenly convex. Bluish above, silvery below; spinous

dorsal and margins of dorsal and caudal dusky; other fins pale; a black opercular spot.

Size and Weight: Grows to one foot. A 95 mm. specimen weighed 16.5 grams.

Color: A 95 mm. fish had 8 well-marked vertical cross-bars. It was brassy in lustre with yellow dorsal and caudal fins, rather than greenish yellow. A dusky opercular and axillary spot present.

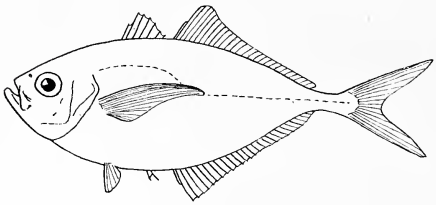
General Range: Cape Cod to Brazil.

Occurrence in Port-au-Prince Bay: Found usually over fairly deep banks.

Abundance: Uncommon, seen occasionally in the markets.

Study Material: Specimens, 7; 92 to 324 mm., Nos. 6844 and 7117.

Chloroscombrus Girard, 1858



Bumper, Casabe

Chloroscombrus chrysurus (Linnaeus)

References: *Scomber chrysurus*, Linnaeus, 1766, Syst. Nat. Ed. XII, p. 494.
Chloroscombrus chrysurus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 369, Plate XXX.

Field Characters: Small, very compressed fishes, with convex dorsal and ventral outlines, the latter more convex than the former; anal and dorsal fins long and low. Silvery, specimens over 30 mm. in length with a black spot on the upper side of the caudal peduncle; fins yellowish.

Description: In a series of 25 specimens the soft rays of the dorsal fin were 27 in number in 22 individuals, 28 in two and 29 in one, instead of 26 to 27 as given by Meek and Hildebrand. The anal fin count in all our specimens was 26 to 28. The young are deeper than the adults, and in individuals from 13 to 30 mm. standard length, the depth was from 1.9 to 2. At 35 mm. and over our specimens had the described depth assigned to the species of 2.1 to 2.4. A procumbent dorsal spine was present in all of our specimens.

Size and Weight: Grows to 8 inches. Specimens in the Haitian collection range from 6.5 to 180 mm. in length.

Color: "Bluish gray above, sides silvery; a small opercular spot present; a prominent black, quadrate blotch on the upper half of the base of caudal: fins yellowish in life; vertical fins edged with black; pectorals and ventrals pale in spirits." (Meek and Hildebrand.)

The quadrate black spot on the upper side of the caudal peduncle is not present in very small fish. In a series of 408 ranging from 6.5 to 60 mm. it does not begin to show until the fishes are about 30 mm. in length. When the fish approach this length the pigment becomes more concentrated and in some individuals the black spot has already taken its intense black adult form.

In 10–11 mm. preserved specimens there is a considerable concentration of pigment along the bases of the dorsal and anal fins, the pigment spots having their longer axes horizontal in those beneath the dorsal. A line of elongated horizontal pigment spots present along the posterior half of the body. Upper surfaces of the body peppered with minute chromatophores, especially prominent above the brain and a few on the posterior half of the body beneath the lateral line pointing backward toward the tail. These spots tend to become elongate. A few scattered chromatophores on the anal and lower caudal rays. Through the transparent skin a number of chromatophores are visible on the peritoneum.

In a 7.5 mm. fish the coloration is much the same, except that the spots above the anal fin are concentrated so that they form a continuous line, and some of the pigment spots on the lower posterior part of the sides, follow the direction of the myomeres.

In a 23 mm. fish the spots are more numerous, and they are especially abundant on the upper part of the sides. The chromatophores along the base of the anal and ventral fins are not as noticeable. Chromatophores are visible on the dorsal fin, there are very few on the anal, and quite a number on the caudal.

General Range: Cape Cod to Brazil.

Occurrence in Port-au-Prince Bay: Generally distributed over the bay, and especially along the coast north of Port-au-Prince.

Abundance: Bumpers are among the most abundant of fishes to be found in the vicinity of Port-au-Prince, and they are taken in large numbers by the seine and net fishermen. Although a poor food fish, they are commonly seen in the market, either whole and fresh in the morning, or, later in the day, with slashed sides, which have been rubbed with salt and lime as a preservative.

Method of Capture: Although practically all of our fish and especially the larger ones, were taken by seines and drift nets considerable distances from shore, all of the small ones (6 to 20 mm.) were captured at night as they came to our submerged lights. Three groups were captured in daylight with scoop nets placed under jelly fish, 303 specimens from 12.5 to 47 mm. under a *Chiropsalmus* (T. R. S. 27469) on May 10, 1927; 18 fish from 24 to 34.5 mm. from under the bell of *Tamoya haplonema* (T. R. S. 27324) on April 21, 1927, and twenty-two of an estimated 400 from beneath the tentacles of a *Cyanea* about 3 feet across the disk. In the last mentioned instance the medusa was swimming about 4 feet beneath the surface under the poop of our schooner. When the jelly broke up during capture, clusters of fish gathered beneath each fragment. The fish that we captured and placed in an aquarium lived but a short time. In the first case mentioned, the 303 specimens under one bell,—the Bumpers were accompanied by a 22 mm. Harvest-fish (*Peprilus paru*); in the second case with several small fish of the same species.

In the first and second captures a fine meshed net was lowered beneath the medusa and the captures can be definitely stated as containing all of the fish beneath the jelly, the fish crowding up as close to the coelenterate as they could, when they observed the net approaching them.

Food: This species apparently feeds mostly in daylight, as the examinations of the stomachs of dozens of specimens caught during the hours just before dawn revealed little or no food. However those that did, had mostly planktonic

forms and our notes lists the following organisms as contributing toward the diet of these fishes. Mass of stalk-eyed shrimps; pure culture of crustaceans resembling *Lucifer;* shrimps; many small transparent shrimps, megalops; in short a truly planktonic diet, specializing in crustacea. Two other specimens had fish scales in their stomachs, and a daylight captured fish had a polychaete worm.

Enemies: Nematodes were found rather sparsely in the alimentary tract. Two fishes had a number of purplish punctures on the sides and especially on the caudal peduncle. These, apparently, were the result of contact with the spines of purplish sea-urchins. Whether this ever results disastrously we do not know.

Size at Maturity: Specimens 80 mm. long carry well developed gonads, and it is possible that they mature at a still earlier stage.

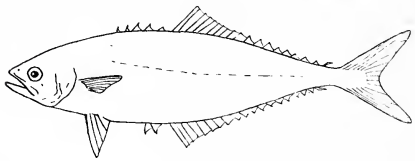
Spawning Season: Eggs were mature during March and April, but we have no evidence of their being laid, or of the duration of the spawning season before or after these dates.

Eggs: Eggs .17 to .34 mm. in diameter observed on March 19.

General Habits: The habits of the young living beneath medusa have already been mentioned.

Study Material: Photograph, 3878; Specimens, 1500 individuals; 6.5–180 mm., including Nos. 6830, under medusa, 6842, 7006, 7024, 7050, 7054, 7087a, 7183, 7184, 7185, 7192, 7193 under medusa, 7203, 7243, 7250, 7259, 7281 under medusa.

Oligoplites Gill, 1863



Leather Jacket, Kal
Oligoplites saurus (Bloch and Schneider)

References: *Scomber saurus,* Bloch and Schneider, 1801, Syst. Ichth., p. 321.
Oligoplites saurus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 390, Plate XXXIX.

Field Characters: Medium, compressed, lanceolate fishes with unarmed lateral line, long second dorsal and anal fins, the membranes very deeply cut down, so that the depressed fin resembles a series of finlets, similar to those of the mackerels. Skin leather like. Bluish above, sides silvery, fins mostly yellowish.

Size and Weight: Grows to 12 inches. Our 233 mm. fish weighed 132 grams.

General Range: Both coasts of tropical America, extending north to New York and Lower California.

Occurrence in Port-au-Prince Bay: Small specimens fairly common at light, the adults seen in the market rarely.

Abundance: Rather a rare species.

Method of Capture: Our large specimen was seined. The smaller ones were

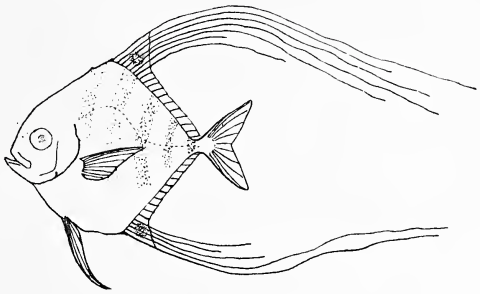
taken with scoop nets at the surface, both at light at night and during the day time.

Food: Small anchovies found in stomach.

Study Material: Specimens, 4; 13.5–233 mm., Nos. 6968, 7113, 7163 and 7243.

Alectis Rafinesque, 1815

Threadfish
Alectis ciliaris (Bloch)



References: *Zeus ciliaris*, Bloch, 1787, Naturg. Ausl. Fische, III, p. 36, Plate CXCI.
Alectis ciliaris, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 364.

Field Characters: Adults: elongate, very strongly compressed fishes with outline everywhere trenchant, scales very small; anterior profile convex; dorsal and anal filamentous. Young: body strongly ovate; dorsal and anal filaments exceedingly long and thread-like.

Description: The maxillary in our specimen is narrow and barely reaches the front of the eye.

Size: Grows to 22 inches and possibly larger.

Color: The 2nd, 3rd and 4th dorsal filaments and the 2nd and 3rd anal filaments black. All others white.

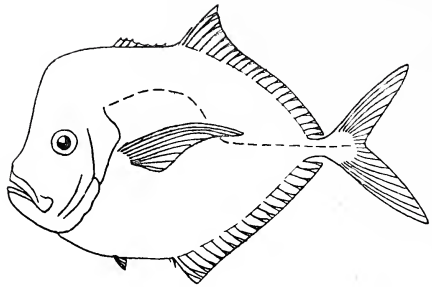
General Range: Cosmopolitan in tropical seas.

Occurrence in Port-au-Prince Bay: Our single specimen seined close along shore.

Method of Capture: Our single small specimen was taken in a seine.

Study Material: Color Plate, H20, No. 6872; Specimen, 1; 118 mm. No. 6872.

Vomer Cuvier, 1817



Bristle-finned Moonfish
Vomer setapinnis cubensis Nichols

REFERENCES: *Argyreiosus setipinnis*, var. a (In part) Günther, 1860, Cat. Fishes Brit. Mus., II, p. 459.
Vomer gabonensis (Not of Guichenot), Jordan and Evermann, 1896, Bull 47, U. S. National Mus., I, p. 934.
Vomer setapinnis cubensis Nichols, 1918, Bull. Amer. Mus. Nat. Hist., XXXVIII, p. 672.

FIELD CHARACTERS: Very much compressed, bright silvery fishes with vertical forehead, soft dorsal and anal fins low anteriorly, not falcate. Jaws weak, pectorals falcate.

DESCRIPTION: All of the specimens of this genus in our collection can be assigned to this subspecies as it is described by Nichols. Our experience parallels that of Evermann and Marsh in Porto Rico, as all of their specimens were assigned to "*gabonensis*," which Nichols has shown to be invalid as a name for this fish.

SIZE AND WEIGHT: Grows to 12 inches. An 88 mm. fish weighed 16 grams.

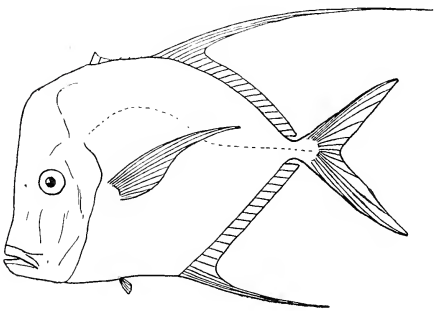
GENERAL RANGE: West Indies.

METHOD OF CAPTURE: Taken with seines at night.

FOOD: Several small anchovies and long, eye-stalked shrimps found in the stomach of one fish.

STUDY MATERIAL: Specimens, 21; 59–181 mm., No. 6821.

Selene Lacépède, 1803



Look-down
Selene vomer (Linnaeus)

References: *Zeus vomer*, Linnaeus, 1758, Syst. Nat. Ed. X, p. 266.
Selene vomer, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 372.

Field Characters: Very deep, exceedingly compressed silvery fishes with falcate second dorsal and anal fins. Edges of the body trenchant. Anterior line of the head sloping backward.

General Range: Maine to Uruguay.

Method of Capture: In seine at night.

Abundance: Rare. Not seen at the market.

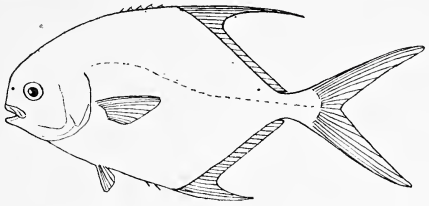
Study Material: Photographs, 3775, 4000, 4001; Specimen, 1; 123 mm., No. 6836.

Trachinotus Lacépède, 1802

Key to Port-au-Prince Bay Species

A. Body deep ovate, the depth 1.3 to 1.8 in the length, sides without black cross bars.....*falcatus*
AA. Body moderately elongate, depth 1.9 to 2.65 in the length, sides with cross bars, except in the very young.....*glaucus*

Round Pampano; Palometa, Kareng-a-plime
Trachinotus falcatus (Linnaeus)



References: *Labrus falcatus*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 284.
Trachinotus falcatus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 378, Plate XXXIII.

Field Characters: Small to medium compressed, rather deep fish without enlarged keeled scales on the sides; abdomen rounded, never trenchant; anal fin about as long as soft dorsal; pectoral fins not falcate; adults with lobes of soft dorsal and anal fins elongate, sometimes reaching to the caudal fin.

Description: With the exception of one fish, all of our specimens have been small. Our fish differs from the photograph (Plate XXXIII) of a 48 mm. fish given by Meek and Hildebrand in that the depression over the eyes is not so marked. In all the specimens the profile from the nostrils to the dorsal fin is almost straight, with a slight convexity on the posterior part. The spines on the opercles are considerably more in evidence than they are in the illustration mentioned above. In a 13 mm. fish there is a large spine, one-half the diameter of the eye, at the lower angle of the preopercle, flanked above and below by a smaller one; 3 small spines are present on the lower and 6 on the upper limb of the preopercle. A 10.5 mm. fish differs in having 4 spines on the upper and 2 on the lower.

In all of our small specimens the two spines preceding the anal fin are connected by membrane with the fin.

Size and Weight: Grows to 12 inches and a weight of 3 pounds. Our specimens ranged from 10.5 mm. to 180. Our 180 mm. fish weighed 206 grams.

Color: Great variation exists among the small specimens taken in Haiti, and the variations change while the fish is being watched. Some of these small fishes instead of being silvery, have parts of the sides a warm brown, usually unsymmetrically. Descriptions from life of a 13, 15 and 45 mm. specimens are given below:

13 mm. Entire body thickly covered with small brown spots, so close together that the paler ground color is almost obliterated; the brown color absent on the maxillary, premaxillary and on the branchiostegal membranes. Top of head brick-red. Membrane of the spinous dorsal and base of the anterior membranes of the soft dorsal black, the black on the soft dorsal becoming less as it progresses backward. A few black dots on the dorsal spines. Base of the anal, membranes between the anal spines and the anterior membranes of the anal fin black. All other fins pale.

15 mm. Two specimens of this length were recorded as being iridescent bronze throughout; the iris and thickened web about the dorsal and anal spines grenadine red; the web between these spines and the basal half of the dorsal and anal rays black.

45 mm. Bluish silvery, with minute blackish punctulations over the entire body with the exception of the lower chin, isthmus and just before the ventrals. Dorsal membranes dusky. Anal membranes dusky basally, the duskiness decreasing posteriorly. Pectorals clear. Tips of the ventrals, the anal spines and tip of the anal lobe orange-red.

General Range: Cape Cod to Brazil.

Occurrence in Port-au-Prince Bay: Small specimens were not uncommon inshore over shallow, weed-covered beaches and about shallow coral reefs. Other small fish of 15 to 20 mm. came to light at our ship, which was anchored one quarter of a mile offshore in from 40 to 60 feet of water, so that the young are very likely surface forms, quite widely distributed.

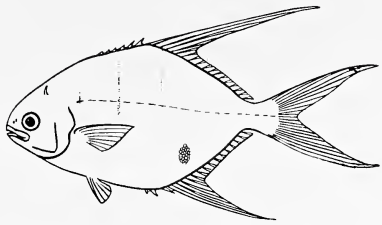
Abundance: Uncommon, rarely seen at the markets.

Method of Capture: Seined near shore, and taken in scoop nets at surface near lights at night.

General Habits: The small specimens captured by us demonstrated the most amazing vitality and powers of motion. Two or three that were placed in aquariums for observation, kept whirling about at a rapid rate for long periods at a time, the one that persisted longest maintaining this whirling for several days. We could see no reason for this habit, and the fish were not injured when captured.

Study Material: Color Plate, H59, No. 7018; Specimens, 6; 13–180 mm.; Nos. 6906, 7018 and 7120.

Gaff-topsail; Pampano; Palometa
Trachinotus glaucus (Bloch)



References: *Chaetodon glaucus,* Bloch, 1787, Naturg. Ausl. Fische, III, p. 112, Plate CCX.
Trachinotus glaucus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 382, Plate XXXVI.

Field Characters: Medium sized, somewhat elongate, strongly compressed fishes with blunt snout and with the profile over the snout very steep. Color, variable, bluish black to pale brown above, silvery below; sides with 4 or 5 cross bars, varying much in width and intensity and wanting in fishes smaller than 75 mm.

Description: Two small specimens of 22 mm. length are assigned to this species. The lateral line in both is somewhat straighter than is shown in the illustration given of an adult by Meek and Hildebrand.

Size and Weight: Grows to 12 inches.

General Range: Virginia to Argentina.

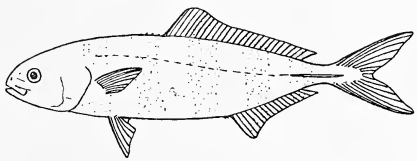
Occurrence in Port-au-Prince Bay: Our 2 specimens were taken over a smooth sandy beach at Source Matelas. We did not take it along the southern shore of the Bay.

Method of Capture: Seining.

Study Material: Specimens, 2; 22 mm., No. 7106.

Naucrates Rafinesque, 1810

Pilot Fish
Naucrates ductor (Linnaeus)



References: *Gasterosteus ductor,* Linnaeus, 1758, Syst. Nat., Ed. X, p. 295.
Naucrates ductor, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 400.

Field Characters: Small, rather elongate cigar-shaped fishes with small mouth; spinous dorsal with 3 to 4 low disconnected spines; young and old with 6 vertical cross bands.

This species is included on the basis of a 5-inch specimen which was seen three times while diving at Sand Cay in Port-au-Prince Bay. It was swimming in the midst of a school of Caranx ruber, came close to me for five minutes, and measured from 10 to 16 inches. (W. B.)

Family Amiidae; the Cardinal Fishes

Key to Port-au-Prince Bay Genera

A. Margin of preopercle serrate; ventral fins not reaching to base of anal. *Amia*

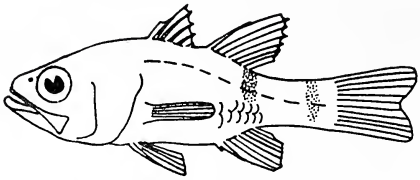
AA. Margin of preopercle not serrate; ventral fins reaching to middle of anal fin. . . . . *Apogonichthys*

Amia Gronow, 1763

Key to Port-au-Prince Bay Species

A. Color scarlet, with a black band from posterior portion of soft dorsal to anal fin, and a similar bar on the caudal peduncle. . . . . *binotatus*

AA. Color pinkish iridescent coppery, an oval dark blotch on the caudal peduncle. Small pigment spots over entire body. . . . . *pigmentarius*



Two-spotted Cardinal Fish
Amia binotata Poey

References: *Amia binotata*, Poey, 1867, Repertorio, II, p. 234.
Apogon binotatus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 416.

Field Characters: Small, compressed, large-mouthed fishes with continuous lateral line; large scales; dorsal fins separated; scarlet, with narrow black band on sides from posterior dorsal rays to anal fin and another on caudal peduncle.

Description: A 93 mm. fish from Haiti agrees with the description of similar sized specimens from Panama with the following slight differences in proportional measurements:

	Haiti	*Panama*
Depth	3.15	3
Head	2.5	2.58
Eye	3.1	2.9
Interorbital	5.3	5
Snout	4.2	4.6
Maxillary	1.8	1.85
Pectoral	1.65	1.6
Caudal peduncle	2.8	2.75

A second fish, 53 mm. long, is provisionally identified as this species, although differing considerably in a number of details. In color (we possess a drawing of the specimen in life) it agrees perfectly with the description of the species. It differs in having the maxillary shorter, reaching only to between the center of the eye and the posterior margin of the pupil; the lower profile is not angulated at the angle of the jaw, but at the ventral fins. In contrast to the larger Haitian fish, the dorsal profile is absolutely straight from snout to dorsal fin.

Whether these differences can be laid to age is a question, and in the present state of our knowledge of the growth stages of these West Indian fishes, it seems better to assign this specimen to this species.

Size and Weight: Grows to less than 4 inches. A 93 mm. fish weighed 25 grams.

Color: Scarlet, including the fins, which are especially rich in color. Upper surfaces of head and body with dark punctulations. A blackish bar from posterior rays of dorsal fin to the anal and a similar bar on the caudal peduncle.

General Range: Haiti, Cuba, Panama, Curacoa and Venezuela.

Distribution in Port-au-Prince Bay: Taken by us on the coral reefs.

Abundance: Rare.

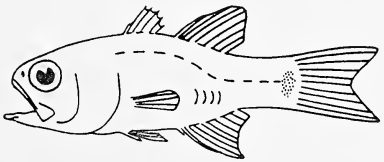
Method of Capture: Dynamite.

Food: The smaller fish had swallowed an enormous shrimp, creamy white, variegated and banded with scarlet. Its stomach was extended greatly by this prey.

Breeding: The ovaries in the 53 mm. fish captured April 30 were well developed and contained about 200 round white eggs, averaging .25 mm. in diameter.

Study Material: Colored Plate, H109, No. 7205; Photograph, 4249; Specimens, 2; 53–93 mm. including Nos. 7256, 7267.

Peppered Cardinal Fish
Amia pigmentarius (Poey)



References: *Monoprion pigmentarius*, Poey, 1860, Memorias, II, p. 123.
Apogon pigmentarius, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 418.

Field Characters: Small, compressed, large mouthed fishes with continuous lateral line, large scales, dorsal fins separated; coppery colored, with a dark peduncular spot, and a dark line from eye downward and backward. Lives in sponges.

Description: 30 Haitian fishes in the collection ranging from 23 to 43 mm. are assigned to this species. When compared with the descriptions given by Meek and Hildebrand, Jordan and Evermann (except color) and in the key to West Indian forms of *Amia* given by Breder (1927), we are unable to separate our specimens from *pigmentarius*. Poey, in the original description, however, makes the statement that *pigmentarius*, is "rouge carmine dore," which the Haitian specimens never were, either in life or preservative. Jordan and Evermann translate this as carmine red, but it is possible that the "dore" of Poey, may be the coppery bronze appearance of our fish. Our preserved fish agree with the description of similar fish taken by Meek and Huldebrand.

One pattern, present on our fishes, is not mentioned by anyone, and we have not been able to obtain specimens to compare with our fishes. This is a dark bar which runs downward and backward from the eye across the opercle.

This is present in the majority of our fish, and is vaguely indicated in all but the very palest of our specimens. Four of the fish are very pale, lacking all pattern but a few scattered pigment cells.

The present series without exception came from the interiors of tubular sponges, and this may be significant in relation to Poey's statement as to the rarity of examples. Our experience in Haiti was that without a diving helmet it is practically impossible to capture these fish.

Because of the difference in color and habitat there is a temptation to describe these fishes as new, but it is felt that further knowledge will demonstrate these fishes to be *pigmentarius*.

Size and Weight: Grows to two inches. A 40 mm. fish weighed 2 grams.

Color: Iridescent, changing from coppery to silvery, bronze and violet on the maxillary, sides of head, opercles, anterior half of the body and on the mid-sides to the caudal, the general effect being pinkish gold. The back and posterior sides and belly pinkish flesh. The whole head, except the crown is thickly speckled with reddish brown, rayed pigment spots. The whole body has a scattering of these spots, which can be closed up, leaving a sparse peppering of minute black specks. Two distinct pattern spots are always present, an elongated upright blotch at the base of the caudal, and a broad dark bar of pigment spots, down and back from the eye to the lower edge of the preopercle. The fins are pink finely dotted with pink and black, the bases of the vertical fins darkly pigmented. Iris dull gold.

General Range: Cuba, Haiti, St. Eustatius, Curacoa and Panama.

Distribution in Port-au-Prince Bay: Found only in tall, tubular sponges.

Abundance: Fairly common in their restricted habitat, more than fifty percent of the sponges being inhabited by these fish.

Method of Capture: Diving and stuffing cotton into the efferent apertures of the sponges, and then sending the sponges to the surface whence the fish were removed. Dynamite often killed these fishes while they were in their sponges, even though fifteen to twenty feet or more away from the explosion.

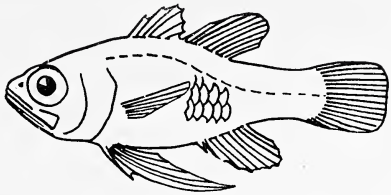
Eggs: About 285 eggs in a 40 mm. fish taken on February 11th measured .35 mm. in diameter; there were about 770 eggs altogether in the ovary. In a second individual examined there were about 750 eggs, most of them measuring about .4 in diameter.

Enemies: A proportionately large number of these fish are attacked by parasitic isopods. On one fish a pair of these crustaceans had been firmly attached to the side of a fish in front of the dorsal fin. They were removed with difficulty long after the fish's death, and left a bare area, free of scales, eaten into the flesh.

Study Material: Color Plate, H104; No. 7179; Photographs, 3813, 3856, 4053; Specimens, 30; 23 to 43 mm., including Nos. 6869, 6911, 6912, 6919, 6964, 6986, 6989, 7179, and 7180.

Apogonichthys Bleeker, 1859

Spot-finned Cardinal Fish
Apogonichthys stellatus Cope



References: *Apogonichthys stellatus*, Cope, 1866, Trans. Amer. Philos. Soc., p. 400.
Apogonichthys stellatus, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 1110.

Field Characters: Very small, rather deep, large-eyed fishes with separate spinous and soft dorsal fins; margin of preopercle smooth; ventral fins long; all fins except pectorals and caudals with a dark blotch; body with minute black punctulations.

Description: A single 14.4 mm. fish is believed to belong to this species.

Color: Dark golden, much like *Amia pigmentarius*. At death the pigment cells contract and are visible only as small points.

General Range: Bahamas, Haiti and St. Eustatius.

Abundance: Rare.

Method of Capture: Seine.

Study Material: Specimen, 1; 14.4 mm. No. 7114.

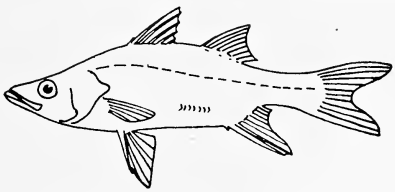
Family Centropomidae; the Robalos

Centropomus Lacépède, 1803

Key to Port-au-Prince Bay Species

A. Scales small, 67 to 90 in lateral series from supraclavicle serrae to base of caudal; pectorals short, not nearly reaching tips of ventrals, 1.5 to 2.2 in head.
B. Gill rakers on lower limb of first arch 13 to 15, exclusive of rudiments. *pectinatus*
BB. Gill rakers 7 or 8 on lower limb of first gill arch, exclusive of rudiments. *undecimalis*
AA. Scales larger, 50 to 56 in lateral series from supraclavicle serrae to base of caudal, pectorals longer, reaching to or nearly to tips of ventrals. *ensiferus*

Comb-toothed Snook
Centropomus pectinatus Poey



References: *Centropomus pectinatus*, Poey, 1860, Memorias, II, p. 121.
Centropomus pectinatus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 421.

Field Characters: Medium sized, elongate, compressed fishes with rather low head and snout, and prominent, lateral line; second and third anal spines of equal length; pectoral fin tips not reaching tips of ventrals; 13 to 15 gill-rakers on lower limb of first arch exclusive of rudiments.

Description: Our specimens agree perfectly with typical descriptions.

Size and Weight: Seldom grows larger than a foot. Our four specimens measure and weigh as follows:

	Length	*Weight*
Number 7236	281 mm.	327 grams
" 6936	272 "	325 "
" 7324	272 "	320 "
" 7327	236 "	202 "

Color: The black lateral line is especially conspicuous in our specimens, although it is supposed to fade out in larger individuals.

General Range: Known from both coasts of tropical America, ranging in the Atlantic from the West Indies to Bahia, and in the Pacific from Guaymas, Mexico to Buenaventura, Colombia.

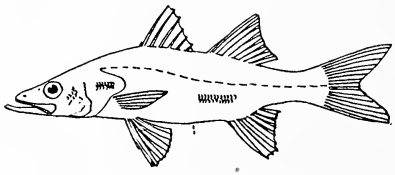
Distribution in Port-au-Prince Bay: Taken by fishermen generally.

Method of Capture: Mainly by seines.

Food: The stomach contents of four specimens contained an almost pure culture of shrimps and anchovies, the latter group containing specimens of *Anchoviella* sp. and *Centengraulis edentulus*, up to 90 mm. in length.

Breeding: Two males and two females taken in February showed practically no indication of breeding.

Study Material: Specimens, 4; 236 to 281 mm. including Nos. 6936, 7236, 7324 and 7327.



Common Snook
Centropomus undecimalis (Bloch)

References: *Sciaena undecimalis*, Bloch, 1792, Naturg. Ausl. Fische, VI, p. 60, Plate CCCIII.
Centropomus undecimalis, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 425.

Field Characters: Medium to large, elongate, somewhat compressed fishes, with long, low head and projecting lower jaw; scales rather small, 67 to 77 in lateral series to base of tail; gill rakers 7 or 8 on lower limb of first arch.

Description: Our specimens are typical. The smallest and largest examined measured as follows:

Number	*6857*	*7252*
Length	83 mm.	795 mm.
Depth	21 "	192 "
Head	33 "	274 "
Eye	7 "	26 "
Snout	9 "	19 "

Size and Weight: A female measuring 31 inches or 795 mm. weighed 16 pounds.

General Range: Florida and the West Indies to Brazil.

Occurrence in Port-au-Prince Bay: Taken generally by the fishermen in the Bay and seen sparingly in the market. Small ones were taken in brackish streams, and several in the land-locked, brackish, sulphurous lagoons inhabited by small tarpon at Source Matelas.

Abundance: Uncommon.

Method of Capture: Taken in seines.

Food: Specimen 6857, length 83 mm., from land-locked tarpon lagoon, had eaten 41 water boatmen, *Trichocorixa reticulata* (Guerin), and a small fish, somewhat comminuted, but resembling a small *Centropomus*.

Size at Maturity: A female 795 mm. was in full breeding condition.

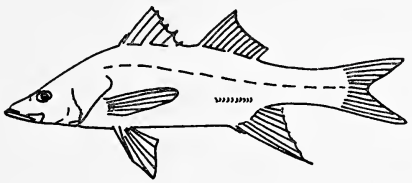
Spawning Season: The above individual was taken on May 3rd.

Eggs: In the 795 mm. female, each ovary is 210 by 45, by 25 mm. high, and weighed 206 grams. Conservative count of 200 to each fortieth of a gram worked out at 1,648,000 eggs. Average diameter of the round, white eggs .5 mm.

Study Material: Photographs, 3910, 4253; Specimens, 5; three small ones 72 to 83 mm., Nos. 6857, 7330, 7331, two large ones, 665 and 795 mm., Nos. 7129 and 7252.

Sword-spined Snook

Centropomus ensiferus Poey



References: *Centropomus ensiferus*, Poey, 1860, Memorias, II, p. 122, Plate XII, fig. 1.

Centropomus ensiferus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 433.

Field Characters: Rather small, elongate, moderately compressed fishes with rather long, depressed head; scales rather large, 50 to 56 in lateral line to base of tail; second anal spine much enlarged, reaching to or beyond base of caudal fin when deflexed. Pectoral fin reaching to or nearly to tip of ventrals.

Description: All of our specimens are typical.

Size and Weight: Our largest and smallest specimens; Length 173 mm., weight 102 grams; 212 mm., weight 212 grams.

General Range: West Indies and the Atlantic coast of tropical America, from Cuba to Rio de Janeiro.

Distribution in Port-au-Prince Bay: Taken generally near shore, and also in center of bay.

Abundance: Uncommon.

Method of Capture: Taken by seines, and on hooks and lines.

Food: Like the other Snooks, this species also devoured shrimps and anchovies.

Breeding: In a 260 mm. fish taken on March 3rd, the ovaries measured 60 x 26 mm. and the eggs were well developed.

Study Material: Specimens, 5; 173–212 mm., including Nos. 6834, 7057, 7325, 7328, and 7329.

Family Epinephilidae; Sea-Bass; Groupers

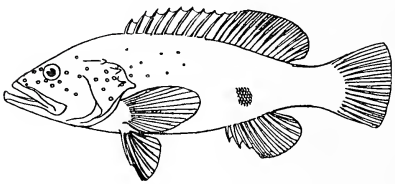
Key to Port-au-Prince Bay Genera

A. Anal fin with 3 spines.
B. Dorsal fin normally with 9 spines. Caudal fin rounded; dorsal fin rather high, with 14 to 17 soft rays; gill rakers rather short, fewer than 18 on the lower limb of the first arch.
C. Dorsal fin IX–15 to 17; anal rays III–9 ..... *Cephalopholis*
CC. Dorsal fin IX–14; anal rays III–8 ..... *Petrometopon*
BB. Dorsal fin normally with 10 or 11 spines.
D. Anal fin with 11 or 12 soft rays ..... *Mycteroperca*
DD. Anal fin shorter, with 7 to 9 soft rays.
E. Posterior margin of the preopercle serrate, the lower limb entire; no antrorse spines.
F. Scales of the lateral line normal.
G. Cranium narrow above the interorbital space, deeply concave; occipital crest meeting the interorbital region ..... *Epinephilus*
GG. Cranium very broad and flat above, the interorbital space little concave; the occipital crest disappearing before reaching the interorbital region. *Garrupa*
FF. Scales of the lateral line with 4 to 6 strong radiating ridges; cranium short, extremely broad and depressed between the eyes; anterior profile of the head a little concave; dorsal spines low, dorsal fin XI–16 ... *Promicrops*
EE. Posterior margin of the preopercle serrate; a single antrorse spine on the lower posterior angle. ..... *Alphestes*
AA. Anal fin without spines; dorsal fin with 2 or 3 spines only ..... *Rypticus*

Cephalopholis Bloch and Schneider, 1801

Key to Port-au-Prince Bay Subspecies

A. General color red ..... *ruber*
AA. General color brown ..... *punctatus*



Red Guativere; Outalibi

Cephalopholis fulvus ruber (Bloch and Schneider)

References: *Gymnocephalus ruber*, Bloch and Schneider, 1801, Syst. Ichth., p. 346, plate 67.

Bodianus fulvus ruber, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 1145.

Field Characters: Scarlet sea-bass; sides and back with small black or bluish spots. Two black spots on upper part of caudal peduncle and two black spots on the tip of the lower jaw.

Description: Some of our fish have a slightly smaller eye than has been published for the species.

Size and Weight: Grows to about a foot. Our three examples measure and weigh as follows:

Length	*Weight*
172 mm.	104 grams
194 "	190 "
209 "	250 "

Color: Reddish with an orange tone, deepest on the dorsal surfaces and especially on the head. Small blue spots, surrounded by a narrow brownish line, scattered over the entire surfaces except below and on the tail. In some specimens these spots are black, and occasionally they are white. Tips of the ventral and anal fins especially brilliant.

General Range: West Indian fauna; Florida Keys to Brazil.

Occurrence in Port-au-Prince Bay: Seen rarely on reefs, rather common on the banks at the eastern end of Gonave Island.

Abundance: This is a common species, especially about the banks of Gonave Island, as mentioned above. It is often seen in the fish markets of Port-au-Prince.

Method of Capture: Hook and line and traps.

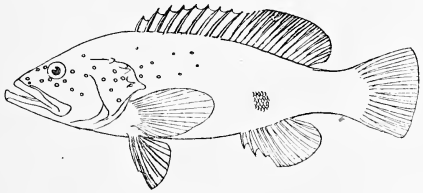
Food: Most of our specimens contained crustaceans, mostly shrimps. One, however, was filled with algae.

Enemies: In two fish small cysts (?) were found loosely attached to the intestine near the anus. They were grape-like in consistency, mainly metallic blue and gray in color, the largest measuring 6 by 7 mm. Three of them collapsed when removed from the fish.

Study Material: Colored Plate, H58, No. 6992; Specimens, 3; 172–209 mm. including 6992.

Nigger-fish; Negro-fish; Black Guativere

Cephalopholis fulvus punctatus (Linnaeus)



References: *Perca punctatus*, Linnaeus, 1758, Syst. Nat., X, p. 291.

Bodianus fulvus punctatus, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 1146.

Field Characters: Brown sea-bass; sides and back with small black or bluish spots. Two black spots on upper part of caudal peduncle and two black spots on the tip of the lower jaw.

Size and Weight: Grows to about a foot. Our 177 mm. fish weighed 143 grams.

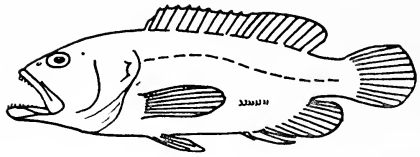
General Range: West Indies.

Occurrence in Port-au-Prince Bay: Found on reefs.

Abundance: As far as we were able to observe this fish is not as common as the red variety.

Study Material: Specimen, 1; 143 mm., No. 7238.

Petrometropon Gill, 1865



Brown Hind; Petit Negre

Petrometopon cruentatus coronatus (Cuvier and Valenciennes)

References: *Serranus coronatus*, Cuvier and Valenciennes, 1828, Hist. Nat. Poiss., II, 371.

Petrometopon cruentatus coronatus, Jordan and Evermann, 1896, Bull. 47, U. S. National Museum, I, p. 1142.

Field Characters: Small, compressed sea-bass with nine dorsal spines and rounded tail; brown with very dark, red, round spots on lower part of sides and head; a jet black spot on the back just below the base of first soft dorsal rays; sometimes with several dark spots on back just below base of dorsal.

Size and Weight: Grows to about a foot. None of our specimens were larger than 166 mm., such a fish weighing 114 grams. A 59 mm. fish weighed 6 grams.

General Range: Florida to Brazil.

Occurrence in Port-au-Prince Bay: Found more or less all over the Bay, and especially common on the banks just east of Gonave Island. It was by far the most abundant species taken at our schooner anchorage, where the bottom ranged from 40 to 60 feet beneath the surface. Authors speak of finding it among rocks, but we found it most common over mud.

Abundance: Common, seen every day at the market. Especially abundant in the deeper waters away from shore.

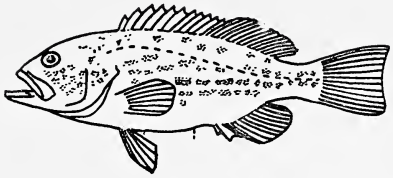
Method of Capture: Taken almost entirely by hook and line, but it is also captured in wicker traps.

Food: One fish caught with a stomatopod in its mouth.

Study Material: Color Plate, H7, No. 6831; Photograph, 3760; Specimens, 59; 59 to 166 mm., Nos. 6831 and 7241.

Mycteroperca Gill, 1862

Bonaci Cardinal
Mycteroperca venenosa apua (Bloch)



References: *Bodianus apua*, Bloch, 1790, Naturg. Ausl. Fische, IV, 50, Plate CCXXIX.
Mycteroperca venenosa apua, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 446.

Field Characters: Medium-sized sea-bass with long anal fin of 11 rays. General color red or scarlet with large blackish spots on upper part of sides, and with red spots on a gray background on lower sides. Soft dorsal, anal and caudal fins with a black subterminal band.

Size and Weight: Grows to 2½ to 3 feet. Our specimen measured 406 mm. and weighed four pounds.

Color: General color above scarlet, becoming gray on sides of head and body and under parts; the red below the soft dorsal somewhat paler than the rest. Scales on the upper part of the caudal peduncle with conspicuous, small black spots. Sides of the head and chin with small reddish spots becoming paler below. Upper parts and sides of body from the beginning of the dorsal fin backward with rather large black spots. Lower parts of sides with red spots becoming elongate between the ventral and anal fins. Spinous dorsal reddish with an orange tone toward the tips of some of the spines and membranes, the central portion mottled gray and pinkish. Soft dorsal with medium sized pinkish spots along the base, pink and white medianly and with a rather wide, subterminal black band and a very much narrower terminal white band. Caudal fin brilliant scarlet mottled with gray and pinkish yellow and also with a wide subterminal black band and a narrow terminal white one. Anal fin scarlet with grayish markings, and tipped in the same way as the soft dorsal and the caudal. Pectoral fins pinkish at base and yellow on their distal half. Ventral fin red with a narrow black edge anteriorly. Eye with an orange pupil rim.

General Range: Florida to Brazil.

Occurrence and Abundance in Port-au-Prince Bay: Uncommon. Only a single specimen seen at the fish market.

Study Material: Color Plate, H73; Specimen, 1; 406 mm., No. 7078.

Epinephelus Bloch, 1793

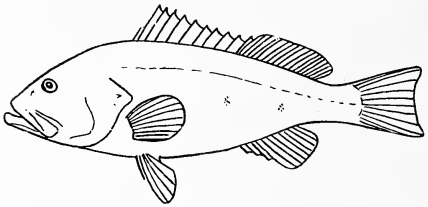
Key to Port-au-Prince Bay Species

A. Second dorsal spine nearly as long as third; posterior spines not noticeably reduced in length; caudal fin with straight or concave margin; color nearly uniform brownish.....*morio*

AA. Second dorsal spine noticeably shorter than third; posterior spines more or less reduced in length.

B. Soft dorsal noticeably higher than spines; sides with 5 or 6 dark cross bars; no red spots.....*striatus*

BB. Soft dorsal lower than longest spines; soft dorsal, anal and caudal fins broadly edged with black.....*guttatus*



Red Grouper; Cherna Americana; Negue coleur rouge

Epinephelus morio (Cuvier and Valenciennes)

REFERENCES: *Serranus morio,* Cuvier and Valenciennes, 1828, Hist. Nat. Poiss., II, p. 285.

Epinephelus morio, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 455.

FIELD CHARACTERS: Large, somewhat compressed sea-bass, with second dorsal spine almost as long as third; caudal fin with posterior margin straight or slightly concave. Brown with more or less distinct paler blotches; well defined dark spots around eye; an indistinct saddle-like blotch on the caudal peduncle.

DESCRIPTION: Some of our specimens have the tail slightly rounded.

SIZE AND WEIGHT: Grows to 1 to 3 feet. A 265 mm. fish weighs 460 grams.

COLOR: Our fishes have been colored as in typical descriptions, but in many the saddle-like blotch on the caudal peduncle has been absent, and the pectoral fins have been lemon yellow on the basal half, the outer end tipped with orange.

GENERAL RANGE: Massachusetts to Brazil.

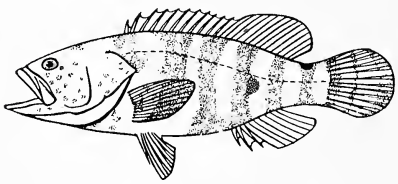
DISTRIBUTION IN PORT-AU-PRINCE BAY: Found usually on the banks along shore.

ABUNDANCE: Uncommon, but seen occasionally at the markets.

METHOD OF CAPTURE: Hooks and lines.

GENERAL HABITS: The vitality of this fish is quite remarkable and they are able to live under poor conditions for a long time. Very often, these fish were placed in milk cans containing from 2 to 5 gallons of water with 30 to 50 other specimens, mostly dead, and shipped to us by the fishermen. They almost invariably arrived alive, thrashing about in the tanks and in full possession of their faculties.

STUDY MATERIAL: Photograph, 4006; Specimens, 7; 145 to 255 mm., No. 6904.



Nassau Grouper, Hamlet, Negue

Epinephelus striatus (Bloch)

References: *Anthias striatus*, Bloch, 1792, Naturg. Ausl. Fische, VI, p. 92, Plate CCCXXIV.
Epinephelus striatus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 460.

Field Characters: Large, compressed sea-bass with rays of soft dorsal somewhat longer than spines and with gently rounded posterior margin of tail. Brown above, sometimes gray or green, paler below, a black spot on the caudal peduncle; black dots about the eye; a dark stripe from eye to upper angle of gill opening.

Size and Weight: Grows to three feet and to a weight of 50 pounds.

Color: When excited this fish becomes a dark brown or uniform black; in aquarium when it quieted, the pattern returned and soon it was marbled in strong contrast of black and white; before death and afterward it turned a uniform pale olive green, with the pectoral fins tinged with orange.

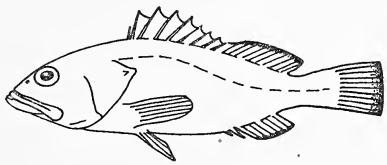
General Range: North Carolina to Brazil.

Abundance: Fairly common, seen quite often at the fish market.

Food: Small fish.

Study Material: Colored Plate, H8; Photographs, 3978, 4002; Specimens, 1; 61 mm.

Red Hind; Cabrilla; Grandgêle
Grand forte
Epinephelus guttatus (Linnaeus)



References: *Perca guttata*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 292.
Epinephelus guttatus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 461.

Field Characters: Small to medium sized compressed sea-bass, with 3 broad oblique, obscure olive bands running upward and backward on side; spots on body scarlet, darker above; soft dorsal, anal and caudal fins widely edged with black; pectoral fins yellow with rows of small scarlet spots.

Size and Weight: Rarely exceeds 18 inches in length. Our two specimens measure and weigh as follows:

Length	*Weight*
138 mm.	58.5 grams
235 "	303 "

Color: Our two preserved specimens differ widely in body coloration although agreeing in all essentials with the published descriptions. In the larger specimen the spots are pale. leaving the surrounding darker net work of color dominant, while in the smaller fish small dark spots against a lighter background are the conspicuous features of the color pattern. Otherwise these fish agree in all other phases of coloring.

The difference in coloration mentioned above caused us to separate these two specimens as different species, until we found two *Petrometopon cruentatus*

coronatus, each of which exhibited this same difference in color, the anterior parts of their bodies being light spots on a dark background and the posterior dark spots on a light background.

General Range: Carolinas through the West Indies to Brazil.

Abundance: Apparently rare as the two specimens purchased in the market were the only ones seen during our visit.

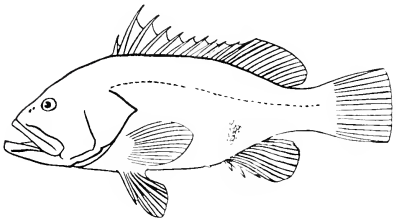
Method of Capture: Taken with hook and line.

Food: 1 specimen contained unrecognizable animal matter, while the second contained a small parrot-fish and shrimps.

Breeding: A 235 mm. female captured on March 1, 1927 had the ovaries well developed.

Study Material: Specimens, 2; 138 and 235 mm., No. 6993.

Garrupa Jordan, 1890



Black Jewfish; Black Grouper; Mero de la Alto

Garrupa nigrita (Holbrook)

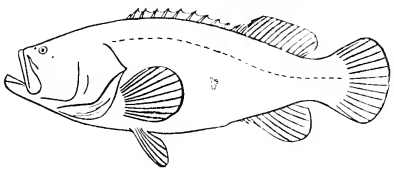
References: *Serranus nigritus*, Holbrook, 1856, Ichthyol. South Carolina, Ed. I, p. 173, Plate XXV, fig. 11.

Garrupa nigrita, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 1161.

This species is included on the following evidence. After a dynamite explosion at Lamentin Reef on May 4, 1927, a large fish took a dead victim at the surface. When we dived a few minutes later, we found a huge olive-gray grouper at least five feet long, searching for dead fish in the coral. The distal parts of its fins were dusky and the eyes dull yellow. The teeth were irregular and seemed to be at least an inch in length. The fish showed practically no fear of us, and remained from 8 to 10 feet away, advancing and retreating as we moved away or toward it, and showing much interest in our operations.

From the close contact with this fish, and careful observation of its grouper characters, color and size, the identification seems beyond question.

Promicrops Poey, 1868



Spotted Jew-fish

Promicrops itaiara (Lichtenstein)

References: *Serranus itaiara*, Lichtenstein, 1821, Abh. Ak. Wiss. Berlin, p. 278.

Promicrops itaiara, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 450.

Field Characters: Very large sea-bass with broad cranium, narrower in the young, depressed between the eyes. Scales of the lateral line with 4 to 6 strong radiating ridges. Brown, sometimes with a greenish shade, 4 or 5 crossbands on sides; head, body and fins with many black spots.

Size and Weight: Grows to 8 feet and a weight of 693 pounds. A 122 mm. specimen weighed 45 grams.

General Range: Both coasts of tropical America.

Occurrence in Port-au-Prince Bay: Found on rather deep banks.

Abundance: Uncommon.

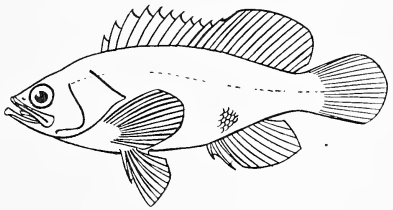
Method of Capture: Both specimens taken on a hook.

Food: The stomach of the 367 mm. fish contained the remains of a parrot fish, the solidified teeth being quite evident.

Study Material: Specimens, 2; 122 and 367 mm., Nos. 6876 and 7050.

Alphestes Bloch and Schneider, 1801

Guaseta; Cherna
Alphestes afer (Bloch)



References: *Epinephelus afer*, Bloch, 1793, Ichthyologia, Plate 327.

Alphestes afer, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 463, Plate XLIII.

Field Characters: Small, rather large-eyed sea-bass with a forward curved spine on the lower angle of the preopercle. Brownish with indistinct darker blotches.

Size and Weight: Grows to a foot or more. Our specimen measured 145 mm. and weighed 102 grams.

General Range: West Indies to Brazil. Also found at the Falkland Islands.

Abundance: This species seems to be rather rare. It was not seen during the expedition, and only a single example was purchased or seen at the market.

Food: The stomach contents of our single fish contained one crustacean and a lump of coral mud.

Study Material: Specimens, 1; 147 mm.

Rypticus Cuvier, 1829

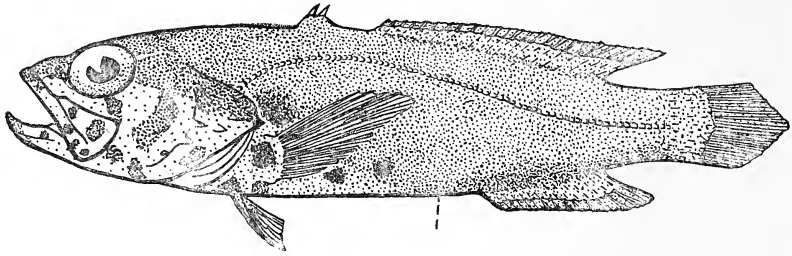
Key to Port-au-Prince Bay Species of *Rypticus*

A. 3 spines on the opercle; brown, the anterior part of the body grayish with good sized black spots.....*bornoi* new species

AA. 2 spines on the opercle, plain brown, edges of the vertical fins dusky. *coriaceus*

Haitian Soap-fish

Rypticus bornoi sp. nov.



Type: No. 7206; Length 51 mm.; Lamentin Reef, Port-au-Prince Bay, Haiti; dynamited among coral; 27–IV–1927.

Measurements and Counts:

Length	51 mm.	Dorsal fin	II–26
Head	20 (2.5)	Anal fin	15
Depth	14 (3.6)	Pectoral rays	13
Eye	5.1 (3.9)	Pectoral length	11 (1.8)
Snout	4.6 (4.3; 1.1)	Ventral length	5.5
Maxillary	8.1 (2.4)	Ocular angle	30° up
Interorbital	1.6 (3.2)	Mouth angle	50° down
Weight	2.5 grams	Scale count	92
		Lateral line pores	70

Description:

Body: Rather elongate.

Back: Slightly elevated.

Anterior profile: Convex.

Mucous pores: Abundant on head.

Interorbital: Flat, 3.2 in eye.

Snout: Short, strongly convex in front of eye.

Eye: Large, directed obliquely upward.

Mouth: Medium, oblique.

Lower jaw: Projecting.

Maxillary: Reaches between pupil and posterior edge of eyeball.

Gill-rakers; 9, Slender, graduated from lower rudiment to uppermost, which is 2 mm. long.

Teeth: Sharp, recurved; in each jaw forming a wide patch of several rows near the symphyses, narrowing to two rows along the side of the jaws; round patch on vomer, thin line along palatines.

Tongue: Free, very long and slender, parallel-sided.

Preopercular margin: 3 spines, far apart, upper small, others subequal.

Opercular margin: 3 spines, upper smallest, middle largest.

Dorsal fins: Close together but not united.[1]

Dorsal spines: Subequal.

Pectorals: Twice length of ventrals.

Ventrals: Small, slightly larger than eye.

[1] The gap between soft dorsal and spinous is somewhat less marked than is shown in the figure.

Color: General color wood brown, the body uniformly immaculate, except for three large round spots of darker olive brown just behind the pectorals, two above them, and three more close in front. The body color is continued over the head to the snout, and extends down over the upper third of the opercles. The remainder of the head is greyish white, the branchiostegals immaculate. A few large, round, olive brown spots on head as follows: 2 on lower operculum, 3 on preoperculum, 2 on maxillary, 5 on premaxillary, and 5 on each side of the rim of the lower mandible. Iris golden, with the outer rim sepia. The spots on each side of the head are slightly unsymmetrical in number and placing.

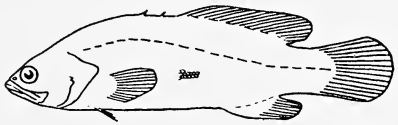
Study Material: Type specimen, Color Plate H107.

Comparison: This species approaches nearest to *arenatus*, but differs radically in pattern, in possessing two dorsal spines, in the larger head and eye, the concentration of teeth at the symphyses, in the longer, much narrower tongue, in the longer ventrals, in three opercular spines, and in the upper opercular spine being the smallest.

Type Name and Location: The name is given in honor of President Borno of Haiti, who did everything to further our work. The type and only specimen is deposited in the collection of the Department of Tropical Research of the New York Zoological Society.

Soap-fish

Rypticus coriaceus (Cope)



References: *Eleutheractis coriaceus*, Cope, 1870, Trans. Amer. Phil. Soc., p. 467.

Rypticus coriaceus, Jordan and Evermann, 1895, Bull. U. S. National Museum 47, I, p. 1233.

Field Characters: Small, compressed fish with pointed head and rounded tail; dorsal fin with 3 spines, no spines in anal fin. Brown with paler spots, tips of fins dark.

Description: All of our large soap fishes agree in possessing the weak armature and other characters of this species as contrasted with those of *saponaceus*.

Size and Weight: A 129 mm. fish weighed 47 grams.

General Range: West Indies.

Abundance: Fairly common, occasionally seen in the market, but not an especially good food fish.

Food: All fishes of this species examined had been feeding upon shrimps.

Study Material: Photograph, 3774; Specimens, 8; 112–120 mm., including No. 6806.

Family Serranidae; Sea-Bass

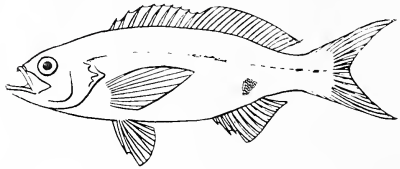
Key to Port-au-Prince Bay Genera

A. Ventral fins inserted a little behind the pectorals.

B. Dorsal fin normally with 9 spines. Caudal fin deeply forked. 19 or 20 soft rays in the dorsal fin. Gill rakers long and slender, about 25 on the lower limb of the first arch.....*Paranthias*

BB. Dorsally fin normally with 10 or 11 spines, anal fin with 7 to 9 soft rays; jaws without enlarged depressible teeth..... *Hypoplectrus*
AA. Ventral fins inserted below or a little in advance of the base of the pectoral fins. Dorsal fin with 7 to 10 spines.
C. With 7 branchiostegal rays..... *Prionodes*
CC. With 6 branchiostegal rays, and truncate caudal fin..... *Eudulus*

Paranthias Guichenot, 1868



Creole Fish; Rabirubia de la Alto
Paranthias furcifer (Cuvier and Valenciennes)

References: *Serranus furcifer*, Cuvier and Valenciennes, 1828, Hist. Nat. Poiss., II, p. 196.
Paranthias furcifer, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 436.

Field Characters: Small, short-headed, short-snouted seabass with long, deeply forked tail and low dorsal fin with 9 spines and 19 to 20 rays. Bright red or salmon color, with small violet spots, 1 on side of the back and 1 or 2 on the sides of the tail.

Size and Weight: Grows to 10 inches. A 164 mm. fish weighed 96 grams.

Color: Our fish agreed with the following description given by Jordan and Evermann (Bull. 47, U. S. National Museum, p. 1222). "Color bright red or salmon color, with 3 small violet spots, 1 on side of back and 1 or 2 on side of tail; a bar of similar color extending from upper corner of pectoral across the humeral process; sides with faint oblique streaks along the rows of scales; dorsal fin with a longitudinal blackish streak" with the following exceptions:—in a number of fish the small violet spots on the tail and body were practically obsolete; under surfaces of head and body pale pinkish. Center of spinous dorsal dark greenish yellow; center of soft dorsal yellowish and dusky.

General Range: Both coasts of tropical America from Cuba to Brazil and from Cape San Lucas to Peru.

Distribution in Port-au-Prince Bay: Taken by us only over the deeper coral reefs.

Abundance: Rather uncommon, observed occasionally in the fish markets.

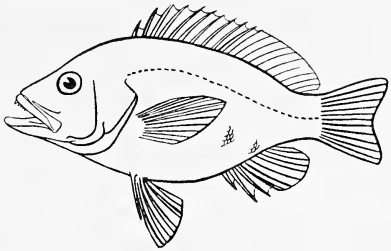
Method of Capture: As far as known all our specimens were taken on a hook and line on fairly deep banks.

Food: The stomach contents of one fish were recorded as masses of small shrimps and other crustacea, mainly plankton.

Breeding: A 170 mm. female on March 11, had moderately developed ovaries.

Study Material: Specimens, 2; 167–170 mm., including No. 7034.

Hypoplectrus Gill, 1862



Vaca; Petit Negre
Hypoplectrus unicolor (Walbaum)

References: *Perca unicolor*, Walbaum, 1792, Artedi Piscium, Part III, p. 352.

Hypoplectrus unicolor, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 1190. (plus forms listed on following pages.)

Field Characters: Small, rather deep, compressed sea-bass without depressible inner teeth; with short, tapering head and slightly emarginate caudal fin. Color extremely variable, the commonest varieties with six vertical dark bands on side, the one below the spinous dorsal widest; head and body spotted and lined with blue. Other varieties are with or without pattern of various colors, sometimes plain or with black and other colored blotches on snout or caudal peduncle.

Description: Although differing widely in appearance, our series of 109 specimens agree in all essentials with the description given in Jordan and Evermann. However, in measuring a series of different color forms, the following range of variations in proportions were found:

Depth in Body	2 to 2.25
Head in Body	2.6 " 2.8
Eye in Head	3.45 " 4
Snout in Head	2.8 " 3.4
Maxillary in Head	1.8 " 2.06

Size and Weight: Grows to 12 inches. In Haiti specimens over 5 inches were very rare.

Color: The unraveling of the many color phases of this fish is a tremendous problem, and to write a color description that would fit all the specimens observed by us in life or preserved in our collection is almost impossible. Nevertheless, widely differing though these patterns and colors are, the extreme forms can be linked to each other in one way or another, and if sufficient specimens were at hand there is little doubt that the gaps in a series such as ours could be filled, and that all the variations would be connected by intermediates.

The seven extreme forms in the Haitian collection are described herewith:

Form A.—(=*Hypoplectrus puella* Cuvier and Val.) Spec. 6866—Port-au-Prince Bay, Feb. 5, 1927.

General color of head and body olive buff, paler below, body and head crossed by six dark vertical bands, the third widest and almost black. These bands are distributed as follows:

1. From eye through center of preopercle.
2. From nape through base of pectoral fin to just in back of the base of the ventrals. Broad above, narrower on sides.
3. From spinous dorsal to anus and anterior end of anal. This is very broad and becomes slightly narrower on the belly.
4. A narrow weak band from the middle of the soft dorsal to the middle of the anal fin.
5. A slightly stronger band from the end of the soft dorsal downward.
6. A well marked band on caudal peduncle.

The following narrow blue lines and small spots are also found:—

1. A lavender blue line beginning beneath the eye posteriorly, running back and completely around it and then to the lower edge of the preopercle.
2. Four vertical blue lines on the opercle, the first short, the second beginning back of the upper level of the eye, running across the opercle and connecting with the blue anterior edge of the ventral fins; the third back of the second and ending at the edge of the opercle, and the fourth beginning at the spines on the opercle, crossing the edge of the branchiostegal membrane and ending in front of and at the lower insertion of the pectoral.
3. Faint lavender blue vertical bands on the sides, paler and often not visible in the dark bands.
4. Seven blue spots on each side of the snout.
5. One blue spot on front of lower lip.
6. Four round blue spots on top of snout.
7. Two short lines of blue spots on top of the head.

Spinous dorsal dark on the basal fourth continuing the wide dark band below it, dark yellow above with narrow blue edge. Soft dorsal with many irregular oblique bands and lines of pale blue and lemon yellow. Caudal fin pale yellowish green. Pectorals hyaline. Ventral fins dark green with narrow blue anterior edge.

Pupil pear-shaped. Iris dull golden yellow, with a small bright gold streak above and below pupil; a broad band of lavender blue across the upper iris.

The immediate variations upon this ground color and pattern are numerous, and no one of the specimens assigned to *puella* is quite like any other. However, they all agree in possessing the dark vertical bands and bluish stripes, in most cases possessing all the above mentioned lines or at least the great majority of them. The most important variations in this type are concerned with the general body color. This varies considerably but with no correllation to the pattern. Thus in one fish the general color was quite brownish, while the central broad vertical band was bright blue, this color being continued to the tips of the dorsal fin. In another the anterior half of the body was bluish lavender and the posterior part a lilac gray.

Cuvier and Valencienne's colored plate (Hist. Nat. Poiss., II, pl. 37) representing a fish of this variety is fairly typical. It differs in that the membrane of the spinous dorsal is pinkish with blue spots; the blue vertical lines along the sides are absent; two short oblique bands are present on the upper parts of the sides just anterior to the large vertical dark bar. These characters, especi-

ally the first and the last have not been observed in the Haitian fishes, but very likely ought to be considered as other patterns belonging to this variety.

Poey's uncolored plate (Memorias, Vol. I, Pl. 9, fig. 2) also shows a form like ours, differing in that the pale vertical blue lines on the sides are much stronger, and the blue line on the head does not start immediately below the eye but is a continuation of a line which comes up abruptly from below. This can be considered as a variation in which the blue lines are especially brilliant and well marked.

Form B.—Dark bluish purple or purplish blue; all fins, except the hyaline pectorals, black. Dark broad vertical bands of *puella* are retained, those on the head merged with each other so that the head is completely black. All of the narrow blue lines and spots of *puella* are absent.

Form C.—Dark brown, more or less unicolor, with dark fins. Bluish line about eye present.

Form D.—Brown above with brown dorsal fin; pectorals dusky; orange yellow beneath with orange-yellow pelvic, anal and caudal fins. Oblique cross bars of dull orange on dorsal fin. The blue line partly surrounding eye present, pale lilac in one specimen instead of blue.

Form E.—Brilliant yellow, with traces of oblique bluish bands on soft dorsal fin. A black spot on caudal peduncle and one on each side of snout.

Form F.—Same coloration as E., but lacking the spot on the snout.

Form G.—Orange with remnants of the blue line that partly surrounds the eye and descends to the opercle. An irregularly-shaped black spot on snout surrounded by bluish lines and dots. The variations in the form of this spot and the surrounding lines is very great, and two sides of the same fish only remotely resemble each other.

This fish is close to Poey's *gummigutta.*

It will be noticed that the color form A (*puella*) has been described in considerable detail, more so than any of the others. This has been done because the patterns of this fish seem to be the basic ones within the species and after studying the materials the suggestion can be made that all of the many varieties in the Haitian collection have arisen by the suppression or obliteration of parts or of all this pattern, usually by means of or accompanied by a changed or intensified body color, the great majority of specimens retaining at least a remnant to prove their relationship.

It may also be significant that this form (*puella*) is by far the most abundant of all the varieties taken in Haiti. It must be remembered however that the specimens grouped under Form A. vary tremendously within themselves, the character holding them together being the possession of the majority of pattern elements.

At first glance the variation among the Vacas seems to be a radial one, but closer study seems to indicate that a three dimensional variation would be a better way to describe it—with typical form A placed at the center of a sphere and the different forms at varying intervals toward and at the surface.

The tendency of this species to vary in color was first noticed in systematic ichthyology, by the describing of some 15 species.

Jordan and Evermann in 1896, (Fishes of N. and M. America I, p. 1190) say of these many nominal species; "We have examined large numbers of specimens of this type in the Museum at Cambridge and elsewhere. The best series seen is that sent from Havana by Poey to the Museum at Cambridge. So far as we can discover, the various nominal species of this type are absolutely identical in all respects except in color. Many of them—e. g. *puella, indigo, colorurus,*—seen at first sight to be certainly different. Nevertheless, each of these forms is subject to wide variations, and from the material which we have seen, we can draw no other conclusion than this: All belong to a single species, which varies excessively in its coloration. Blue, yellow and black are arranged in a great variety of patterns, in different specimens, and the cause of such variation is still unknown . . . "

Breder, 1927, has resurrected one of these forms, *nigricans,* differing in color from *puella,* in possessing 10 scales from the dorsal to the lateral line instead of 11 to 12 and a few other characters. He suggests that there are possibly two variable species in the West Indian fauna.

Specimens similar to Breders *nigricans* are not present in the Haitian collection, so his suggestion is quite possibly right.

The problems offered by the fishes of this genus, must, because of the changes after preservation, be solved in the field, where specimens can be watched in life, and where their breeding habits can be observed. The rearing of a single batch of eggs would solve many of our problems, and this would not be exceptionally difficult in their native surroundings as the fishes live quite well in captivity. Such a procedure would answer questions as to whether dark purple forms spring directly from *puella* types or not or whether the variations can be laid to age, habitat, temperature or other conditions. It is of interest in this light, to note that the larger dark fishes of Form B. and the orange fish of Form G. came from much deeper water than the others; all of the other fishes having been taken in shallow water along shore and on the reefs down to 30 or 40 feet.

Although the variation in color in the species is tremendous, there is but little change in the individual fishes. Certainly color changes such as individual Pomacentrids demonstrate were never observed in *Hypoplectrus.*

Interesting problems and questions as to the correlations of colors constantly intrude as the specimens are looked over,—the problem of why the line about the eye in some brown and yellow fish should be changed to lilac instead of blue, as in most of the other fish, being but one indication of the many fascinating aspects of the coloration of these fish.

One other problem can be mentioned here. In some of the fishes intermediate between *puella* and the extreme forms the intensity of the dark bar under the eye seems to directly control the presence or absence of the light blue bands in front of and behind it. It almost seems as if the fish had a limited amount of pigment and that when the amount taken by the dark bars increased beyond a certain limit it was necessary to take pigment from the blue line, thus making a direct balance between the amounts of blue and black pigments.

This suggestion also applies to the forms with black spots on caudal peduncle and snouts. In these fishes the complicated body pattern of *puella* is reduced, usually only the lines on the dorsal being present.

The above paragraphs can do little more than indicate the vast field offered to the student of color and variation by this species. Unfortunately, the lack of time on the Haitian expedition precluded doing more with these fish. (J.T-V.)

General Range: Florida, West Indies, Grenada, Panama.

Occurrence and Abundance in Port-au-Prince Bay: One of the most abundant of Haitian Fishes, being found practically everywhere along shore and on the various reefs. It is especially abundant near the *Thalassia* covered bottoms on the shallower, slowly shelving beaches.

Method of Capture: Taken by seining weed-covered shore zones, traps and by dynamiting.

Food: Crustaceans, fishes.

Proportions of Sexes: All of the extreme types of coloration with the exception of one of the *indigo* forms were females. The central color form seems to average a few more females than males.

General Habits: This species seems to be found everywhere along shore where the bottom is sufficiently diversified to enable it to hide. They were often observed hiding among the leaves of the weed *Thalassia*, not only in the shallows in water two to four feet deep, but also farther out in depths of fifteen to twenty feet. However, it must be noticed that only the *puella* and the solid yellow forms were found here. The orange and indigo forms were taken from deeper water.

Although this fish likes to hide under weed, it is far from shy. When we were diving on the coral reefs, they were most inquisitive and often came very close.

Study Material: Colored Plates, H10, 17, 47, 93, No. 7161; Photographs, 3732, 3772; Specimens, 109; 42–113 mm., including Nos. 6866, 6867, 7280, 7161, 6945, 7135.

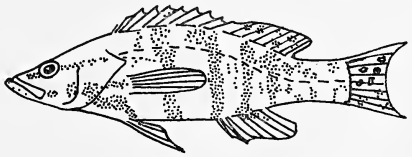
Prionodes Jenyns, 1842

Key to Port-au-Prince Bay Species

A. Sides yellow, body conspicuously marked with cross-bands, bars and spots of black..... *tigrinus*

AA. Reddish brown, with 5 or 6 yellowish white blotches on upper surfaces; a brown bar on each lobe of the caudal fin..... *tabacarius*

Harlequin Serranid
Prionodes tigrinus (Bloch)



References: *Holocentrus tigrinus*, Bloch, 1790, Ichthyologia, Pl. 237, after Seba, Thesaurus, III, plate XXVII, fig. 5.

Prionodes tigrinus, Jordan and Evermann, 1896, Bull. U. S. National Museum, 47, I, p. 1214.

Field Characters: Small, compressed sea-basses with pointed head and lunate caudal fin. Sides yellow, the entire body and fins very conspicuously spotted, barred and marked with black.

Description: Some of our specimens differ in having the dorsal fin X–12.

Size and Weight: A 73 mm. fish weighed 7.5 grams.

Color: Our specimens agree with the description in Jordan and Evermann (l. c.) in most particulars, the differences being that the anal was not plain in our specimens, and that a certain amount of regularity exists in the pattern of the black. The following description is taken from a typical example from the Haitian reefs:

Length 72 mm. Upper surfaces of head and body anterior to the dorsal fin, grayish brown. Remaining body color yellowish to grayish white, more yellowish beneath. A wide yellow band from maxillary and mandible under the eye to end of opercle, continued more or less in the coloration of the sides to the caudal fin. Upper part of head spotted with subcircular spots of black. A series of black spots from the upper part of the eye, along the top of the head, continued on the sides as smaller spots, and ceasing somewhere under the center of the soft dorsal. A band of black from the snout through the eye, continued across the opercles and thence, as a paler series of spots, to the caudal. Under surfaces of head with large irregular black spots, two especially large ones on the posterior part of the preopercle and on the opercle, followed by one on the anterior base of the pectoral fin,—this line continued as a vague series of dots to the caudal. A large irregular black spot beneath the pectoral continued under the belly to meet its fellow. Sides with six black bands, each one meeting its fellow of the opposite side beneath, blackest inferiorly. These bands are displaced somewhat forward above the lateral line, so that in the case of the anterior bands, the portion above the lateral line is almost between the bar to which it belongs and the bar just anterior to it. These bars are placed as follows:—one beneath the anterior end of the spinous dorsal, 2 others beneath the spinous dorsal, 2 beneath the soft dorsal and one at the base of the caudal fin. Dorsal fin yellowish white,—a series of pale blackish spots along the base of the posterior ⅔ of spinous dorsal and the first few rays of the soft dorsal. A large black spot on the membrane between the 3rd and 5th spines followed by a row of smaller spots about ⅔ the way up the fin. Membranes following the 5th to 9th spines with a black spot at the tip followed by a yellow spot. A narrow band of yellow along the outer border of the soft dorsal, the remainder of the fin with blackish spots, largest anteriorly. Pectorals salmon color. Ventrals yellowish. Anal milky white basally, yellow distally, with small black spots on the distal portion. Caudal spotted with black, forming 3 or 4 more or less regular vertical bands. Tips of the caudal lobes yellowish orange.

The variation in pattern in this species, however, is quite large and spots in some specimens are found forming lines in others, or the opposite may be true and lines can easily be transformed into a group of spots.

General Range: West Indies.

Distribution in Port-au-Prince Bay: The only place that we have seen this fish is on the coral reefs, both inshore and out in the center of Port-au-Prince Bay.

Method of Capture: Traps and hooks and lines seemed to be of no value whatsoever in catching these fish, and our only successful method was by employing dynamite.

Food: Most of our fish had fed upon shrimps and other small crustaceans.

Eggs and Breeding: A 72 mm. fish carried roe in a fairly advanced state, the diameter of the largest eggs averaging .41 mm.

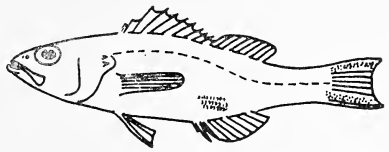
General Habits: This fish was observed for many days on the reefs before we could capture one. They usually kept close to the ground or to the larger coral lumps, sometimes waving in and out among the sponges and gorgonians. In movement they slightly resemble the elongate wrasses.

Metzelaar mentions taking it in sponges, but we have seen no indications of the Haitian specimens possessing this interesting habit.

Study Material: Color Plate, H100, No. 7171; Photograph, 4166; Specimens, 2; 72 mm., No. 7171.

Jacome; Tobacco-fish; Bout-de-tabac

Prionodes tabacarius (Cuvier and Valenciennes)



References: *Centropristes tabacarius,* Cuvier and Valenciennes, 1829, Hist. Nat. Poiss., III, p. 44.

Prionodes tabacarius, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 1215.

Field Characters: Small, compressed, large-eyed, sea-bass. Reddish-brown, with 5 or 6 yellowish white blotches on upper surfaces; a brown stripe on each lobe of the caudal fin.

Description: Our specimens agree fully with the description given by Boulenger,[1] but not so well with Jordan and Evermann (Bull. 47, U. S. Nat. Mus.). The latter give the depth as 3.75 while Boulenger states it as 3¼ to 3½ in the total length, which happens to be the case in our fishes. In addition the eye is given as 3.25 in Jordan and Evermann, and 3.5 to 3.66 by Boulenger. Our fish average from 3.45 to 3.7.

Size and Weight: The following are the sizes and weights of our fish:

Length	*Weight*
107.5 mm.	29 grams
107.5 "	34 "
105 "	26.4 "

General Range: West Indies.

Occurrence in Port-au-Prince Bay: Found occasionally along shore in fairly shallow water and also seen while diving on the reefs along shore. It is also taken in deeper water by the fishermen. and can practically always be found in the market, although never more than five or six a day.

Abundance: Fairly common.

Method of Capture: Taken by hook and line, in traps and by dynamiting.

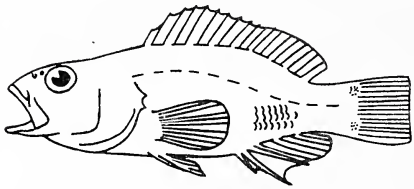
[1] Cat. Fish Brit. Museum, 2nd ser., I, p. 291.

Food: An engraulid, too far gone to identify was found in the stomach of one individual.

Breeding: A 107 mm. fish had its ovaries quite well developed, the entire organ measuring 20 mm. long by 3.5 mm. in diameter.

Study Materials: Specimens, 3; 105 to 107.5 mm., Nos. 6954 and 7111.

Eudulus Fowler, 1907



Mottled Sea-basslet
Eudulus dispilurus (Günther)

References: *Centropristes dispilurus*, Günther, 1867, Proc. Zool. Soc. London, p. 99.
Dules dispilurus, Jordan and Evermann, 1896, Fishes of North and Middle America, I, p. 1219.

Field Characters: Small, somewhat compressed sea-bass with six branchiostegal rays and truncate tail; a conspicuous, rather sharply defined creamy white bar extending upward on each side from just before the vent; two small black spots at the base of the tail.

Description: The following variations in measurements were found in our fish; depth 2.72 to 3; head 2.6 to 2.78. All have the dorsal fin X–12.

Color: Our specimens agreed in life with the description given by Jordan and Evermann, and especially with the somewhat better description given by Evermann and Marsh in the "Fishes of Porto Rico." Some were especially brilliant in life, the mottlings on the anal, caudal and soft dorsal fins being quite scarlet; the lower surfaces of the cheeks and face were also spotted with red. The brown line from the shoulder through the eye was especially well marked in our fish. In some specimens the base of the dorsal fin, both spinous and soft, was quite greenish.

While there has been a considerable amount of discussion and changes in the validity of the three West Indian species of this genus, we are unable to add anything to it. In coloration our fishes are certainly nothing like the plate given by Fowler of *Dules subligarius* or of Cuvier and Valenciennes' plate in "Hist. Nat. Poiss.," of *Dules auriga*. In Jordan and Evermann's key our specimens run straight to *dispilurus*, and agree especially well with the somewhat complicated color description of that species. As our 49 mm. specimens carry eggs of quite good size, it is possible that this species is quite valid.

Size and Weight: This species apparently never grows to a large size. Evermann and Marsh report a 2¾ inch fish. None of our specimens were longer than 60 mm. A 58 mm. specimen weighed 5.5 grams.

General Range: Trinidad, St. Eustatius, Jamaica, Haiti and Porto Rico.

Distribution in Port-au-Prince Bay: This fish lived mostly inshore, over weed covered shallow banks, in company with small snappers, and in

localities that we called "Nurseries." They were especially common about the fronds of a weed *Thalassia*, and could be usually seen with a water-glass winding in and out among the leaves.

Abundance: Fairly common, Usually 3 or 4 could be taken in each haul over the shallow inshore weedy banks when using a small seine. Evermann and Marsh found this species at Porto Rico in 7 fathoms, and also one nine miles from Mayaguez in 220 fathoms on rocky bottom.

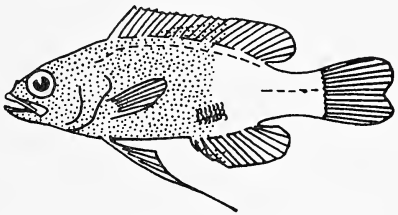
Eggs: A 49 mm. fish had the ovaries quite well developed, the largest eggs averaging .35 to .4 mm.

Study Material: Colored Plate, H70; Specimens, 7; 28.5–50 mm., including No. 6902.

Family Pseudochromidae.

Gramma Poey, 1868.

Purple and Gold Fairy Bass
Gramma hemichrysos Mowbray



References: *Gramma hemichrysos*, Mowbray, 1927, in C. M. Breder, Bull. Bingham Oceanographic Coll., Vol. 1, Art. 1, p. 42, figure 2.

Field Characters: Small, compressed, sea-bass-like fishes, with lateral line running concurrently with the back and ending under the 6th or 7th dorsal ray, beginning again on the caudal peduncle; conspicuously colored, the anterior half of body rhodamine purple, the posterior half lemon yellow; a black blotch on anterior rays of spinous dorsal.

Description: Our single fish, when compared with Mowbray's figure, (l. c.) disagrees considerably in the relation of the placing of the dorsal, pectoral and pelvic fins. We have compared it with all of Mowbray's original specimens except the type (No. 526, Bingham Coll.) and one paratype (No. 215 Bingham Coll.).

All of these Bingham fish agree with ours and differ from the figure in having the pectoral fins proportionately longer and in having their origin further forward. This change of position alters the relation of the origin of the dorsal and pelvic fins. Both of these arise under or over the base of the pectorals, or very slightly in advance, never in all the specimens examined by us, as far away from the pectoral base as shown by Mowbray's figure.

This figure is of the type, which we have not been able to examine, and it is possible that this fish may be different from the rest of the specimens. However, Mr. Albert C. Parr, in shipping the specimen to us, mentions that the type which he had examined, differs in no way from the remaining specimens.

The Haitian fish differs from the paratypes examined in being slightly deeper, 2.9 instead of 3.5, a condition due possibly to its carrying eggs, in having a

slightly shorter maxillary, reaching to the posterior edge of the pupil instead of the posterior edge of the eye, in having 11 dorsal rays instead of 9 or 10, and in the color pattern. Our fish has the purple extending considerably further back than the Bingham specimens, this color reaching to the origin of the soft dorsal. The purple extends onto the spinous dorsal, making this fin markedly darker than in the Bingham fish.

It is possible that the Haitian fish represents a different species or subspecies but the paucity of our material does not allow us to do more than point out the differences.

Twelve or fifteen of these fish were constantly seen about a tall clump of millepore corals on Lamentine Reef. We were unable to trap them, and only a single individual was obtained by using dynamite.

SIZE: Grows to a little more than two inches.

COLOR: Anterior part of body as far back as origin of soft dorsal and anal, including the spinous dorsal and pelvic fins, rhodamine purple; posterior part of body, including the soft dorsal, caudal and anal fins, cadmium yellow. A small yellowish spot below eye extending on maxillary. A black spot on anterior spines of dorsal; a narrow band of reddish along tip of anterior dorsal rays. Anal spines pinkish, the border of the fin with a very narrow pinkish line. A narrow diagonal line of reddish from base of anal spines extending downward and backward over middle of fin. Pectoral rays yellowish, the fin transparent.

Mowbray gives the color of the anterior part of his fish as royal purple, which in Ridgway's color key is quite different from the living color of the Haitian specimen.

ABUNDANCE: Uncommon.

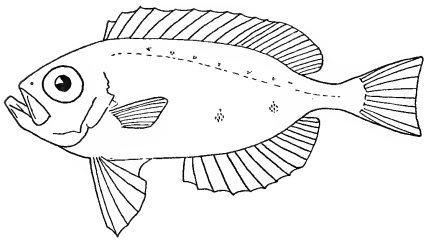
METHOD OF CAPTURE: Dynamite.

FOOD: Small crustaceans.

STUDY MATERIAL: Color Plate, H112; Specimen, 1; 47 mm., No. 7225, Lamentin Reef, Port-au-Prince Bay.

Family PRIACANTHIDAE; THE BIG-EYES

Priacanthus Oken, 1817



Spineless Big-eye, Juif

Priacanthus arenatus Cuvier and Valenciennes

REFERENCES: *Priacanthus arenatus,* Cuvier and Valenciennes, 1829, Hist. Nat. Poiss., III, 97.

Priacanthus arenatus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 487, Plate LI.

Field Characters: Elongate, considerably compressed, bright red fish with extremely large eyes, very long ventral fins, and with a single small indentation on the opercle just above the flat preopercular spine.

Size and Weight: A 240 mm. fish weighed 357 grams.

General Range: Tropical Atlantic, from Gulf Stream northward as far as Rhode Island and southward to Brazil.

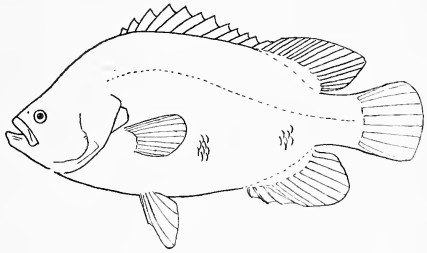
Abundance: Not uncommon, usually one or two being brought to the market each day and sometimes more. However, we never saw this species while diving on the shallower inshore reefs.

Study Material: Specimens, 2; 240 mm., No. 6947.

Family Lobotidae; Triple-Tails

Lobotes Cuvier, 1829

Triple-tail; Flasher
Lobotes surinamensis (Bloch)



References: *Holocentrus surinamensis*, Bloch, 1790, Naturg. Ausl. Fische, IV, 98, Plate CCXLIII.
Lobotes surinamensis, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 485, Plate L.

Field Characters: Rather large, deep, compressed, bass-like fishes with projecting lower jaw and serrate opercle. Soft dorsal and anal fins almost as large as the tail, combining with the caudal fin to give the fish its name of "Triple-tail." Outline of body concave over eyes; scales small and rough.

Size and Weight: Reaches three feet in length. Our specimens are from 18 to 161 mm. in length. The 33 mm. fish weighed 1.2 grams, and the 161 mm. fish 194 grams.

Color: "Dark brown to pale brown, with more or less silvery, at least below the lateral line; an indistinct dark band from eye to occiput, 2 narrower bands or lines extending backward for a short distance from interorbital, another band from lower margin of eye to angle of preopercle; all the fins, except the dorsal, darker than the body, the caudal fin with an abruptly pale margin in young, which is not present in adult; pectoral fins pale translucent." (Meek and Hildebrand, l. c.)

Our largest specimen agrees fully with the above description. The 33 mm. example also agrees with this except that the general body color was dull grayish green. All the fins except the pectorals were black, their bases the same color as the rest of the body. Caudal broadly and dorsal and anal narrowly tipped with grayish white. Five black spots at base of soft dorsal, the second and

fourth much paler than the others. A black spot at base of posterior rays of the anal fin. A narrow grayish line continues forward from this spot along the base of the rays.

The 18 mm. fish differed from the older examples in having the soft dorsal tipped with pinkish, the remainder of the fin being gray with a pinkish tint toward the base. Caudal with a very wide translucent terminal band. Snout pale, not black.

General Range: Massachusetts to Uruguay.

Distribution in Port-au-Prince Bay: Under Sargassum weed at surface.

Abundance: Uncommon, only one specimen seen in the markets during four months of observations.

Method of Capture: The two smaller fish were taken by scooping up Sargasso weed in a hand net, the fish being found among the fronds.

Food: The 118 mm. fish contained the vertebrae of a small fish.

General Habits: Our only notes relate to the young individuals being found under weed. The two smaller individuals were taken under separate patches of Sargassum, so that there can be but little doubt that the young are to be found living under these conditions.

Study Material: Specimens, 3; 18 to 161 mm., No. 7227.

Family Lutianidae; the Snappers

Key to Port-au-Prince Bay Genera

A. Pterygoid teeth[1] wanting; dorsal spines 10 or 11.
B. Gill rakers few and short, fewer than 12 on the lower limb of the first gill arch; the caudal lobes not especially produced in the adult; anal fin with 7 to 9 rays ..... *Lutianus*
BB. Gill rakers long and numerous, about 20 on the lower limb of the first arch; caudal lobes much produced in the adult ..... *Ocyurus*
AA. Pterygoid teeth present, at least in adult; dorsal spines about 12. Gill rakers long and slender, about 17 or 18 on the lower limb of the anterior arch; color red or yellowish red ..... *Rhomboplites*

Lutianus Bloch, 1790

Key to Port-au-Prince Bay Species

A. Vomerine teeth in a crescent-shaped patch. Dorsal fin X—14, anal fin III—8. 55 to 60 scales in a lateral series. A small, jet black spot on the side ..... *analis*
AA. Vomerine teeth anchor-shaped, with a distinct median backward projection.
B. Dorsal fin normally with 12 rays; a black lateral spot, rarely as large as the eye; body chiefly greenish, with 3 golden stripes on the head and 9 on the body ..... *synagris*
BB. Dorsal fin normally with 14 rays.
C. Gill rakers 10 or 11 on lower limb of the first arch. Color uniform rose-red; young with a black lateral patch ..... *campechanus*

[1] A group of teeth found on the roof of the mouth, continuing backward the line of the palatines.

CC. Gill rakers fewer, 7 or 8 on the lower limb of the first arch.

D. Scales rather small, series above the lateral line very oblique, 7 or 8 rows between the lateral line and the base of the first dorsal spine; a broad white bar from eye to angle of mouth..... *jocu*

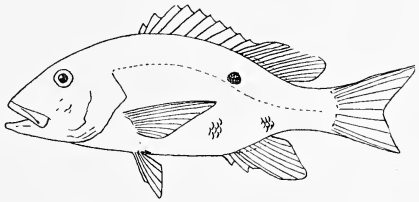
DD. Scales rather larger, the series above the lateral line usually fewer than 7; no white bar below the eye.

E. Body rather deep, 2.45 to 2.7 in length; anterior profile notably concave in the adult; snout long, pointed, 2.4 to 3.25 in the head; 5 or rarely 6 rows of scales between the lateral line and the base of the first dorsal spine; rows of scales not marked by dark lines or only faintly so; caudal fin not edged with black..... *apodus*

EE. Body more elongate, 2.65 to 2.9 in length; anterior profile only slightly concave in the adult; snout less strongly pointed, 2.55 to 3.2 in the head; 6 or rarely 7 rows of scales between the lateral line and the base of the first dorsal spine; rows of scales on sides marked by dark lines; caudal fin edged with black..... *griseus*

Mutton Fish; Card Claire

Lutianus analis (Cuvier and Valenciennes)



References: *Mesoprion analis*, Cuvier and Valenciennes, 1828, Hist. Nat. Poiss., II, p. 452.

Lutianus analis, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 501.

Field Characters: Large, elongate, compressed snappers with rather deep head and long snout. Greenish brown above, yellowish green below with a tinge of red on chest and abdomen. Blue lines on head. Fins all reddish, caudal with a black margin. A small jet black spot, smaller than eye, on the lateral line under the anterior rays of the soft dorsal.

Size and Weight: Reaches a weight of 25 pounds. A 542 mm. fish weighed 10 pounds.

General Range: Massachusetts to Brazil.

Distribution in Port-au-Prince Bay: Found mostly on the deeper banks, especially near the eastern end of Gonave Island.

Abundance: Fairly common, practically always found in the market, although in small numbers.

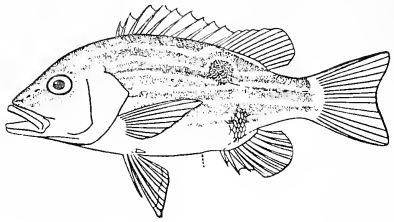
Method of Capture: Hook and line and with traps.

Food: Strictly carnivorous according to the stomach contents examined, specializing in small fish, one specimen containing a porcupine fish (*Diodon hystrix*), crustaceans such as shrimps and crabs, and mollusks.

Breeding: A 542 mm. fish weighing 10 pounds and taken on March 11th, had ovaries measuring 88 by 20 mm. The eggs were not especially enlarged.

The smaller specimens examined during the period of January to March gave few signs of breeding.

Study Material: Specimen, 1; 204 mm., No. 7017.



Lane Snapper; Argente
Lutianus synagris (Linnaeus)

References: *Sparus synagris*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 280.
Lutianus synagris, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 505.

Field Characters: Medium, elongate, compressed snappers, with 9 horizontal golden bands on the sides and 3 on the head. A black spot present on the sides on and above the lateral line under the anterior part of the soft dorsal. Anal and ventral fins golden, dorsal and caudal fins reddish. Vertical bands present at times.

Size and Weight: Reaches a weight of four pounds. Our largest fish measured 320 mm. A 285 mm. fish weighed 2 pounds, and a 128 mm. specimen 50 grams.

Color: The following notes were made on the colors of some of these fish:

22 mm. length—In this fish the iris was silvery, and there were 5 golden lines along the sides, the black spot being smaller than the eye. Seven broad, faint dark vertical bands from the nape to the caudal, the black spot being in the 4th band counting from the head. Dorsal fin edged with red, the caudal faintly pink, and the ventral fins bright orange.

Spec. 7011, about 300 mm. Body above the lateral line dusky silvery with shading of heliotrope gray. Below the lateral line pale silvery with shadings of pink, except the belly and the lower jaw which are silvery white. The pink color especially noticeable on the lower part of the caudal peduncle, on the opercle and preopercle and at the base of the pectoral. Nine rather wide golden stripes, each about ⅔ the width of the pupil, along the sides of the body, and 3 on head. Above the lateral line are numerous smaller irregular stripes of gold running obliquely upward towards the dorsal fin. A black spot on the sides twice the diameter of the eye, situated below the center of the soft dorsal fin.

Lips brilliant grenadine pink as is also the caudal fin and the iris. The dorsal fin is lighter pink with a golden splotched band about the width of the pupil and with the tips of the fin edged with gold. Ventral fins, anal fin, mouth and tongue splashed with gold. Pectorals pale pinkish.

Individual Change of Color: This was extreme. The permanent pattern was a pearly white background, with the conspicuous golden stripes extending lengthwise along the body and sides. There was also usually a faint black

spot on the upper posterior sides below the center of the soft dorsal. Within one or two minutes in an aquarium, this spot might double in size and become intense black, while over the entire body would spread nine vertical dark bands, very wide and black along the back, becoming narrower and of a maroon color down the sides. The top of the head would change from pale pink to deep sepia, but the scarlet iris and the yellow and scarlet fins were never altered.

General Range: Florida to Brazil.

Distribution in Port-au-Prince Bay: A widely distributed species found near reefs and along shore. It is also found on the reefs off Gonave Island, and practically everywhere else we were able to observe.

Abundance: The Lane Snapper is by far the most abundant of its genus to be found within the bay, and also one of the most abundant Haitian fishes, regardless of species. It is to be found in large numbers in the markets, and was the commonest species brought to us by our Greek fishermen.

Method of Capture: Seines, traps, hook and line and dynamite.

Food: This species, like its relatives, is almost entirely carvivorous, and the vegetable records can most likely be regarded as accidental. The examination of the stomach contents of 78 fish show an interesting combination of foods. Among these various elements, fish and crustaceans were dominant. In the following list the number denotes the number of times that the food was found:

Eels 2 times, Silversides (*Atherina*) 5, Anchovies (*Anchoviella*) 5, Porcupinefish (*Diodon*) 10, Unidentified Fish 8, Stomatopods 2, Crabs, 15, Shrimps 15, other crustaceans 3, Mollusks 1, Polychaete Worms 3, Purple Holothurians 1, Sponge spicules 1, and Seaweed 2 times.

Proportion of Sexes: Of 80 specimens examined 47 were males, 22 were females. The remainder represented specimens in which the gonads were too small to be determined by macroscopic examination.

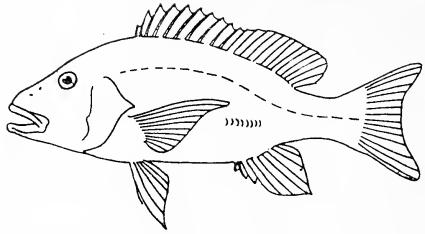
Size at Maturity: In examining the 80 specimens ranging from 70 to 320 mm. in length, our notes, made mostly during March, record that specimens less than 140 mm. in length do not have the gonads developed to any great extent.

The greatest length and width of the ovaries were recorded in twenty-two fish. This varied in actual measurements from 40 by 7 mm. in a 180 mm. fish, to a maximum of 75 by 13 in a fish of 300 mm. Fish larger than 300 mm. seemed to be spent, a 320 mm. fish showing an ovary of only 38 by 20 mm.

Eggs: In a 252 mm. fish with an ovary of 72 by 10 mm. the eggs varied in size from .22 to .45 in diameter, while in a 220 mm. fish they were larger, from .34 to .45 mm.

Enemies: Red leeches were found in the stomachs of two fishes. These animals measured 6 x 15 mm., and were very active when removed from their host.

Study Material: Colored Plate, H11, figs A and B; Photographs, 3861, 3944, 4072, 4106, 4107, 4108; Specimens, about 500; 22–320 mm.



Red Snapper; Sard Rouge; Ronde
Lutianus campechanus (Poey)

REFERENCES: *Mesoprion campechanus*, Poey, 1860, Memorias, II, p. 149.
Lutianus campechanus, Hildebrand & Ginsburg, 1926, Bull. U. S. Bur. Fish., XLII, 82.

FIELD CHARACTERS: Large, elongate, deep-headed, pointed-snouted snappers. Deep rose-red; bluish streaks along the sides, fins brick red. A large black lateral spot on the sides in young specimens.

SIZE AND WEIGHT: Reaches a length of three feet and a weight of 40 pounds. Our 217 mm. fish weighed 252 grams.

GENERAL RANGE: Massachusetts south to Rio de Janeiro, Brazil.

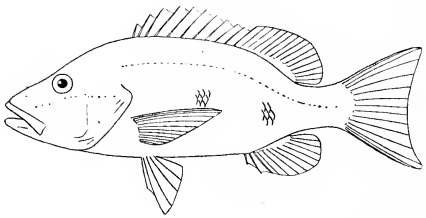
DISTRIBUTION IN PORT-AU-PRINCE BAY: Found mostly in the deeper banks in the bay, and especially off the eastern end of Gonave Island and along the north coast of the southern peninsula of Haiti.

ABUNDANCE: Abundant, but not seen by us on the shallower inshore reefs. In the market it is one of the commonest of the larger fishes.

METHOD OF CAPTURE: Mostly by hook and line.

FOOD: Carnivorous, the stomach of two of our specimens containing anchovies.

STUDY MATERIAL: Specimens, 3; 217 mm., No. 6931.



Dog Snapper; Carde Roulesse
Lutianus jocu (Bloch and Schneider)

REFERENCES: *Anthias jocu*, Bloch and Schneider, 1801, Syst. Ichthy., p. 310.
Lutianus jocu, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 508.

FIELD CHARACTERS: Medium-sized, elongate, long-snouted, deep-headed snappers. Brown above, reddish below, sides of head with a blue stripe below the eye. A broad, whitish bar from eye to angle of mouth, sometimes wanting in the young.

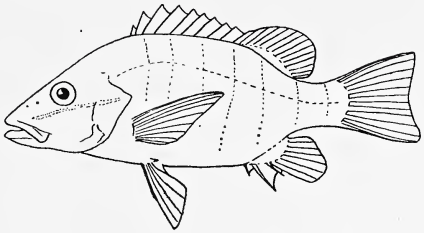
SIZE AND WEIGHT: A 150 mm. fish weighed 107 grams.

GENERAL RANGE: Massachusetts to Bahia, Brazil.

ABUNDANCE: Rare, only one specimen seen in four months, seined by fisherman.

Study Material: Specimen, 1; 150 mm. No. 6910.

Schoolmaster
Lutianus apodus (Walbaum)



References: *Perca apoda*, Walbaum, 1792, Artedi Piscium, Plate III, p. 351 (based on Catesby, Hist. Carolina, 1743, Plate XLI).
Lutianus apodus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, 1925, p. 509.

Field Characters: Medium, elongate, compressed snappers. Greenish above, pale below, no lateral spot. Fins, except the orange ventrals, pale yellow to green. Young with about 8 pale vertical bars and a blue stripe on the head below the eye.

Size and Weight: Attains a weight of 8 pounds. The lengths and weights of the two extremes of our specimens are as follows:

Length 114.5 mm., weight 42 grams; length 225 mm., weight 308 grams.

Color: Like its congeners, this species is extremely changeable in color, the vertical bars practically disappearing in pale specimens. The line from the snout through the eye is also subject to great variation in intensity. The blue stripe below the eye was conspicuous in all of our specimens.

General Range: Massachusetts to Brazil.

Distribution in Port-au-Prince Bay: A wide spread species inhabiting almost all of the localities visited.

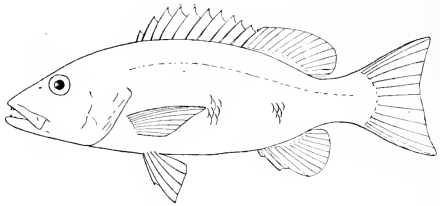
Abundance: Abundant during our stay in Haiti, but by no means as common as the Lane Snapper. It was always to be seen in the markets, and our seine fishermen constantly brought it to us in quite large numbers.

Method of Capture: Seines, hooks and line, traps, and dynamite.

Food: Strictly carnivorous, our records containing notes on crabs, shrimps of various kinds and numerous fish, most conspicuous of which were silver-striped anchovies (*Anchoviella*), thread-herrings (*Opisthonema oglinum*), and porcupine fish (*Diodon hystrix*). The latter were very commonly found in the stomachs of this fish, in fact they were taken from 15 out of 25 stomachs examined. In one case the porcupine-fish was found fully inflated. We recorded of three other specimens that they were found facing toward the cardiac end of the stomach. The number of species of fish that consume these apparently unpalatable pincushions is quite amazing. The secretions of the captors are sufficient, however, to reduce most of the porcupine-fish to chyme but the spines are found intact.

Breeding: Most of the specimens examined by us did not seem to be breeding (February to May). The testicles of a 245 mm. fish captured on March 18, 1927, measured 35 by 3 mm.

Study Material: Specimens, 78; 114.5–225 mm.



Gray Snapper; Carde Gris
Lutianus griseus (Linnaeus)

References: *Labrus griseus*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 283.
Lutianus griseus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 511.

Field Characters: Large, elongate, compressed snappers. Dark green above, chest and abdomen dark red; scales on the sides with rusty centers, forming lines along the sides. Fins all red, vertical fins darkest.

Size and Weight: Grows to 3 feet and a weight of 18 pounds. A 90 mm. fish weighed 13.5 grams.

General Range: Massachusetts to Brazil.

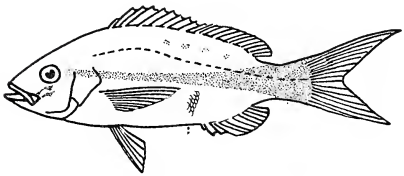
Occurrence in Port-au-Prince Bay: Widely distributed in the bay. Small specimens were found by us along shore, and larger ones taken in deeper water near Port-au-Prince and on the fishing banks off Gonave Island.

Abundance: Very common, always seen at the Markets and captured sometimes in large numbers by the seine fishermen.

Method of Capture: Seines, hand nets, hook and line, traps and dynamite.

Study Material: Specimens, 4; 145 to 208 mm., No. 6863.

Ocyurus Gill, 1862



Yellow-tail; Kola
Ocyurus chrysurus (Bloch)

References: *Sparus chrysurus*, Bloch, 1791, Naturg. Ausl. Fische, V, p. 28, Plate CCLXII.
Ocyurus chrysurus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 515.

Field Characters: Medium, elongate, compressed snappers with very compressed head and tapering snout, and a long and deeply forked caudal fin. Violet above, silvery below; a bright yellow-bronze stripe from the snout through the eye to the caudal peduncle. Caudal fin and peduncle golden yellow.

Size and Weight: Grows to a length of two feet.

Color: Most of our specimens have the ground color violet. Iris silvery, irregularly mottled with scarlet.

General Range: Florida to Brazil.

Occurrence in Port-au-Prince Bay: A widespread species, the young being found in relatively large numbers along shore in weedy areas, and the larger ones further off shore. They were constantly present on the various reefs where we dived.

Abundance: Very common, always seen in the markets. An excellent food fish. Small fish are found quite abundantly along shore in shallow water.

Method of Capture: Seines, traps, dynamite.

Food: Sixteen stomachs examined contained a general assortment of food, both vegetable and animal matter being represented.

A 40 mm. fish had fed almost exclusively upon plankton, being full of copepods and 1 pteropod. The larger fish contained remnants of bottom detritus, with numerous coral fragments, sand grains, mud, algae, sponges, polychaete worms, crustacea such as shrimps and crabs, and small fish, notably silver-striped anchovies.

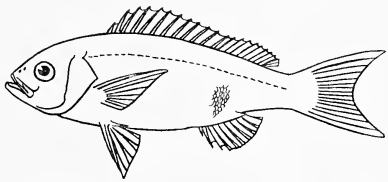
Breeding: The gonads were not developed to any extent in the few specimens examined by us during February to April.

Study Material: Color Plate, H124; Photograph, 3750; Specimens, 20; 40 to 251 mm., No. 6818.

Rhomboplites Gill, 1862

Golden-red Snapper; Fadate

Rhomboplites aurorubens (Cuvier and Valenciennes)



References: *Centropristes aurorubens*, Cuvier and Valenciennes, 1829, Hist. Nat. Poiss., III, p. 45.

Rhomboplites aurorubens, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 517.

Field Characters: Small, elongate, compressed snappers with moderate-sized oblique mouth, dorsal and ventral outlines equally curved. 12 dorsal spines, 11 rays. Pterygoid teeth present in adults. Color vermillion.

Size and Weight: A 150 mm. specimen weighed 102 grams.

Color: Vermillion, paler below. Caudal bright red. Iris gold.

General Range: North Carolina to Southern Brazil.

Abundance: Like the red snapper, this species is one of the most abundant of Haitian fishes. Strings of 20 to 30 are brought in by the fishing boats to the market, and are to be found there practically all of the time.

Enemies: One of these fishes was found in the stomach of a tunny (*Parathunnus obesus*).

Study Material: Specimens, 4; 103–153 mm., Nos. 7036, 7041.

Family Haemulidae; the Grunts

Key to Port-au-Prince Bay Genera

A. Preopercle strongly serrate, two of the spines at the angle enlarged, the serrae on the lower margin directed forward; body elongate, not much compressed..... *Conodon*

AA. Preopercle rather finely serrate, none of the serrae directed forward.

B. Soft parts of the dorsal and anal densely scaled.

C. Dorsal spines normally 13; body elongate, the back little elevated. *Bathystoma*

CC. Dorsal spines normally 12, occasionally 11 or 13.

D. Snout short, more than 3 in head; mouth small, more or less oblique; maxillary short, not curved. Sides with about 5 yellow horizontal stripes..... *Brachygenys*

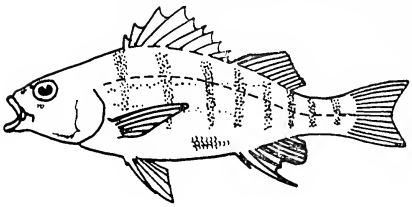
DD. Snout long, usually 3 or less in head; mouth large, nearly or quite horizontal, maxillary long and curved..... *Haemulon*

BB. Soft parts of dorsal and anal not densely scaled, naked or with small scales on the inter-radial membranes.

E. Body rather elongate; head long, snout pointed; lips thin. Anal fin with III, 6 to 8 rays; second anal spine somewhat enlarged... *Pomadasys*

EE. Body short and deep; head short; snout blunt; lips thick; second anal spine notably enlarged..... *Anisotremus*

Conodon Cuvier and Valenciennes, 1830



Large-toothed Conodon Grunt; Bureteado

Conodon nobilis (Linnaeus)

References: *Perca nobilis*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 191.
Conodon nobilis, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 521.

Field Characters: Small, slightly compressed, elongate grunts with about 8 vertical dark bands; preopercle serrate, the serrations largest at the angle, those below the angle pointing forward.

Size and Weight. Our three specimens are as follows:

Length	*Weight*
139.5 mm.	78 grams
152 "	100 "
169 "	135 "

Color: Meek and Hildebrand mention that the very young of this species have 3 or 4 indistinct horizontal bands. These bands persist in our 139 mm.

fish, which is 2½ times as long as their smallest specimen and almost half as large as their largest. This fish has 4 horizontal bands, the three lowermost being well defined, while the fourth is rather indistinct. The width of the lowermost bands is about one-third that of the eye.

General Range: Atlantic, from Texas to Brazil; Pacific from Lower California to Panama.

Abundance: Uncommon. Rare in the market, about 6 having been seen in four months.

Method of Capture: Hook and line and by seining.

Food: The stomach of one of our fishes was filled with rather large fish scales and with the remains of a shrimp.

Study Material: Specimens, 3; 139–169 mm., No. 6863.

Bathystoma Scudder, 1863

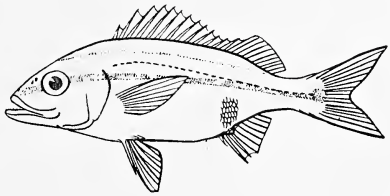
Key to Port-au-Prince Bay Species

A. Body elongate, depth 2.85 to 3.1 in length; scales 50 to 59 in lateral series; a large black caudal spot present.....*rimator*

AA. Body very elongate, the depth 3.4 to 3.85 in length; scales small, 65 to 72 in lateral series; caudal spot wanting.....*striatum*

Tom Tate; Red-mouthed Grunt

Bathystoma rimator (Jordan and Swain)



References: *Haemulon chrysopteron*, Cuvier and Valenciennes, 1830, Hist. Nat. Poiss., V, p. 240.

Haemulon rimator, Jordan and Swain, 1884, Proc. U. S. Nat. Museum, p. 308.

Bathystoma rimator, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 523.

Field Characters: Small, rather elongate, red-mouthed grunts with two yellow stripes on side, one from interorbital to base of last dorsal rays, the other from eye to base of caudal where it ends in a large black spot.

Description: Small specimens of 50 to 60 mm. occasionally have the depth 3.3 to 3.4.

Size and Weight: Our specimens range from 44 to 139 mm.

Color: In fish of 50 mm. the deeper portion of the throat and the inner opercular rim is pink; in fish of 85 to 100 mm. this color has become scarlet and has extended to the sides and the whole floor of the mouth, the tongue and the posterior half of the lower tooth-bearing bones, both inside and out.

In the small fish and increasingly so in some of the larger individuals, there are numerous, irregularly scattered patches of pigment dots.

Small fish have the iris silvery, except antero-posteriorly, where gold carries through the gold line from snout to caudal.

The black peduncle spot is present in all our specimens, but it is exceedingly variable in strength. The peritoneum is black in all specimens examined.

General Range: North Carolina to Trinidad.

Distribution in Port-au-Prince Bay: Found usually close inshore in shallow water, especially over weed-covered patches.

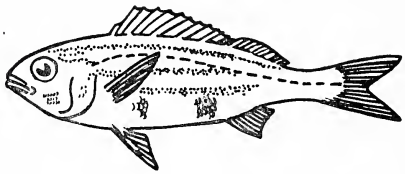
Abundance: Very common, taken in numbers in almost every seining. Occasionally seen in the market, but owing to its small size, not a common commercial fish.

Breeding: A 110 mm. female examined on February 20 had eggs moderately developed. Two males, 80 and 125 mm. long dissected on March 21st seemed to be in full breeding; the testes of the 125 mm. specimen measured 15 by 3 mm.

Food: This species is omnivorous, usually feeding near the bottom, but not necessarily confined to it. Our examination of stomach contents of this species reveals an amazing number of different foods, chief of which were the following:

Sand, mud and bottom detritus, algae sometimes in very large amounts; worms of various kinds; mollusk shells, broken and entire; with one record of a small, brilliantly colored cardium; crustaceans, such as copepods, isopods, "plankton," shrimps and small crabs.

Study Material: Photograph: 3902; Specimens, 406; 44 to 139 mm., No. 6822.



Striped Grunt

Bathystoma striatum (Linnaeus)

References: *Perca striata*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 233.
Bathystoma striatum, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 524.

Field Characters: Very elongate, red-mouthed compressed grunts with 5 or 6 greenish yellow stripes on sides and without a black caudal spot.

Description: Our single specimen of this species does not agree entirely with the published descriptions, but for lack of other material we are assigning it to this species. It differs in the following particulars; eye 3.76 instead of 2.6 to 3.35; snout 2.65 instead of 3.5 to 3.6. In other words it has a smaller eye and longer snout than is usually recorded for this species. It has eighteen gill rakers on the lower half of the first arch.

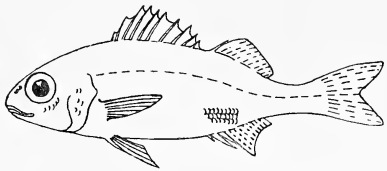
General Range: Bermuda Islands to Brazil.

Abundance: Apparently rather rare, our single specimen being the only one seen during the expedition.

Study Material: Specimen, 1; 174 mm., No. 6933.

Brachygenys Scudder, 1868

Small-mouthed Golden Grunt
Brachygenys chrysargeus (Günther)



References: *Haemulon chrysargeum*, Günther, 1859, Cat. Fish Brit. Mus. 1, p. 314.
Brachygenys chrysargeus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 527.

Field Characters: Elongate, large-eyed, short-snouted, red-mouthed grunts, with 5 horizontal yellow stripes along sides, almost half as broad as the interspaces.

General Range: Florida to Brazil.

Distribution in Port-au-Prince Bay: All of our specimens were taken on Sand Cay, a coral and sand reef three miles from shore in Port-au-Prince Bay.

Abundance: Uncommon, seen occasionally on the reefs, and now and then in the fish markets.

Method of Capture: All of our fish were taken by dynamite. Two of them had evidently been very close to the explosive as they came to the surface with irregular patches of black on various parts of their fins and bodies.

Study Material: Color Plate, H96; No. 7166; Specimens 2; 153 mm., No. 7166.

Haemulon Cuvier, 1829

Key to Port-au-Prince Bay Species

A. Scales below lateral line notably enlarged, very deep; sides with yellow stripes, parallel with lateral line above it, very oblique below it. *flavolineatum*

AA. Scales below lateral line not especially enlarged.

B. Scales above lateral line enlarged, four rows between the lateral line and the origin of the dorsal; about twelve well defined, more or less wavy, horizontal blue stripes, most prominent on the head, occasionally extending on the upper body..... *plumieri*

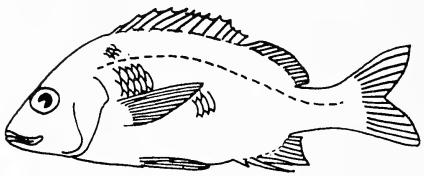
BB. Scales above the lateral line not enlarged, not fewer than 5 series between the lateral line and the origin of the dorsal.

C. Maxillary reaching nearly or quite to middle of eye, 1.9 to 2.3 in head; sides with blue, black or golden stripes.

D. Soft dorsal with strongly convex margin, the anterior rays scarcely longer than the posterior ones; head and body with about 10 horizontal blue stripes, becoming pale but not disappearing in spirits, well defined on snout and cheeks..... *sciurus*

DD. Soft dorsal with nearly straight margin, anterior rays nearly twice as long as the posterior ones; upper part of sides with 4 or 5 dark stripes, present at all ages, no stripes on snout and cheeks..... *macrostomum*

CC. Maxillary reaching to or slightly past anterior margin of eye, 2.2 to 2.8 in head; sides with continuous dark stripes following the rows of scales, wavy above the lateral line. No caudal spot in adult.....*bonariense*



French Grunt; Open-mouthed Grunt
Haemulon flavolineatum (Desmarest)

REFERENCES: *Diabasis flavolineatus*, Desmarest, 1823, Premier Dec. Ichth., p. 35, Plate II, fig. 1.
Haemulon flavolineatum, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 531.

FIELD CHARACTERS: Small, somewhat elongate, compressed, fairly large mouthed grunts with very large and deep scales on the sides below the lateral line. Sides with yellow stripes more or less parallel with lateral line above it, those below the lateral line quite oblique.

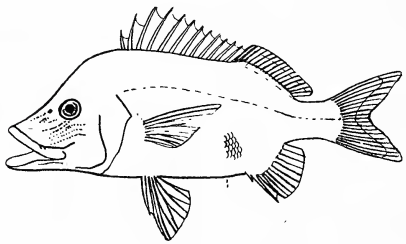
COLOR: The ground color in all of our specimens is bluish pearl gray as stated by Jordan and Evermann and not greenish as stated by Meek and Hildebrand. The yellow stripe from occiput along the base of the dorsal is not evident in our specimens.

GENERAL RANGE: West Indies; Bermuda and Florida Keys to Brazil.

ABUNDANCE: This species is fairly common on the various reefs in Port-au-Prince Bay, and is also brought in small numbers from the deeper reefs by the fishermen.

FOOD: Echinoderms and crustacean remains.

STUDY MATERIAL: Colored Plate, H4, No. 6890, H28, fig. B; Specimens, 9; 105 to 157 mm., Nos. 6890 and 7236.



Common Grunt; Ronco-ronco
Haemulon plumieri (Lacépède)

REFERENCES: *Labrus plumieri*, Lacépède, 1802, Hist. Nat. Poiss., III, p. 480, Plate II, fig. 2.
Haemulon plumieri, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 532.

FIELD CHARACTERS: Medium, rather deep, large-mouthed grunts with very large scales above the lateral line. Bluish-gray, bases of scales above bright

bronze tinged with olive. Head bronze, with many narrow stripes of clear deep blue.

Size and Weight: Reaches a length of 18 inches, and a weight of 4 pounds. A 235 mm. specimen weighed 316 grams.

Color: Considerable variation in color is shown by this species. All of our specimens had black pigmented peritoneums.

General Range: West Indies; North Carolina to Brazil.

Occurrence in Port-au-Prince Bay: Fish up to 100 mm. have been seen quite often on the shallower diving reefs, while most of the larger fish are taken on the deeper banks further off shore.

Abundance: The commonest grunt in the bay, and practically always seen in the market.

Method of Capture: Taken in seines, traps, hook and line and by dynamite.

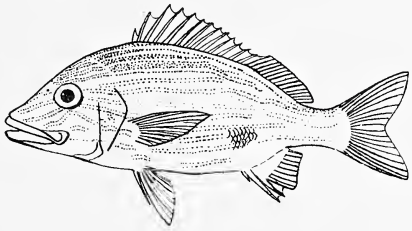
Breeding: Of 7 specimens examined during February and March, none gave any indications of breeding.

Food: Echinoderms, polychaete worms, mollusk shells, shrimps, crabs, otolith of undetermined fish, porcupine-fish (*Diodon hystrix*), and unidentifiable bottom debris.

Study Material: Colored Plate, H28, fig. A; Photograph, 3754; Specimens, 22; 35–235 mm., Nos. 6891 and 6881.

Yellow Grunt; Boar Grunt

Haemulon sciurus (Shaw)



References: *Sparus sciurus*, Shaw, 1803, Gen. Zool., IV, Plate LXIV.
Haemulon sciurus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 533.

Field Characters: Medium, somewhat elongate, compressed, large-mouthed, long-snouted grunts with about 10 horizontal blue stripes on head and body, one below the eye wavy.

Color: One of our specimens represents *multilineatum*, which appears to be based solely on a lack of dusky shading.

Size and Weight: Grows to a length of 18 inches. A 211 mm. fish weighed 270 grams.

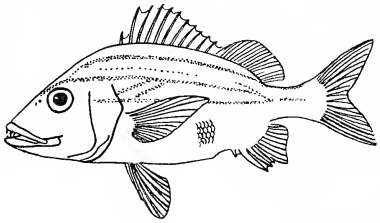
General Range: West Indies; Florida Keys to Brazil.

Distribution in Port-au-Prince Bay: Found generally over the reefs and along shore, the smaller specimens being especially common in shallow water.

Abundance: Very common, and next to *Haemulon plumieri*, the commonest grunt about Port-au-Prince. It can always be seen in the markets.

Method of Capture: Seines, traps, hook and line and dynamite.

Study Material: Colored Plate, H28, fig. C; Specimens, 8; 49 to 305 mm. No. 7270.



Gray Grunt; Striped Grunt; Caco Gris

Haemulon macrostomum Günther

References: *Haemulon macrostoma*, Günther, 1859, Cat. Fish Brit. Mus., 1, p. 308.

Haemulon macrostomum, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 535.

Field Characters: Medium, rather deep, long-snouted, large-mouthed grunts, with 4 or 5 dark horizontal stripes on the upper part of the sides. Greenish above, brownish below.

Description: Our 304 mm. fish has a slightly smaller eye, 4.9 in the head instead of 3.1 to 4.4 as given by Meek and Hildebrand.

Color: Greenish silvery above becoming clearer silver below, scales mostly with pearly centers. Under surface of head dusky. Conspicuous dark streaks along the sides of the body; a median streak from tip of snout to dorsal, one from snout above eye along side of the back to last ray of the soft dorsal, two below this from eye above, to the last ray of the soft dorsal, the upper one more or less interrupted posteriorly, a fourth from eye nearly straight to base of caudal; traces below this of a fifth streak. Spinous dorsal brownish green; soft dorsal and anal greenish yellow. Caudal dusky, greenish yellow distally.

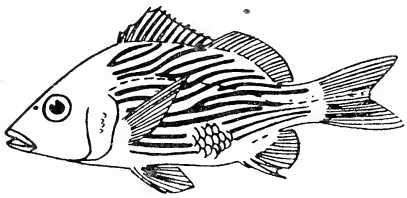
General Range: West Indies, Florida, Panama and Columbia.

Distribution in Port-au-Prince Bay: Taken by us only over rather deep coral reefs.

Abundance: Uncommon, not seen at the markets.

Method of Capture: Taken by us only with dynamite.

Study Material: Specimen, 1; 304 mm., No. 7273.



Black Grunt; Ronco Prieto

Haemulon bonariense Cuvier and Valenciennes

References: *Haemulon bonariense*, Cuvier and Valenciennes, 1830, Hist. Nat. Poiss., V, p. 254.

Haemulon bonariense, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 541.

Field Characters: Medium, moderately deep, rather long-snouted grunts with rusty brown lines on the sides following the lines of scales; young with 3 or 4 black longitudinal stripes and with a distinct caudal spot.

Size and Weight: A 185 mm. fish weighed 147 grams and a 264 mm. fish weighed 401 grams.

General Range: West Indies, south to Buenos Aires.

Abundance: Fairly common, usually seen in the market 2 or 3 times a week.

Study Material: Photograph, 3925; Specimens, 6; 175 to 259 mm., Nos. 6970, 6971 and 6873.

Pomadasys Lacépède, 1803

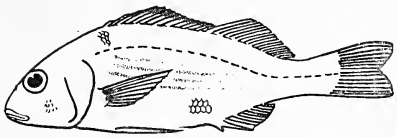
Key to Port-au-Prince Bay Species

A. Pectoral fins long, reaching to or past tips of the ventrals, 1.05 to 1.6 in head; scales large, 3½ to 4 series between the lateral line and the middle of the soft dorsal.....*corvinaeformis*

AA. Pectoral fins very short, not reaching the tips of the ventrals, 1.5 to 1.9 in head; scales small, 5 to 6½ series between the lateral line and the middle of the soft dorsal.....*crocro*

Croaker-like Roughcheek

Pomadasys corvinaeformis (Steindachner)



References: *Haemulon corvinaeforme*, Steindachner, 1868, Ichthy. Notizen, VII, p. 16.

Pomadasys corvinaeformis, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 549.

Field Characters: Elongate, compressed, small-mouthed grunts, with 49 to 52 scales in a lateral series. Silvery below, greyish above; several dark, longitudinal streaks along the side. Pectorals long, reaching to or past the ventrals.

Description: The tail is not forked to any great extent in our specimens, but deeply emarginate.

Size and Weight: A 122 mm. fish weighed 45 grams and a 184 mm. fish weighed 153 grams.

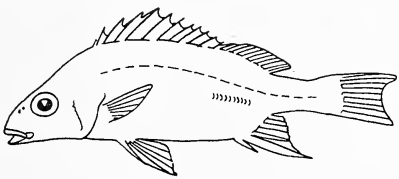
General Range: Atlantic coast from the West Indies south to Brazil.

Abundance: Fairly common, often seen in the fish market, but never as a common food fish.

Study Material: 3; 122 to 184 mm., No. 6907.

Crocro Roughcheek

Pomadasys crocro (Cuvier and Valenciennes)



References: *Pristipoma crocro,* Cuvier and Valenciennes, 1830, Hist. Nat. Poiss., V, p. 264.
Pomadasys crocro, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 559.

Field Characters: Elongate, compressed, small-mouthed grunts, with 57 to 63 scales in a lateral series. Silvery below, dark olivaceous above, sides often with dusky punctulations. Pectorals short, not reaching ventrals.

Description: Our single specimen runs to *ramosus* in Jordan and Evermann.

Color: Dark olivaceous above, silvery white below; all of the scales when viewed from the side, silvery blue with a gray green edge. Sides with dusky punctulations most prominent about the axil, below the pectoral, the lower part of the cheeks, maxillary, and in front of the nostril. Fins dusky.

General Range: Atlantic coast of tropical America, from the West Indies south to Brazil; ascending rivers.

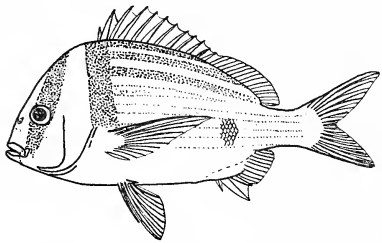
Distribution: Our one specimen was found at Source Mariani, an artificially constructed pool, about 50 feet wide and 120 feet long, surrounding and including the spring from which it originated, situated about a mile from the sea and connected with the ocean by two small and narrow streams. The pool was completely emptied of fish by running a wide and deep seine through from one end to the other, and this specimen was the only one of its species taken. It lived in company with large (2 foot) mullets (*Mugil curema*) and smaller fresh-water mullets (*Agonostomus monticola.*)

Abundance: Rare. Not seen at the fish markets.

Method of Capture: Seine.

Study Material: 1; 305 mm., No. 7173.

Anisotremus Gill, 1861



Pork Fish
Anisotremus virginicus (Linnaeus)

References: *Sparus virginicus,* Linnaeus, 1758, Syst. Nat., Ed. X, p. 281.
Anisotremus virginicus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 569, Plate LX.

Field Characters: Deep, small-mouthed grunts with 10 horizontal golden lines on a silvery blue background. A wide black band from the nape through eye, another from origin of dorsal to or across the base of the pectorals.

Description: Our specimens agree with the description given by Meek and Hildebrand, but the profile in our 158 mm. fish is by no means as steep as is shown in their plate.

Size and Weight: Grows to the length of 1 foot and a weight of 2 pounds. Our 205 mm. specimen weighed 330 grams.

Color: The pectoral fins were golden in our fish, while the other fins were golden mottled with black.

General Range: Florida to Brazil.

Occurrence in the Gulf of Gonave: Uncommon, seen occasionally in the fish markets.

Method of Capture: One specimen was taken during airplane bombing practice in water from 50 to 100 feet deep.

Food: Stomach contents dominated by minute crustaceans such as those found crawling about on coral; other comminuted animal remains, including many small elongate spines and small mollusks.

Study Material: Specimens, 2; 158–205 mm., Nos. 6817, 7336.

Family Sparidae; the Porgies

Key to Port-au-Prince Bay Genera

A. Front teeth conical or pointed, not compressed; second interhaemal spine enlarged, hollowed anteriorly, cone-like.....*Calamus*

AA. Front teeth broad, incisors; dorsal fin preceded by a small antrorse spine; interhaemal spine not cone-shaped.....*Archosargus*

Calamus Swainson, 1839

Key to Port-au-Prince Bay Species

A. Scales rather small, 54 to 57 pores in lateral line.

B. Outer teeth $\frac{10-12}{12-10}$ in number, outer canines of upper jaw directed forward except in young.

C. Preorbital with reticulations of bluish ground-color around bronze spots. *calamus*

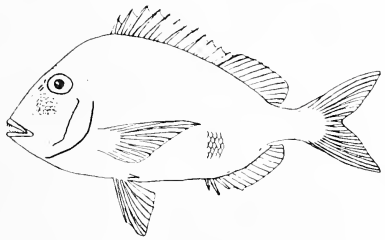
CC. Preorbital region, snout, cheeks and opercles brassy, crossed by horizontal, wavy, non-reticulating lines of violet-blue.....*proridens*

BB. Anterior teeth strong $\frac{4-8}{8-10}$. No antrorse canines at any age...*bajanado*

AA. Scales larger, 45 to 52 pores in lateral line.....*arctifrons*

Saucer-eyed Porgy

Calamus calamus (Cuvier and Valenciennes)



References: *Pagellus calamus*, Cuvier and Valenciennes, 1830, Hist. Nat. Poiss., VI, p. 206, Plate CLII.

Calamus calamus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 575.

Field Characters: Medium sized, compressed, rather deep fishes with moderate sized horizontal mouth, placed low; sides of jaws with molar teeth, outer teeth 10 to 12 in number, the outer canines of the upper jaw directed forward, except in young; 54 to 57 pores in lateral line. Preorbital with reticulations of bluish ground color around bronzy spots.

Size and Weight: Grows to 15 inches. A 219 mm. fish weighed 295 grams.

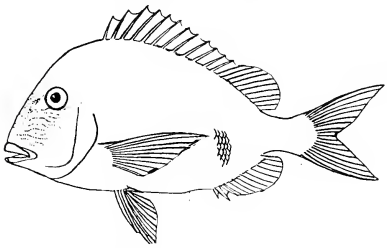
General Range: Florida to Brazil.

Abundance: Uncommon, rarely seen at the markets.

Method of Capture: Taken by seine fishermen.

Food: Omnivorous, our records showing algae, shells of foraminifera, sea urchins, mollusk shells, shrimps, crabs and small anchovies.

Study Material: Photograph, Specimens, 1; 219 mm., No. 7333.



Little-head Porgy; Pez de Pluma
Calamus proridens Jordan and Gilbert

References: *Calamus proridens*, Jordan and Gilbert, 1884, Proc. U. S. Nat. Mus., p. 150.
Calamus proridens, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1350.

Field Characters: Compressed, oblong fishes, considerably elevated; the mouth small, low and horizontal; dorsal fin continuous; head large, deep, the suborbital very wide; anterior profile in adult rising in a very steep line to nape, thence in a gentle curve to front of dorsal; scales 54 to 57; teeth on sides molar; outer canines of upper jaw directed forward except in very young; preorbital region, snout, cheeks and opercles brassy, crossed by horizontal, wavy, non-reticulating lines of violet blue.

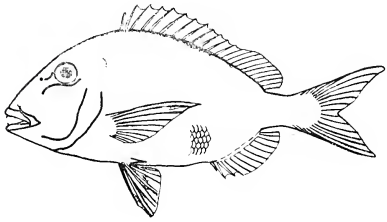
Size and Weight: Our 255 mm. fish weighed 580 grams.

General Range: West Indies north to Florida Keys.

Abundance: Not uncommon, seen quite often in the markets.

Food: The stomachs contained small crustaceans.

Study Material: Specimens, 5; 84–260 mm. including No. 7334.



Jolt-head Porgy; Diol pas bleu
Calamus bajanado (Bloch and Schneider)

References: *Sparus bajanado,* Bloch and Schneider, 1801, Syst. Ichth., p. 284.

Calamus bajanado, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1352.

Field Characters: Compressed, oblong fishes, considerably elevated; mouth rather small, horizontal, low; anterior profile rising in a fairly regular curve to front of dorsal; scales 54; no antrorse canines; a blue line bordering the eye below and another above, extending on forehead.

Size and Weight: Reaches a length of two feet and a weight of 10 lbs. The single specimen taken measured 143 mm. and weighed 94 grams. It was a female past breeding.

General Range: Florida and the West Indies.

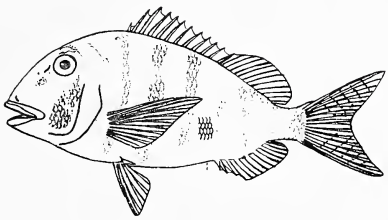
Occurrence in Port-au-Prince Bay: A single specimen taken in a seine at night.

Food: An omniverous browser; comminuted sea urchins, shells, bits of coral, sponge, and worms, crabs and other crustaceans.

Study Material: Specimen, 1; 143 mm. No. 7335.

Grass Porgy; Shad Porgy

Calamus arctifrons Goode and Bean



References: *Calamus arctifrons,* Goode and Bean, 1882, Proc. U. S. Nat. Mus., p. 425.

Calamus arctifrons, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1355.

Field Characters: Small to medium sized, compressed, rather deep fishes with moderate sized horizontal mouth placed rather low; sides of jaws with molar teeth; scales larger than other Haitian species in the collection, 45 to 52 in lateral line.

Size and Weight: A 185 mm. fish weighed 95 grams.

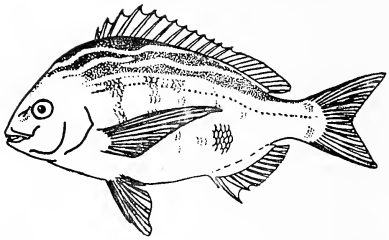
General Range: Shores of the Gulf of Mexico; Porto Rico and Haiti.

Abundance: Rather uncommon.

Food: The stomach contents of three fish contained comminuted animal matter, too far gone to definitely identify, and vegetable matter, notably two or three leaves of *Thalassia.*

Study Material: Specimens, 3; 145–195 mm., including No. 6895.

Archosargus Gill, 1865



Tropical Sheepshead; Medance
Archosargus unimaculatus (Bloch)

References: *Perca unimaculatus*, Bloch, 1792, Naturg. Ausl. Fische, VI, Plate CCCVIII, fig. 1.
Archosargus unimaculatus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 578.

Field Characters: Body short and deep, back much elevated; mouth small; incisors and molar teeth in two rows; 13 dorsal spines; sides with golden stripes, dark bars in young.

Size and Weight: A 145 mm. specimen weighed 142 grams.

General Range: Florida and the West Indies, south to Rio de Janeiro.

Occurrence in Port-au-Prince Bay: Taken commonly by the fisherman in seines at night.

Food: A browser: small crustaceans and anemones, much algae and bits of *Thallasia*.

Size at Maturity: A 165 mm. fish was in full breeding condition, and ripe ovaries were found in late March in females from 160 to 210 mm.

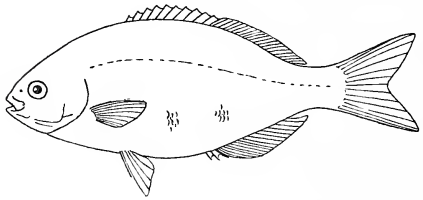
Spawning Season: Three mature females were taken in mid and late March.

Eggs: In a female of 170 mm. the ovaries measured 65 x 10 mm. and the eggs were .34 to .45 in diameter.

Study Material: Specimens, 4; 145 to 210 mm. including Nos. 6849, 6856 and 7336.

Family Kyphosidae; the Rudder-Fishes

Kyphosus Lacépède, 1802



Rudder-fish; Bermuda Chub; Chub; Chopa Blanca
Kyphosus sectatrix (Linnaeus)

References: *Perca saltatrix*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 293.
Kyphosus sectatrix, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 608, Plate LXV.

Field Characters: Medium, rather deep, compressed fishes with small mouths, rather large flattened teeth, and the soft dorsal and anal fins scaly

in the adult. Dark brown above to pale brown below; sides with blue lines and purplish reflections.

Size and Weight: Grows to 18 inches. Our specimen, 78 mm. long, weighed 13 grams.

General Range: Massachusetts south to the West Indies.

Occurrence in Port-au-Prince Bay: 1 specimen from market; a 15-inch specimen clearly seen in motion picture film, taken two fathoms down.

Abundance: Rare, a single specimen found at the fish market.

Food: Small crustaceans.

Study Material: Specimen, 1; 78 mm. No. 7379.

Family Gerridae; the Mojarras

Key to Port-au-Prince Bay Genera

A. Second interhaemal spine hollow, cone-shaped, its cavity entered by the posterior end of the air bladder; preopercle entire; anal spines 3, the second not much enlarged..... *Eucinostomus*

AA. Second interhaemal spine normally developed, not hollow, and not entered by air-bladder; preopercle entire or serrate; anal spines, 2 or 3, the second large or small.

B. Second interhaemal small; anal spines 2, the second small; preopercle entire..... *Ulaema*

BB. Second interhaemal long; spear-shaped; anal spines 2 or 3, the second enlarged.

C. Preopercle entire; the second anal spine moderate..... *Gerres*

CC. Preopercle serrate; the second anal spine much enlarged..... *Diapterus*

Eucinostomus Baird and Girard, 1854

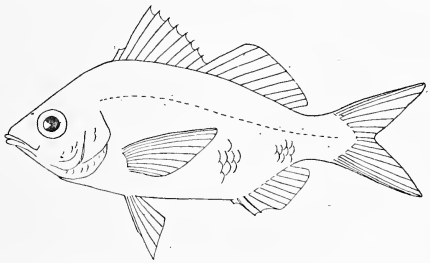
Key to Port-au-Prince Bay Species*

A. Premaxillary groove crossed by scales in front, leaving a naked pit behind; depth 2.2 to 3..... *gula*

AA. Premaxillary groove not crossed by scales in front, usually open and linear, sometimes slightly restricted by scales in front, and wider posteriorly; body less compressed, rather slender; depth 2.5 to 3.3.... *californiensis*

Silver Mojarra

Eucinostomus gula (Cuvier and Valenciennes)



* We keep the two Haitian species *gula* and *californiensis* separate, although there is an apparent over-lapping in our specimens.

References: *Gerres gula*, Cuvier and Valenciennes, 1830, Hist. Nat. Poiss., VI, p. 464.

Eucinostomus gula, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 582.

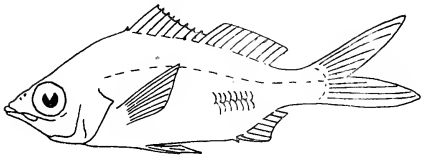
Field Characters: Small, elliptical, moderately compressed, silvery fishes with extremely protractile mouth parts; second interhaemal bone in the shape of a hollow cone; premaxillary groove closed or nearly closed by scales in front.

Size and Weight: A 65 mm. fish weighed 5 grams, and a 35 mm. fish 1.1 grams.

General Range: Massachusetts to Brazil.

Abundance: Fairly common, often seen in the fish markets.

Study Material: Specimens, 77; 25 to 100 mm.



Common Mojarra
Eucinostomus californiensis (Gill)

References: *Diapterus californiensis*, Gill, 1862, Proc. Acad. Nat. Sci. Phila., p. 245.

Eucinostomus californiensis, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 584.

Field Characters: Small, elongate, moderately compressed, silvery fishes with extremely protractile mouth parts; second inter-haemal bone shaped like a hollow cone; premaxillary groove open and linear in young; often oval and restricted in front in older examples.

Size and Weight: A 65 mm. fish weighed 5 grams, and a 35 mm. specimen 1.1 grams.

General Range: Pacific coast from California to Ecuador; Atlantic coast from North Carolina to Brazil, West Indies.

Distribution in Port-au-Prince Bay: Seen mostly along shore, where they fed in shallow water among submerged plants.

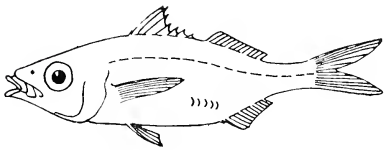
Abundance: A very common species, often seen in the markets and taken in large numbers by seine fishermen.

Method of Capture: Mainly by seines.

Food: A number of specimens examined by us contained detritus of both animal and vegetable origin.

Study Material: Specimens, 39; 37 to 100 mm., including Nos. 6887, 6900 and 7209.

Ulaema Jordan and Evermann, 1895



Lefroy's Mojarra
Ulaema lefroyi (Goode)

References: *Diapterus lefroyi*, Goode, 1874, Amer. Journ. Sci. and Arts, VIII, p. 123.
Ulaema lefroyi, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 588.

Field Characters: Medium, elongate, compressed, silvery fishes with extremely protractile mouth parts; preopercle entire; anal spines 2; second interhaemal spine short and bluntish. Traces of dark cross bars on sides.

Size and Weight: Grows to 8 inches.

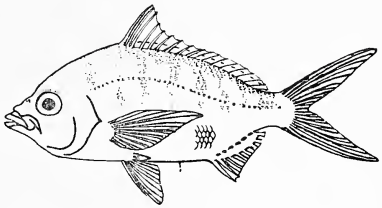
General Range: Florida to Brazil.

Abundance: Rare, only a single specimen seen at market during four months.

Study Material: Specimen, 1; 139 mm. No. 7101.

Gerres Cuvier, 1824

Dark-barred Mojarra
Gerres cinereus (Walbaum)



References: *Mugil cinereus*, Walbaum, 1792, Artedi Piscium, Pt. III, p. 228.
Gerres cinereus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 589.

Field Characters: Elongate, compressed fishes with extremely protractile mouth parts; preopercle entire; 3 anal spines; second interhaemal bone large and spear shaped; sides of body with 7–8 bluish vertical cross bars.

Size and Weight: Grows to 12 to 15 inches. The majority of our fish were about 3 inches long. A 300 mm. specimen weighed 2¾ pounds. During the period of our stay in Haiti, more large specimens of this species were seen than any other of its family.

Color: The dark bars on the sides are well marked in our fish, and especially so in the smaller ones (40 mm.), where they are often concentrated on the midline.

General Range: Atlantic coast from Florida to Cartagena; Pacific coast from lower California to Peru.

Abundance: Not especially common, but seen practically always in the market in small numbers.

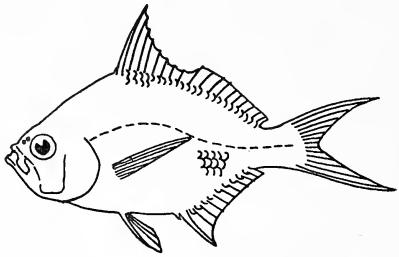
Method of Capture: Mostly by means of seines.

Food: Like other members of its family a general feeder. Our notes mention an assortment of worms, mollusks, crustaceans and parts of small fish.

Breeding: In a 290 mm. fish captured on the 18th of March, the ovaries measured 70 x 8 mm., and in a 285 mm. specimen taken on March 13, the ovaries were 70 x 15 mm. The eggs were not well developed.

Study Material: Specimens, 13; 21 to 300 mm. including Nos. 6843, 7209, 7237.

Diapterus Ranzani, 1840



Rhomboid Mojarra
Diapterus rhombeus (Cuvier)

References: *Gerres rhombeus*, Cuvier, 1829, Règne Animal, Ed. II, II, p. 188; Cuvier and Valenciennes, 1830, Hist. Nat. Poiss., VI, p. 459. *Diapterus rhombeus*, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 593.

Field Characters: Small, short and deep, much compressed, rhomboidal, bright silvery fishes with extremely protractile mouth parts. Preopercle serrate; preorbital smooth; 2 anal spines, the second much enlarged.

Size and Weight: Grows to 8 to 13 inches. Most of our specimens were no larger than 125 mm. One recorded, but unfortunately not preserved, measured 338 mm.

General Range: West Indies south to Brazil.

Distribution in Port-au-Prince Bay: Found rather widely distributed, but mostly along the shore north of Port-au-Prince, near and around mangrove-covered islands. We practically never saw it on the shallower diving reefs.

Abundance: An extremely common species, brought in large numbers to the markets. Like many of the smaller fishes they spoil very rapidly and, like the small engraulids and clupeids, they are usually salted as soon as captured.

Method of Capture: Practically all of our fish were taken in seines, and mostly by purse seines.

Food: The stomach contents of 22 fish were examined. This species is a general feeder, the stomachs revealing algae, *Thalassia*, foraminifera shells, sponge spicules, worms of various kinds, small bivalve mollusks, crustaceans including ostracods, copepods, Nebalia-like forms, paddles of small crabs, and parts of a large red crab in the case of one fish, and finally, a few spines of a very small fish.

Breeding: The gonads of most of the specimens taken during February to April were not advanced. A 130 mm. female however, taken on March 27, 1927 had spherical, nearly ripe eggs measuring .34 to .39 mm.

Study Material: Specimens, 549; including No. 6805.

Family Mullidae; the Surmullets

Upeneus Cuvier, 1829

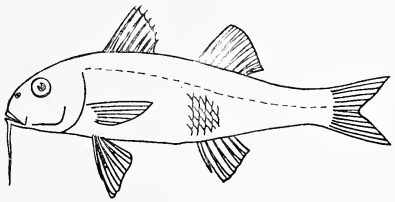
Key to Port-au-Prince Bay Species

A. Scales large, 30 to 32 in a lateral series; several large dark blotches along sides..... *maculatus*

AA. Scales smaller, 39 or 40 in a lateral series; no dark blotches along sides. *martinicus*

Red Goatfish; Salmonete; Barbaray Rouge

Upeneus maculatus (Bloch)



References: *Mullus maculatus*, Bloch, 1793, Naturg. Ausl. Fische, VII, p. 95.

Upeneus maculatus, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 303.

Field Characters: Elongate, rather compressed fish with two long chin barbels; greenish brown above, sides green; head, lower lobe of caudal, anal, ventrals and pectorals red; 3 or 4 large, brownish blotches along sides.

Size and Weight: A 220 mm. specimen has been recorded. Our largest measured 190 mm. and weighed 145 grams.

General Range: Florida and south to Rio Janeiro.

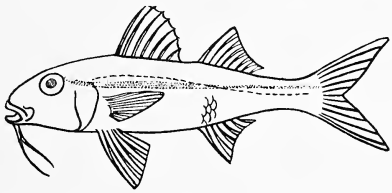
Occurrence in Port-au-Prince Bay: Obtained only from market, where they were common.

Food: Bottom debris, organic and inorganic, animal and vegetable.

Study Material: Photograph, No. 3911; Specimens, 5; 168 to 195 mm. No. 6928.

Yellow Goatfish; Salmonete Amarilla; Barbaray Jaune et Gris

Upeneus martinicus Cuvier and Valenciennes



References: *Upeneus martinicus*, Cuvier and Valenciennes, 1829, Hist. Nat. Poiss., III, p. 483.

Upeneus martinicus, Meek and Hildebrand, 1923, Marine Fishes of Panama, I, p. 306.

Field Characters: Elongate, somewhat compressed fish with two long barbels at chin; pinkish with yellow band on sides from eye to caudal fin; pectorals pinkish; other fins yellow.

Description: Our specimens differ in no way from typical descriptions.

Size and Weight: A 275 mm. specimen is recorded. Our largest measured 165 mm. and weighed 98 grams.

General Range: Florida and the West Indies south to Panama.

Occurrence in Port-au-Prince Bay: All three of our specimens were secured from the fishermen, who took them at night in seines near the reefs.

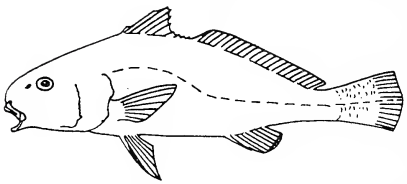
Study Material: Specimens, 3; 113 to 165 mm. No. 6884.

Family Sciaenidae; the Croakers

Key to Port-au-Prince Bay Genera

A. Preopercular margin with bony serrae, or at least with one or more spines.
B. Body elongate; lower jaw with a row of small barbels on each side along the rami, not in a tuft at tip of chin.....*Micropogon*
BB. Body less elongate; no barbels on lower jaw.
C. Head broad above; interorbital space wide; skull excessively cavernous, spongy to the touch.....*Stellifer*
CC. Head narrower, the skull not cavernous; gill rakers comparatively long and slender; preopercle with its lowermost spine directed abruptly downward; lower jaw without canines.....*Bairdiella*
AA. Preopercular margin with a membranous border; never with bony serrae or spines.
D. Mouth small, wholly inferior, horizontal, the snout protruding; second dorsal very long, of 38 to 41 rays; bizarre appearing fishes with conspicuous stripes.....*Eques*
DD. Mouth large, oblique.
E. Mouth very oblique, the lower jaw much in advance of the upper; silvery. *Larimus*
E. Mouth less oblique, the lower jaw little if at all in advance of the upper, lower jaw with canines; brownish, coppery.....*Odontoscion*

Micropogon Cuvier and Valenciennes, 1830



White-mouthed Drummer; Verrugato

Micropogon furnieri (Desmarest)

References: *Umbrina furnieri*, Desmarest, 1823, Prem. Déc. Ichth., 22, Pl. II, fig. 3.

Micropogon furnieri, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 618.

Field Characters: Rather robust, moderately compressed croakers with convex profile over long snout; jaws weak, the lower jaw included and inferior; very small barbels under lower jaw; preopercle armed with teeth; silvery, darker

above, rows of scales above lateral line with dark streaks, 8 or 9 short oblique bars running upward and backward across the arched portion of the lateral line.

Size: All brought to us ranged from 250 to 330 mm. No small fish were observed.

General Range: West Indies south, probably to coast of Argentina.

Distribution in Port-au-Prince Bay: This fish is apparently confined to the deeper waters and fishing banks, especially along the coast of the southern peninsula of Haiti.

Abundance: Fairly common, found in the market quite often.

Method of Capture: Taken mostly with traps and hook and line.

Food: Mostly carnivorous, the stomachs of 15 fish examined contained the following assortment: annelids, shrimps and crabs of various species, a small tarpon, a file fish and three or four unidentifiable small fish. A small piece of limestone was found in the stomach of one fish. The species is a grubber, searching about on the bottom for whatever can be found.

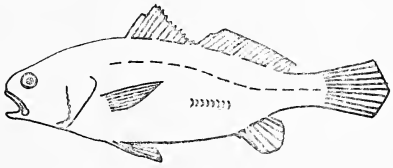
Breeding: The ovaries of 13 specimens taken from February 13 to March 30 averaged 75 mm. long and 15 mm. wide. In those taken from the 9th to the end of March the eggs were quite well developed. Most of the eggs taken from a 310 mm. fish on March 18th measured .45 mm. in diameter, the remainder measured .28 mm.

Study Material: Specimens, 6; 250–330 mm., No. 6839.

Stellifer Oken, 1817

Spongy-headed Croaker

Stellifer colonensis Meek and Hildebrand



Reference: *Stellifer colonensis*, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 623.

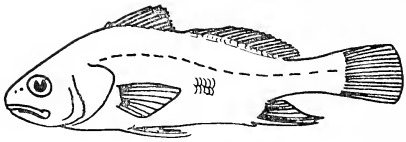
Field Characters: The bones of the skull of these fish are hollowed out to paper thinness; rather deep, thick-bodied fish, back elevated, sloping straightly to the rounded snout; mouth inferior, almost straight; gill-rakers 18 to 21; dorsal fin XI–I, 23.

Description: Agrees well with the original description. In Meek and Hildebrand's specimen No. 81220 there is decided obliquity of the mouth, and the anterior end of the premaxillary cuts the eye, so that there is agreement in these two uncertain characters.

General Range: On coral reefs at Atlantic end of Panama Canal, and Haiti.

Study Material: Specimens, 3; 120–133 mm., No. 7035.

Bairdiella Gill, 1861



Ronco; Ground Drummer
Bairdiella ronchus (Cuvier and Valenciennes)

References: *Corvina ronchus*, Cuvier and Valenciennes, 1830, Hist. Nat. Poiss., V, p. 107.
Bairdiella ronchus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 634, Plate LXVII, fig. 2.

Field Characters: Small, oblong, compressed croakers with slightly oblique mouths; preopercle serrate, the serrae becoming stronger toward the angle, the lowermost directed downward. Grayish above, silvery below; sides usually with brownish punctulations, a dark blotch on upper anterior angle of opercle.

Description: Our specimens were typical.

Size and Weight: Grows to 7 inches. The lengths and weights of our 3 specimens were as follows:

Length	*Weight*
163 mm.	85 grams
138 "	58 "
132 "	48 "

General Range: West Indies, coast of Mexico south to Brazil.

Abundance: Uncommon, brought to us by our seine fishermen about once every two weeks. Observed at the market fairly often.

Food: Stomach contents were mainly small fish and crustaceans.

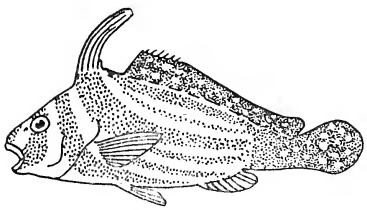
Study Material: Specimens, 3; 132–163 mm., including No. 7124.

Eques Bloch, 1793

Key to Port-au-Prince Bay Species

A. Soft parts of vertical fins with white spots, dorsal fin X to XII–I, 46. *punctatus*

AA. Soft parts of vertical fins without white spots, Dorsal fin XIV or XV–I, 53. *lanceolatus*



Spotted Ribbon-fish, Serrana Hispana
Eques punctatus Bloch and Schneider

References: *Eques punctatus*, Bloch and Schneider, 1801, Syst. Ichthy., p. 106.

Eques punctatus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1488.

Field Characters: Small, oblong, compressed fish; deepest anteriorly, tapering posteriorly to the narrow caudal peduncle. Dark brown, variegated with lighter, and with light spots on soft dorsal, caudal and anal fins and on the caudal peduncle.

Size and Weight: Our 187 mm. fish weighed 137 grams.

General Range: West Indies.

Distribution in Port-au-Prince Bay: Rarely observed by us on the reefs.

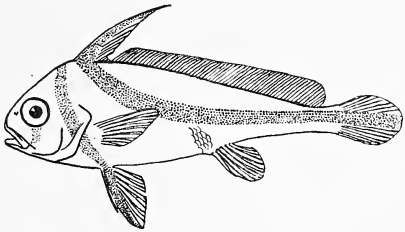
Abundance: Fairly common at the market, but among the uncommon food fish.

Food: The single example had fed exclusively upon crustaceans.

Study Material: Photograph, 3923; Specimen, 1; 187 mm., No. 6955.

Lance-shaped Ribbon-fish; Guapena; Serrana

Eques lanceolatus (Linnaeus)



References: *Chaetodon lanceolatus*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 277.
Eques lanceolatus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1489.

Field Characters: Small, oblong compressed fishes; deepest anteriorly, tapering to the narrow caudal peduncle, and with a short, high spinous dorsal and a long soft dorsal fin. Conspicuously marked with brownish bands; fins not spotted with dirty white.

Description: The single fish assigned to this species had 6 anal rays and a fairly large eye, the diameter of this averaging 3.27 instead of 4 in the head.

Size and Weight: A 140 mm. fish weighed 57 grams.

General Range: West Indies northward to Pensacola.

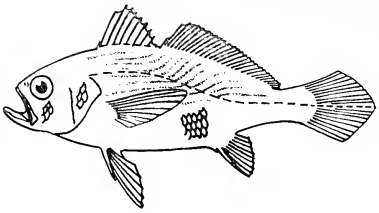
Distribution in Port-au-Prince Bay: Fairly common on the various reefs. Now and then, while diving, these fish were observed swimming about in arena-like spaces in the coral. They preferred sandy places, usually 2 to 3 feet in diameter and surrounded on all sides by masses of coral. Within these barrel-like holes the fishes slowly circled about, retreating and advancing as competitors, such as snappers and sea-basses, shoved their noses into the retreat.

Abundance: Uncommon, seen but rarely at the markets; less often than its relative *punctatus*.

Food: Our 140 mm. fish had fed almost exclusively upon small crustaceans.

Study Material: Photograph, 3987; Specimen, 1; 140 mm., No. 7049.

Larimus Cuvier and Valenciennes, 1830



Cabezon

Larimus breviceps Cuvier and Valenciennes

REFERENCES: *Larimus breviceps*, Cuvier and Valenciennes, 1830, Hist. Nat. Poiss., V, p. 146, Plate CXI.
Larimus breviceps, Meek & Hildebrand, 1925, Marine Fishes of Panama, II, p. 686.

FIELD CHARACTERS: Medium, compressed croaker with large, oblique mouth; the second dorsal fin long, composed of 27 or 28 rays. Brownish above, silvery on sides, clear whitish-silvery below; rows of scales above with distinct dark streaks; a brownish axillary spot.

SIZE AND WEIGHT: Grows to 12 inches. A 140 mm. fish weighed 89 grams.

GENERAL RANGE: West Indies to Brazil.

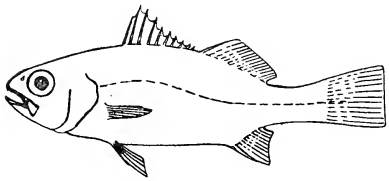
ABUNDANCE: Apparently rather rare. Only one specimen seen in five months.

FOOD: Carnivorous, 2 silver-sides (*Hepsetia stipes*) being found in the stomach of our single specimen.

BREEDING: Our 140 mm. fish had ovaries 39 x 8 mm. long, the great majority of the eggs averaging .4 mm. in diameter (March 23, 1927).

STUDY MATERIAL: Specimen, 1; 140 mm., No. 7091.

Odontoscion Gill, 1862



Corvina; Brown large-eyed Croaker

Odontoscion dentex (Cuvier and Valenciennes)

REFERENCES: *Corvina dentex*, Cuvier and Valenciennes, 1830, Hist. Nat. Poiss., V, p. 139, Plate CIX.
Odontoscion dentex, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 688.

FIELD CHARACTERS: Small, elongate, compressed croakers, with very large eyes; sides of body flattened. Reddish-brown, the rows of scales with faint dark streaks; a conspicuous black axillary spot.

SIZE AND WEIGHT: Grows to 12 inches. A 131 mm. fish weighed 44.3 grams; a 126 mm. fish, 41 grams, and a 95 mm. fish 18 grams.

GENERAL RANGE: West Indies, Panama, Trinidad.

DISTRIBUTION IN PORT-AU-PRINCE BAY: Corvinas were seen constantly on

the coral reefs in 10 to 25 feet of water, and they were among the fishes most commonly found floating at the surface after dynamiting. We seldom saw them swimming free while we were diving, and they spend most of their time hiding among the coral from which they jump forth after whatever luckless prey may happen to pass. We never saw them on the shallower, weed covered reefs near shore.

Abundance: Very common, and brought to the markets in fairly large numbers.

Method of Capture: Traps and dynamite.

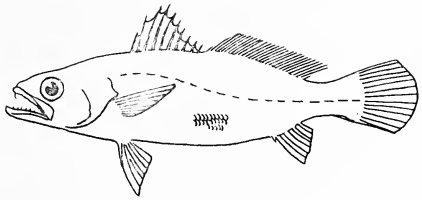
Food: A carnivorous species with crustaceans, especially amphipods and small shrimps, anchovies and other small fish constituting the greater part of their diet.

Study Material: Specimens, 54; 59 to 131 mm., including Nos. 6871, 6957, and 7244.

Family Otolithidae; Weak-Fishes

Cynoscion Gill, 1861

Mongolar Drummer
Cynoscion jamaicensis (Vaillant and Bocourt)



References: *Otolithus jamaicensis*, Vaillant and Bocourt, 1883, Miss. Sci. Mex., etc., Pt. IV, p. 156, Plate VI.
Cynoscion jamaicensis, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 662.

Field Characters: Medium, elongate, compressed, rather deep, conical headed, short and blunt-snouted croakers with large, oblique mouth and fair-sized teeth in two rows; preopercle entire; 2 weak anal spines; a long, low second dorsal fin. Brownish above, silvery below, rows of scales above lateral line with dark streaks which run obliquely upward and back.

Size and Weight: Grows to a foot long. A 193 mm. fish weighed 102 grams.

General Range: West Indies; Colon.

Abundance: Rare, not observed in markets.

Method of Capture: Captured with hook and line.

Food: Carnivorous, our single fish contained a silver-striped anchovy.

Study Material: Specimen, 1; 193 mm., No. 7277.

Family Malacanthidae; the Blanquillos

Malacanthus Curvier, 1829

Plumier's Blanquilla
Malacanthus plumieri (Bloch)

References: *Coryphaena plumieri*, Bloch, 1787, Ichthy., V, 119, Plate 175.
Malacanthus plumieri, Jordan and Evermann, 1898, Fishes of North and Middle America, III, p. 2275.

Field Characters: Medium sized, elongate, slightly compressed small-scaled fishes with conical snout; preopercle entire; long dorsal and anal fins; lateral line complete; caudal fin forked; caudal lobes yellowish.

Description: The interorbital in our fish is wider than the eye, and there are 55 dorsal and 50 anal rays.

Size and Weight: Grows to 15 inches. Our 297 mm. fish weighed 190 grams.

General Range: West Indies.

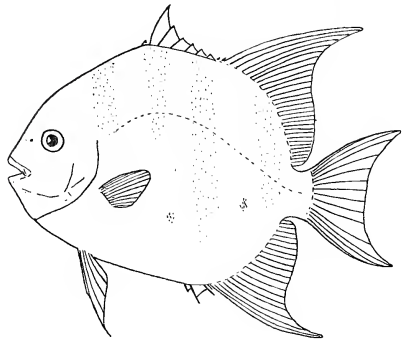
Occurrence in Port-au-Prince Bay: One specimen purchased at fish market.

Abundance: Uncommon.

Study Material: Colored Plate, H64, No. 7044; Specimen, 1; 297 mm., No. 7044.

Family Ephippidae; the Spade-Fishes

Chaetodipterus Lacépède, 1803



Spade-fish; Karengue a plime
Chaetodipterus faber (Broussonet)

References: *Chaetodon faber*, Broussonet, 1782, Ichth. Syst. Pisc., (19), Pl. (VI).
Chaetodipterus faber, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 761.

Field Characters: Moderate-sized, compressed, deep fishes with small but rough scales; spinous dorsal fin separate from soft dorsal; dorsal and anal scaled; mouth very small, teeth in brush-like bands, slender, closely set and movable. Young with third dorsal filament, much more produced than in the adults. Pearly gray, more or less uniform, the young with dark vertical bands.

Size and Weight: Grows to three feet and a weight of twenty pounds.

Color: The 381 mm. fish was dark gray without pattern, the soft dorsal, anal and ventral fins black.

General Range: Cape Cod to Rio de Janeiro.

Occurrence in Port-au-Prince Bay: Found along shore by native fisherman.

Abundance: Fairly common, often brought to the markets, and constantly brought to us by our native seine fisherman.

Method of Capture: Mainly by seines.

Study Material: Drawings, H6, No. 6802; Specimens, 4; 38–280 mm., including Nos. 6802 and 6916.

Family Chaetodontidae; Butterfly Fishes

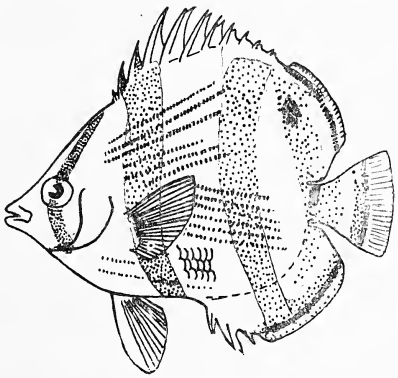
Key to Port-au-Prince Bay Genera

A. Preopercle unarmed; the snout little if at all produced; dorsal spines 12 to 13, not graduated, some of the middle ones highest....*Chaetodon*
AA. Preopercle armed at its angles with a very strong spine, which is sometimes grooved.
B. Interopercle unarmed; vertical limb of the preopercle above the spine entire or nearly so; dorsal fin with 8 to 11 spines.....*Pomacanthus*
BB. Interopercle short and broad, armed with 1 to 4 strong spines; preopercle serrate or spinous; dorsal spines about 14, graduated, the last one longest.
C. Vertical limb of preopercle simply serrate, with 10 to 30 small teeth, body oblong, rather robust.....*Holacanthus*
CC. Vertical limb of preopercle with 3 to 9 conspicuous spines; body ovate, much compressed.....*Angelichthys*

Chaetodon Linnaeus, 1758

Key to Port-au-Prince Bay Species

A. Body without ocelli, crossed by dark bands.....*striatus*
AA. Body with a large black ocellus below the soft dorsal.....*capistratus*



Mariposa, Butterfly-fish
Chaetodon striatus Linnaeus

References: *Chaetodon striatus*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 275.
Chaetodon striatus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 768.

Field Characters: Small, deep-bodied fishes with single dorsal fin of spines and rays; vertical fins densely scaled; mouth small, teeth fine and brush-

like; three vertical black bands on body, one from nape through eye and over cheek, second from anterior part of spinous dorsal, and third from posterior part of spinous dorsal to middle of anal.

Size and Weight: Grows to 4 or 5 inches long. A 102 mm. fish weighed 44 grams.

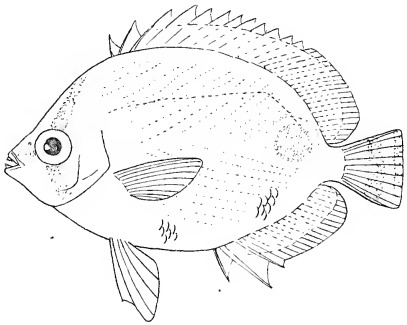
General Range: West Indies to Brazil.

Occurrence in Port-au-Prince Bay: Known to us only by specimens obtained in the markets.

Abundance: Uncommon.

Food: Very minute crustaceans, algae, and other organic matter too disintegrated to identify.

Study Material: Photograph, 4054; Specimens, 3; 59–102 mm.



Mariposa; Parché; Butterfly
Chaetodon capistratus Linnaeus

References: *Chaetodon capistratus*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 275.

Chaetodon capistratus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 767.

Field Characters: Small, deep-bodied fishes with single dorsal fin composed of spines and rays, vertical fins covered with scales; mouth small; teeth fine, brush-like; yellowish, a black line from nape through eye and a large black ocellus under soft dorsal fin.

Size and Weight: Grows to 6 inches.

General Range: Southern Florida, southward through the West Indies, and north to Woods Hole, Mass.

Occurrence in Port-au-Prince Bay: Found generally distributed in the Bay.

Abundance: Fairly common, more so than *striatus*.

Method of Capture: Most of our fish were taken as a result of bombing practice and dynamiting.

Study Material: Color Plate, H19; Photographs, 3988, 4037, 4038; Specimens, 9; 32–72 mm., including No. 6811.

Pomacanthus Lacépède, 1803

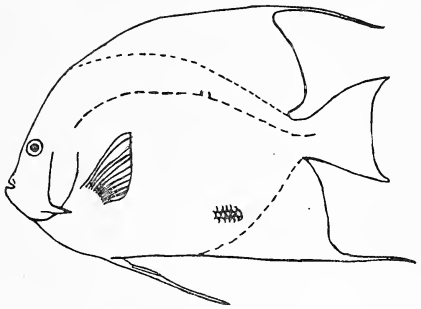
Key to Port-au-Prince Bay Species

A. Scales in lateral line 50 to 55; color of adult steel gray or scarcely yellowish; young with four whitish cross bands..... *arcuatus*

AA. Scales in lateral line 70 to 90; color black in adult with yellow mottlings; base of pectoral yellow; young with several yellowish cross-bands. *paru*

Mariposa; Black Angel; Chirivita; Portugais

Pomacanthus arcuatus (Linnaeus)



References: *Chaetodon arcuatus*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 273.
Pomacanthus arcuatus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 773.

Field Characters: Small to medium sized, deep, compressed, but rather robustly built fishes with dorsal and anal fins completely covered with scales, the two fins falcate and produced; mouth small, teeth brush-like or setiform; eight or nine dorsal spines; grayish or brown, mottled, the young with 4 vertical white cross bands; pectoral fin base without a yellow spot.

Description: Jordan and Evermann call the tail rounded, and this is true in the 103 mm. fish. All the rest have the tail lunate, and in one the tips are slightly produced. The figure given in "Fishes of North and Middle America," and copied by Evermann and Marsh in "Fishes of Porto Rico," resembles *paru* more than *arcuatus*.

Size and Weight: Grows to 1½ to 2 feet. A 240 mm. fish weighed 1¾ pounds.

Colors: (240 mm. fish in life). Head pale gray, chin ivory white. Scales of body dark brown with pale edges. Caudal with a narrow white edge, bordered internally with a still narrower golden line. Edges of fins and the pectoral fins black. Anterior half of iris dark chocolate, posterior half cream.

General Range: West Indies, occasionally north to New Jersey and New York, south to Bahia.

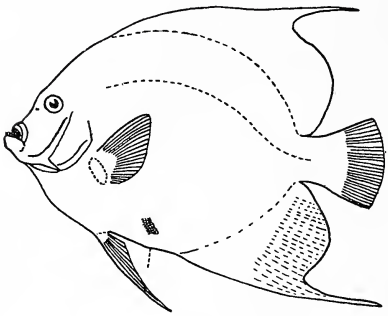
Occurrence in Port-au-Prince Bay: Seen very often on the reefs while diving.

Abundance: Common, often seen in the markets.

Method of Capture: Hooks, spears, dynamite.

Food: Alimentary canal crammed with algae, hydroids, etc.

Study Material: Photograph, 3756; Specimens, 5; 103–240 mm. including No. 6812.



Paru; Indian Fish; Flat Fish
Pomacanthus paru (Bloch)

References: *Chaetodon paru*, Bloch, 1787, Ichthyologia, 57, Plate 197, fig. 1.
Pomacanthus paru, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 775.

Field Characters: Small to medium-sized fishes with small mouth containing fine, brush-like teeth; dorsal and anal fins completely covered with scales, the former containing 10 spines. Black, pectoral fin with an orange bar at base. Young with 5 light cross bars.

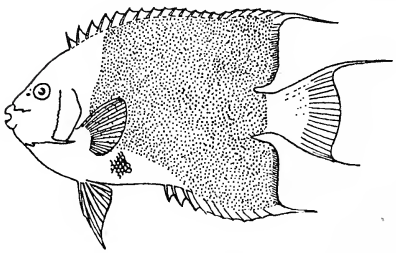
Size and Weight: Grows to a foot or more. Our 235 mm. fish weighed 1½ pounds.

General Range: West Indies, south to Bahia.

Abundance: Uncommon, a single fish purchased at the fish market.

Study Material: Specimen, 1; 235 mm., No. 7123.

Holacanthus Lacépède, 1803



Rock Beauty; Catalineta; Maguerite
Holacanthus tricolor (Bloch)

References: *Chaetodon tricolor*, Bloch, 1795, Ichthyologia, p. 103, Plate 426.
Holacanthus tricolor, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 779.

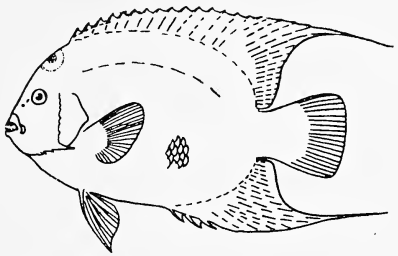
Field Characters: Small to medium-sized fishes with dorsal and anal fins completely covered with scales; mouth small, teeth brush-like; head, anterior third of body and tail rich orange, rest of body black.

Size and Weight: Grows to a foot. A 115 mm. fish weighed 84 grams.

General Range: West Indies south to Bahia and north to Bermuda.
Occurrence in Port-au-Prince Bay: Found on all coral reefs.
Abundance: Rather common.
Method of Capture: Mainly by traps.
Food: Algae and scrapings.
Study Material: Color Plate, H122, No. 6948; Photograph, 3920; Specimens, 4; 89–154 mm., including No. 6948.

Angelichthys Jordan and Evermann, 1896

Angel-fish; Isabelito; Maguerite
Angelichthys ciliaris (Linnaeus)



References: *Chaetodon ciliaris*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 276.
Angelichthys ciliaris, Evermann and Marsh, 1902, Fishes of Porto Rico, p. 252, plate 37.
Field Characters: Medium to large-sized compressed, robust fish with small mouth; teeth fine, brush-like; preopercle with a series of spines on the upper limb; bluish to yellowish; sides of head pale yellow; pectoral, ventral and caudal fins lemon yellow; the nape with a blue ocellus.
Size and Weight: Grows to two feet.
General Range: Southern Florida, West Indies to Brazil.
Occurrence in Port-au-Prince Bay: Seen on all the reefs.
Abundance: Uncommon.
Method of Capture: Mainly by traps.
Study Material: Color Plate, H89; Specimens, 2; 119–195 mm., including Nos. 6961, 7143.

Family Acanthuridae; Surgeon-Fishes.

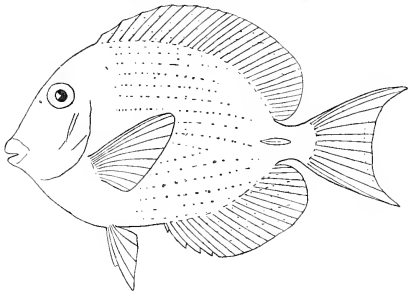
Acanthurus Forskal, 1775

Key to Port-au-Prince Bay Species

A. Body deep, rhomboid, depth 1.55 to 1.75 in length; snout 1.25 to 1.5 in head; longest dorsal spine shorter than snout; dorsal rays IX, 25–27: anal rays III, 24–26; color deep bluish black, base of caudal not paler than rest of body; sides with narrow, horizontal blue lines. . . . *caeruleus*
AA. Body more elongate, at least when specimens of equal size are compared; color lighter, brownish; anal rays III, 21 to 23.
B. Caudal fin deeply concave, the upper lobe notably produced in adult; color uniform, without vertical bars in young; concave portion of caudal

fin with a broad white margin, dorsal fin with about eight horizontal dark lines..... *bahianus*

BB. Caudal fin only moderately concave, the upper lobe not produced and not much longer than the lower; young with narrow vertical bars; concave portion of caudal fin with a very narrow white margin or none; dorsal fin dark, almost black..... *hepatus*



Barbero; Blue Tang; Blue Surgeon; Sous-gé

Acanthurus caeruleus Bloch and Schneider

References: *Acanthurus caeruleus*, Bloch and Schneider, 1801, Syst. Ichthyologia, p. 214.

Acanthurus caeruleus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 782.

Field Characters: Surgeon fishes; small fish with erectile spine on side of caudal peduncle; fairly deep, the depth once and a half in the length. Color, brown, washed with deep blue, with undulating longitudinal pale blue streaks on body.

Size and Weight: Grows to about one foot. A 95 mm. fish weighed 39.5 grams.

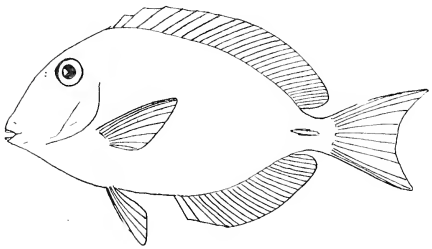
General Range: West Indies; Bermuda to Bahia; occasionally northward to the vicinity of New York.

Occurrence in Port-au-Prince Bay: Taken over all the reefs.

Abundance: Fairly common. Seen quite often in the markets.

Method of Capture: Mainly traps and dynamite.

Study Material: Specimens 5; 81–166 mm., including No. 6926.



Crescent-tailed Surgeon Fish; Ocean Tang

Acanthurus bahianus Castelnau

References: *Acanthurus bahianus*, Castelnau, 1855, Anim. Nouv. Rares Amer. Sud, p. 24, Plate XI, fig. 1.

Acanthurus bahianus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 783.

Field Characters: Medium sized fish with an erectile spine on each side of the caudal peduncle; depth about one half the length, caudal fin deeply emarginate, the upper tip produced in older fish; brown, 8 dark lines running parallel with edge of dorsal fin for its whole length.

Size and Weight: Grows to about a foot. A 125 mm. fish weighed 67 grams.

General Range: West Indies; Florida to Bahia, occasionally northward to Woods Hole.

Occurrence in Port-au-Prince Bay: Quite widely distributed, but mainly on the deeper reefs.

Abundance: Fairly common.

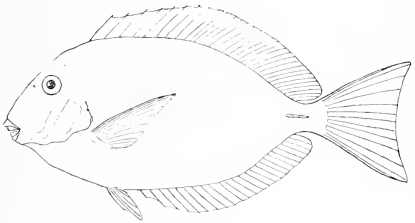
Method of Capture: Traps and dynamite.

Food: Finely disintegrated organic matter, with traces of algae and of worm tubes.

Study Material: Color Plate, H125; Specimens, 9; 57–129 mm., including No. 6815.

Common Surgeon, Doctor-fish; Lancet-fish

Acanthurus hepatus (Linnaeus)



References: *Teuthis hepatus*, Linnaeus, 1766, Syst. Nat., Ed. XII, p. 507.
Acanthurus hepatus, Meek and Hildebrand, 1928, Marine Fishes of Panama, Part III, p. 784.

Field Characters: Surgeon fishes; small fish with an erectile spine on sides of caudal peduncle; depth about one-half the length; caudal fin lunate; brown, with about 12 vertical blackish bars.

Size and Weight: Grows to 10 inches. A 106 mm. fish weighed 48 grams.

General Range: West Indies; Recorded from Massachusetts to Brazil.

Occurrence in Port-au-Prince Bay: Found generally on the reefs.

Abundance: Fairly common and often seen in the markets.

Method of Capture: Traps and dynamite.

Food: The powerful gizzard-like stomach contained unidentifiable vegetable and animal matter.

Study Material: Specimens, 14; 51–181 mm. including Nos. 6862 and 6925.

Family Scorpaenidae; the Scorpion-Fishes

Key to Port-au-Prince Bay Genera

A. Dorsal spines normally 12; palatine teeth present.....*Scorpaena*
AA. Dorsal spines normally 13; palatine teeth absent.....*Scorpaenodes*

Scorpaena Linnaeus, 1758

Key to Port-au-Prince Bay Species

A. A distinct pit below anterior margin of eye; head quite as broad as deep; occipital pit very deep, prominent; axil black, with small white or pale blue spots..... *plumieri*

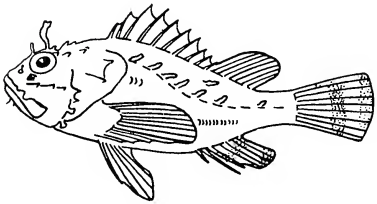
AA. No pit below anterior margin of eye; head not broader than deep.

B. Suborbital stay with 2 or 3 distinct spines, not counting the terminal one on the preopercle.

C. Third anal spine longer, but not stronger than second; scales small, 55 to 60; axil of pectoral pale with small round dark spots..... *brasiliensis*

CC. Second anal spine longer and stronger than third; supraorbital tentacles very long, always longer than eye; scales 41 to 45; axil of pectoral grey with very small bluish spots enclosed in black rings.. *grandicornis*

BB. Suborbital stay without spines, a terminal one on the preopercle; scales about 50; second anal spine not longer than 3rd; maxillary reaches to middle of eye..... *isthmensis*



Plumier's Scorpion Fish
Scorpaena plumieri Bloch

References: *Scorpaena plumieri*, Bloch, 1789, K. Vet. Ac. Nya. Handl., X, p. 234.
Scorpaena plumieri, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 835.

Field Characters: Small fishes with many conspicuous dermal flaps and tentacles on head and body; head very rugose; a small but very distinct pit below anterior border of eye; axil of pectoral usually black, with white or blue spots.

Description: The single specimen in the collection is typical.

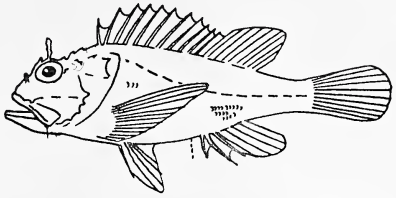
Size and Weight: Grows to about a foot. Our 116 mm. fish weighed 85 grams.

General Range: West Indies, south to Brazil occasionally north to Massachusetts.

Abundance: Rather rare, a single specimen taken in trap.

Study Material: Photographs, 4027, 4028; Specimen, 1; 116 mm., No. 7380.

Small-scaled Scorpion Fish
Scorpaena brasiliensis Cuvier and Valenciennes



References: *Scorpaena brasiliensis*, Cuvier and Valenciennes, 1829, Hist. Nat. Poiss., IV, p. 305.
Scorpaena brasiliensis, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 837.

Field Characters: Rather small fishes with rough spiny head and with a few dermal flaps along the lateral line; no pit below eye; the suborbital stay with 2 or 3 spines; third anal spine longer but not stronger than second; axil of pectoral fin pale with small black spots.

Size and Weight: A 142 mm. fish weighed 92 grams, and an 87 mm. specimen 23.5 grams.

General Range: West Indies, South Carolina and Brazil.

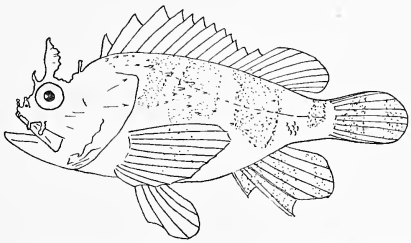
Occurrence in Port-au-Prince Bay: Found along shore, among coral and on reefs.

Abundance: Uncommon.

Method of Capture: Seines.

Study Material: Drawing, H12, No. 6801; Specimens, 2; 87–141 mm., including No. 6801.

Long-horned Scorpion-Fish
Scorpaena grandicornis Cuvier and Valenciennes



References: *Scorpaena grandicornis*, Cuvier and Valenciennes, 1829, Hist. Nat. Poiss., IV, p. 309.
Scorpaena grandicornis, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 838.

Field Characters: Small fishes with many conspicuous dermal flaps and tentacles on head and body, one above the eye always much longer than diameter of the eye; head with numerous sharp spines; axil grayish with small bluish or white spots enclosed in black rings.

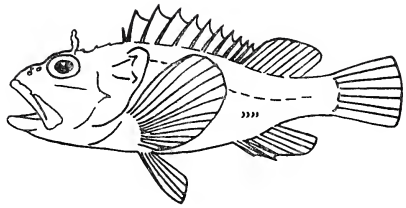
Description: Agrees in all particulars with the type description.

Size and Weight: A 109 mm. fish weighed 47 grams.

General Range: Florida keys to Brazil.

Abundance: A single specimen purchased in fish market.

Study Material: Specimen, 1; 108 mm., No. 6934.



Smooth-cheeked Scorpion Fish
Scorpaena isthmensis Meek and Hildebrand

REFERENCE: *Scorpaena isthmensis,* Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 842, Plate LXXX.

FIELD CHARACTERS: Medium sized fish with fleshy tentacle over eye and small dermal flaps along the lateral line; no pit below the anterior margin of the eye; suborbital stay without spines; scales about 50.

DESCRIPTION: We are assigning a single 169 mm. fish to *isthmensis,* recently described by Meek and Hildebrand from a 90 mm. fish from Porto Bello, Panama, although it is possible that our fish represents a new species. The most marked differences between the two specimens are the possession of a greater number of gill-rakers (5 short and stockily-built and 5 additional smaller ones) in the Haitian fish, in the greater extent of the membranes of the dorsal fin and in the presence of an ocular cirrus. The similarities are quite numerous, however, and considering the fewness of specimens it seems better to call our fish *isthmensis,* at least until further material is gathered.

The following are the dimensions of our fish:

Length	169 mm.	Dorsal fin XII, 9½
Depth	57 (2.96)	Anal fin III, 5½
Head	69 (2.44)	Scales 50, 23 pores
Eye	19 (3.6)	
Snout	18 (3.8)	
Maxillary	37 (1.85)	
Interorbital space	10.5 (1.9)	

The pectoral fin has 20 rays, of which the upper three and the lower 11 are simple, the middle 7 are branched. It possesses an elongate flap above the base of the pectoral.

SIZE AND WEIGHT: The 169 mm. fish weighed 158 grams.

GENERAL RANGE: Panama and Haiti.

OCCURRENCE IN PORT-AU-PRINCE BAY: Taken from a trap 15 feet deep on reef.

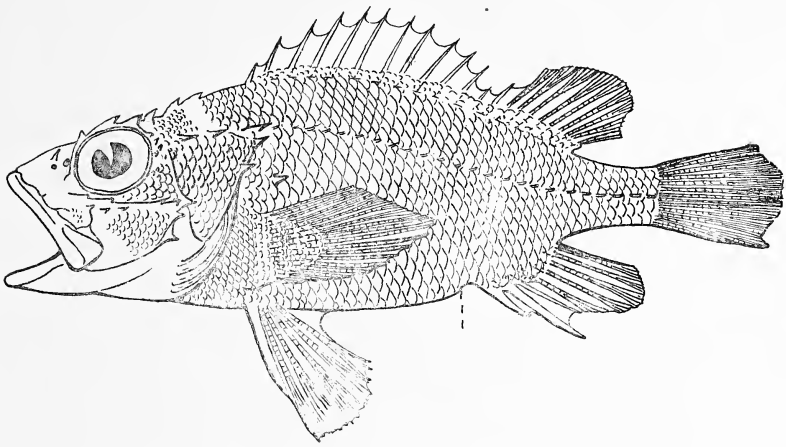
ABUNDANCE: Rare.

STUDY MATERIAL: Specimen, 1; 169 mm., No. 7381. Port-au-Prince Bay.

Scorpaenodes Bleeker, 1857

Haitian Scorpion Fish

Scorpaenodes russelli new species



Type: No. 7207. Length 71 mm. Bizoton Reef, Port-au-Prince Bay, Haiti. Taken in wire trap in 12 feet of water on coral. 27–IV, 1927.

Measurements and Counts:

Length: 71 mm.
Head: 30 (2.3)
Depth: 25 (2.8)
Eye: 9 (3.3)
Snout: 7 (4.3)
Maxillary: 15 (2)
Scale count: 40
Interorbital: 4 (7.5)

Weight: 12.5 grams
Dorsal fin: XIII–9½
Anal fin: III–5½
Pectoral rays: 19
Pectoral length: 21 (1.4)
Ventral length: 16
Ocular angle: 30° up
Mouth angle: 40° down
Lateral line pores: 23–25

Description:

Body: Short, deep, robust.
Back: Slightly elevated.
Anterior profile: Irregularly convex.
Cephalic armature:

Interorbital: 2 longitudinal ridges ending in small spines.

Supraorbital: Prominent ridge with 3 spines all ending in short filaments.

Preorbital: No spines or blunt points.

Narial spine: Well developed.

Occipital region: A strong spine close behind and almost in line with the supraorbital spines; 2 pairs of nuchal spines behind the one just mentioned, much nearer the mid-line and converging obliquely forward.

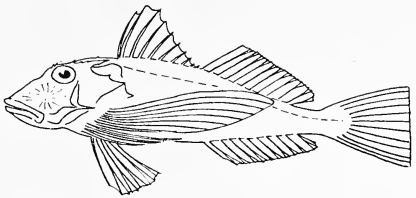
Shoulder girdle: 2 spines at anterior end of lateral line, merging abruptly into lateral line scales each of which has a short spine of its own; 1 spine half way between lateral line and upper base of pectoral.

Preopercular margin: 3 spines, lowermost with dermal flap.
Opercular margin: 2 strong spines, not divergent, upper larger.
Suborbital stay: 4 spines; 3 spines beneath anterior part of stay.
Interorbital: Very concave.
Snout: Broad, high-ridged.
Eye: Large, superior, directed obliquely upward.
Mouth: Wide, oblique.
Lower jaw: Included.
Maxillary: Reaching to mid-eye.
Gill-rakers: Short, thick and widely spaced; 8 + 4 rudiments on left side, 9 + 2 rudiments on right gill.
Teeth: In villiform bands; a broad V-shaped patch on vomer; none on palatines.
Tongue: Narrow, spoon-shaped tip, widening rapidly.
Scales: Small, finely ctenoid, absent from snout, lips and chin.
Lateral line: Prominent, irregularly absent from a few precaudal scales; each with a small spine and dermal flap.
Dorsal fin: Deeply notched, 5th and 6th spines longest.
Caudal fin: Shape indefinite, as tips of rays are broken.
Anal spines: 3; the 2nd enlarged, longer and stronger than 3rd.
Pectoral rays: 19; Upper 2 simple, next 7 branched, lower 10 simple.
Color: Body corinthian red with white mottlings; head and spines scarlet; iris scarlet on inner half, sepia spotted with white outside; spinous dorsal fin pale grey boldly spotted with scarlet; soft dorsal, anal and caudal white, spotted with scarlet and sepia, and broadly tipped with lemon yellow; ventrals wholly lemon yellow, finely dotted with scarlet; pectorals pale grey, thickly streaked with sepia on proximal half, scarlet distally, with wide terminal band of flame orange; lips lemon yellow, touched at symphysis with scarlet.
In preservative all colors fade to a uniform greyish brown.
Comparison: This species is closest to *caribbaeus*, the much larger body scales setting it apart at once from *tredecimspinosa*. From the former it differs in the present of dermal flaps on supraocular spines, in 4 spines on suborbital stay, 2 series of occipital spines, 2nd anal spine not greatly enlarged, different number and diversity of pectoral rays, in ctenoid head scales, slightly less number of body scales, much larger snout, narrower interorbital, and larger number of gill rakers.
Study Material: Type specimen. Color Plate H108.
Type Name and Location: The name is given in honor of General John H. Russell, American High Commissioner of Haiti under the American Occupation, who, with Mrs. Russell, insured the success of the expedition while in the island.
The type, No. 7207, and only specimen, is deposited in the Collection of the Department of Tropical Research of the New York Zoological Society.

Family Triglidae; the Gurnards

Prionotus Lacépède, 1802

Spotted Gurnard
Prionotus punctatus (Bloch)



References: *Trigla punctata*, Bloch, 1793, Naturg. Ausl. Fische, VII, p. 125, Plate CCCLIII.

Prionotus punctatus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 850.

Field Characters: Small to medium fishes with head inclosed in a bony, somewhat spiny armature; pectoral fins with three lower anterior rays separate from the rest and free from each other.

Description: The Haitian fish have no spine in the center of radiation of the cheek. They differ in no other way.

Size and Weight: Grows to about a foot. A 189 mm. fish weighed 171 grams, a 183 mm. fish 131 grams, and a 134 mm. fish 56 grams.

General Range: West Indies, East Coast of Mexico, Brazil and Uruguay.

Occurrence in Port-au-Prince Bay: Most of our specimens were from the market, but two were taken at night with submerged lights.

Abundance: Rather uncommon.

Method of Capture: Seines and scoop-nets.

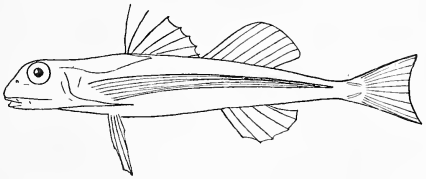
Food: Small crustaceans and shrimps.

Study Material: Color Plate, H33; Specimens, 6; 136–189 mm., including Nos. 6908, 7095, and 7385.

Family Cephalacanthidae; the Flying Gurnards

Cephalacanthus Lacépède, 1802

Flying Gurnard
Cephalacanthus volitans (Linnaeus)



References: *Trigla volitans*, Linnaeus, 1758, Systema Natura, Ed. X, 1, p. 302.

Cephalacanthus volitans, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 860.

Field Characters: Small to medium fishes with head enclosed in a bony armature; pectoral fins long, wing-like, used for flying; pectoral fins without fleshy tentacles at their base anteriorly.

Size and Weight: Grows to 12 inches. A 182 mm. fish weighed 136 grams and a 70 mm. specimen 5.5 grams.

General Range: Known from both coasts of the Atlantic Ocean, straying north to Woods Hole, Mass.

Occurrence in Port-au-Prince Bay: Found widely over the surface of the Bay, small fish often coming to our submerged lamps at night.

Method of Capture: Scoop nets at light and seines.

Habits: A short account, with three figures, of habits has been published by William Beebe as chapter XI, in his volume "Beneath Tropic Seas" (Putnam).

Study Material: Color Plate, H60, No. 6892; Photographs, 3862, 3945, 3968, 3972; Specimens, 19; 43 to 182 mm., including Nos. 6892, and 7208.

Family Pomacentridae; the Demoiselles

Key to Port-au-Prince Bay Genera

A. Body elongate, the depth usually more than 2 in the length; teeth in the jaws conical, in bands, the outer ones enlarged. Tail with upper and lower margin black..... *Chromis*

AA. Body usually deep, ovate; teeth in one or two series, compressed, more or less incisor like; tail variously colored, but never with conspicuous black upper and lower margin.

B. Teeth rather large, immovable, of about equal size in each jaw, usually truncate or more or less notched; suborbital without a deep notch between nostril and maxillary.

C. Preopercle and suborbital distinctly serrate; teeth with straight or slightly truncate margins, never distinctly notched..... *Pomacentrus*

CC. Preopercle and suborbital entire; teeth always with distinctly notched margins; mouth oblique, terminal, the lips thin..... *Abudefduf*

BB. Teeth small, movable, those in upper jaw close set, compressed, with entire margins, those in the lower jaw larger anteriorly, much reduced at sides; suborbital with a deep notch between nostril and maxillary. *Microspathodon*

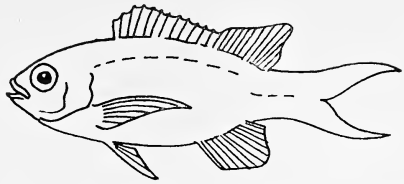
Chromis Cuvier, 1815

Key to Port-au-Prince Bay Species

A. Base of anal fin shorter than longest anal ray, or rarely equal to it, the height of the longest ray averaging 4.4 to 4.9 in standard length. No black axillary spot. Color in life blue and black..... *cyaneus*

AA. Base of anal fin longer than longest anal ray; the height of the longest anal ray averaging 6.9 to 8.1 in standard length. A conspicuous black axillary spot. Color in life light brown and black..... *marginatus*

Blue Chromis
Chromis cyaneus (Poey)



References: *Furcaria cyanea*, Poey, 1860, Memorias, II, 196, Plate 14, figs. 5–8.
Chromis cyaneus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1547.

Field Characters: Small, oblong, compressed fishes with body tapering gradually backward; teeth conical, in bands; anal fin rather high, its longest ray equal to or longer than base of fin; sides bluish and black; axillary spot absent, but a scattering of small spots across upper base of pectoral. Upper and lower lobe of caudal fin with a black band.

Description: The Port-au-Prince Bay fishes of the genus *Chromis* can be divided into two species, differing, as shown in the key, both in shape of the anal fin, and in color. Our specimens show no intermediates between the two, and we possess males and females of both species.

The practice of recent authors has been to consider the various West Indian forms of *Chromis* as belonging to one species. Thus Meek and Hildebrand (Marine Fishes of Panama, II, p. 696) state that "we have referred our specimens to *Chromis marginatus* but we are of the opinion that further study will show that *Chromis multilineatus* (Guichenot). *Chromis cyaneus* (Poey) and *Chromis punctatus* (Poey) are all identical.

Breder (Bulletin Bingham Oceanographical Collection, Vol. I, Article 1, page 50), on the basis of 141 specimens, refers all West Indian fish to *Chromis marginatus*, and tentatively divides his materials into three "ecological races," *marginatus marginatis*, *marginatus multilineatus*, and *marginatus cyaneus*.

We have examined 79 of Breder's 141 specimens, Bingham Collection Numbers, 100, 558, 242 and 244, representing all 3 of his forms.

The 4 specimens in No. 100 are typical *cyaneus* according to our key, possessing the characteristic type of anal fin, a dark blue coloring and lacking an axillary spot. Numbers 242, *m. multilineatus* and 244, *m. marginatus*, are similar to our brown fish. The 15 fish in Number 558, assigned by Breder to *marginatus marginatus* can be divided by our key into two very distinct groups, and like our fish the 9 specimens with higher anals possess a much darker coloration and lack the dark axillary spot. We consider these 9 fish as belonging to *cyaneus*, their coloring in preservative differing in no way from our specimens of *cyaneus*, which in the field were brilliantly blue. The other six fish are typical of our *marginatus*.

Our specimens of *cyaneus* agree in form with the plate given by Poey, and it is of interest to note that Poey in his original description states that the anal and dorsal fins are higher than in *multilineatus*, which is exactly the condition found in the Haitian fish. In measuring the height of the anal rays we have

measured from the base of the fin, ignoring the scales covering the base of the fin.

Size and Weight: Grows to about 5 inches. A 85 mm. fish weighed 26 grams.

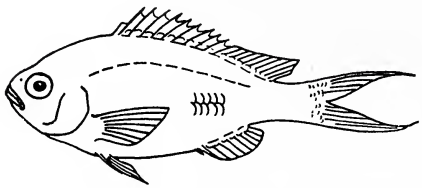
General Range: Cuba, Bahamas, Haiti.

Occurrence in Port-au-Prince Bay: Found on all reefs, living under the same conditions as *Chromis marginatus*, the two species coming to the surface together as the result of the same dynamite explosion.

Abundance: Fairly common.

Method of Capture: Most of our fish were taken by dynamite, but a few were captured in traps.

Study Material: Drawings: H116; Photographs, 4046; Specimens, 7; 65–85 mm., including Nos. 7097, 7232, 7342, 7343, 7345, 7346.



Brown Chromis

Chromis marginatus (Castelnau)

References: *Heliasis marginata*, Castelnau, 1855, Anim. Nouv. Rares Amer. Sud, 9, Plate III, fig. 1.

Chromis marginatus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 695, Plate LXIX, fig. 1.

Field Characters: Small, oblong, compressed fishes with body tapering gradually backward; teeth conical, in bands; anal fin low, its base always longer than longest anal ray, the longest ray 6.9 to 8.1 in length; brownish, with conspicuous black axillary spot; caudal fin with black band along upper and lower lobe.

Description: The brown species of *Chromis* found in Haiti is nearest the descriptions of *marginatus*, but it is very likely that the low-analed brownish forms of the genus vary considerably in color. None of the Haitian fishes had any indication in life of the yellow spot on the caudal peduncle mentioned for *multilineatus* by Jordan and Evermann and for *marginatus* by Meek and Hildebrand.

The plate given by the latter authors resembles our species closely, and shows well the characteristic low anal fin of this species.

Size and Weight: Grows to about 4 inches. A 104 mm. fish weighed 28 grams.

General Range: Bahia, Glover reef, Isle of Pines, Bahamas and Haiti.

Occurrence in Port-au-Prince Bay: Found on all reefs.

Abundance: Fairly common, slightly more so than *Chromis cyaneus*.

Method of Capture: Mostly by dynamite and also in traps.

Study Material: Specimens, 9; 79–104 mm., including Nos. 6927, 7229, 7341 and 7348.

Pomacentrus Lacépède, 1803

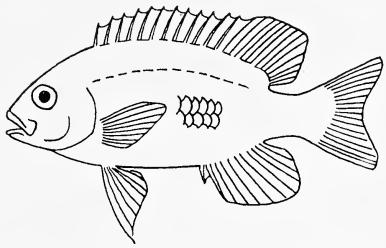
Key to Port-au-Prince Bay Species

A. Color extremely variable, black, brown, blue, yellow or orange in various combinations; often a large ocellus on dorsal fin..... *fuscus*

AA. Anterior part of body purplish-black; posterior portion grayish-white, the caudal fin black; living in tall tubular sponges.
freemani new species

Common Demoiselle

Pomacentrus fuscus Cuvier and Valenciennes



References: *Pomacentrus fuscus*, Cuvier and Valenciennes, 1830, Hist. Nat. Poiss., V, p. 432.

Eupomacentrus fuscus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1552.

Eupomacentrus leucostictus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1555.

Pomacentrus fuscus, Breder, 1927, Bull. Bing. Oceanographic Collection, I, Art. I, p. 54.

Field Characters: Small, compressed, rather deep fishes with one row of entire teeth in each jaw; preopercle and suborbital serrate; coloration variable; sometimes with yellow and blue and an ocellus under the soft dorsal fin, changing to brown with vertical darker stripes.

Description: The systematic problems offered by the Demoiselles can be settled only by study of living or fresh specimens in the field. In an aquarium in Haiti we have had the extreme *leucostictus* form,—blue, yellow and ocellated—change within a half hour to an equally extreme *fuscus*,—brown, with many vertical dark bands, and with no trace of ocelli. We believe that many, if not all of the West Indian species to which names have been given will be found to be ontogenetic color phases. We have satisfied ourselves that utmost diversity in collected specimens may result from whether the fish were killed in the day or at night, and in what liquid they were preserved.

Size and Weight: Six inches seems to be the maximum size of this fish. A 75 mm. individual weighs 20.5 grams.

General Range: Florida and West Indies to Brazil.

Distribution in Port-au-Prince Bay: Found everywhere among the grass along shore and on all the reefs.

Method of Capture: Do not take the hook. Captured with traps and dynamite.

Food: Algae, small organisms and all manner of bottom debris.

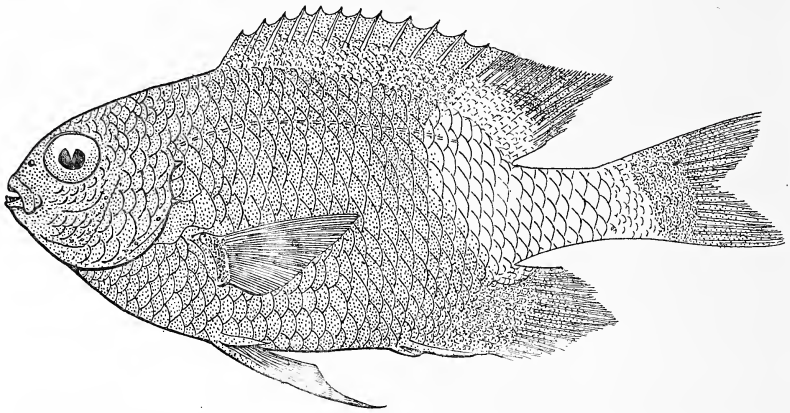
Size of Maturity: Breeding individuals were found less than 2 inches in length.

General Habits: These fish are individually extremely local, living singly or in pairs in some particular crevice or large shell, and defending it fearlessly against any intruder.

Study Material: Colored Plate, H13, No. 6824; Photograph, 3877; Specimens, 107; from 10 to 100 mm., including Nos. 6824, 6874, 6987, 7235, 7338 and 7339.

Haitian Demoiselle

Pomacentrus freemani new species



Type: No. 7269. Length 48 mm. Sand Cay, Port-au-Prince Bay, Haïti; Found in sponge which was growing on coral reef; 7–V–1927.

Field Characters: Small, compressed, deep-bodied demoiselle; dark brown, with the posterior fourth of the body, including the soft dorsal and caudal peduncle white; pectoral fins yellow; caudal fin black.

Measurements and Counts:

Length: 54 mm.
Head: 16 (3.3)
Depth: 26 (2)
Eye: 6 (2.7)
Snout: 4.3 (3.8)
Scales: 28
Lateral line pores: 20

Weight: 6 grams
Dorsal fin: XII–14½
Anal fin: II–13½
Pectoral length: 16 mm.
Ventral length: 17 mm.
Ocular angle: 10° up
Mouth angle: 30° down

Description:

Body: Very deep, compressed.

Back: Elevated.

Anterior Profile: Straight from dorsal to eye, slightly convex from eye to mouth.

Head: Deeper than long.

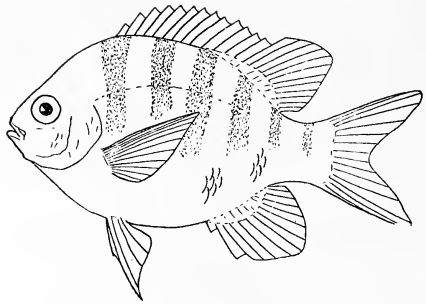
Interorbital: 5.5 mm., convex, 1.09 in eye.

Snout: Broad, swollen.

Eye: Large.
Mouth: Small, terminal, oblique.
Maxillary: Not reaching eye.

Teeth: Palisade-type, flat, with truncate, yellowish tips; about 30 in upper jaw; 28 in lower jaw, 6 large ones on each side of the symphysis, giving place rather abruptly to 8 small, lateral teeth.
Preopercular margin: Finely serrated.
Opercular margin: Smooth.
Gill-rakers: 8–9, longest behind (2 mm.) graduated to an anterior rudiment; slender.
Scales: Large, finely ctenoid, absent only from chin.
Lateral line: Parallel with back, ending beneath 6th ray of the soft dorsal.
Dorsal fin: High, first dorsal strongly scaled to the tip, soft dorsal with smaller scales half-way up; 9th ray longest, 12 mm. three-fourths as long as head, forming with the few adjacent rays an elongated, sharp, posterior angle.
Anal fin: 2nd anal spine five times as thick and long as the 1st spine; soft rays scaled for three-fourths of their length, contour more rounded than in soft dorsal.
Color: General color purplish to black; under surface of head, breast and belly brownish; caudal peduncle, soft dorsal and body posteriorly from a line drawn from the anterior part of the anal fin greyish white with a slight yellowish or orange tinge, especially pronounced on the dorsal fin; pectoral yellowish; remaining fins black.
Comparison: Resembles *fuscus* in the wide sense but with a larger eye than most of the varieties, although some of the so-called species have as large, and with a very different, definite coloration and pattern. The type and six co-types show no variation in this respect, and at least five other individuals were seen but not captured. All, without exception, were living in the tubes of tall chimney and in vase sponges, and came out only when disturbed or killed by dynamite. The larger eye and the lighter patterning may both be related to this mode of life. While it may seem peculiar to regard the other Pomacentrids as consisting of a single or at most two or three extremely variable species, and then to describe a new one, we feel that the coloration, which although it resembles that of *partitus*, is different, and especially the restricted habitat make this species valid.
Study Material: Specimens, 7; Type No. 7269, 6 co-types, 48–53 mm., Nos. 7269a and 7347. Color plate, H120.
Type Name and Location: Named for Dr. George F. Freeman, Directeur General, Service Technique, Haiti, who did all in his power to assist us.
Type in the Collection of the Department of Tropical Research of the New York Zoological Society.

Abudefduf Forskal, 1775



Sergeant Major; Cow-Pilot; Cockeye Pilot
Abudefduf saxatilis (Linnaeus)

References: *Chaetodon saxatilis*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 276.
Abudefduf saxatilis, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 701.

Field Characters: Small, deep, compressed fishes, with small terminal mouth and entire preopercle and suborbital; teeth always notched; grayish-green, sometimes with yellow; sides with 5 broad, dusky vertical bars.

Description: The Haitian specimens do not differ from published descriptions.

Size and Weight: Grows to 6 inches. Our specimens are from 12 to 108 mm. The 108 mm. fish weighed 76 grams.

Color: The smaller specimens, 12 to 20 mm., have the entire body covered with chromatophores, through which the dark bars show as denser concentrations of pigment. The density of these vertical bars in the preserved small fish varies considerably, in some it is barely visible and in others very strongly marked.

A note on coloration shows the ground-color of a 105 mm. fish to be bluish silver on the sides, with considerable golden along the back. Iris, dark brown with silver around the edges.

General Range: Pacific coast from Lower California to Peru. Atlantic coast, Florida to Peru, once accidental in Rhode Island.

Distribution in Port-au-Prince Bay: Widely distributed near shore, especially over shallow reefs.

Abundance: A common species, often seen in markets.

Method of Capture: Taken by us mostly in traps; also by dynamite and with aid of airplane practice bombs.

Study Material: Color Plate, H62; Photograph, 3933; Specimens: 16; 12 to 115 mm., including Nos. 6816, 6963, 7002, 7162, 7192, 7195d, and 7279.

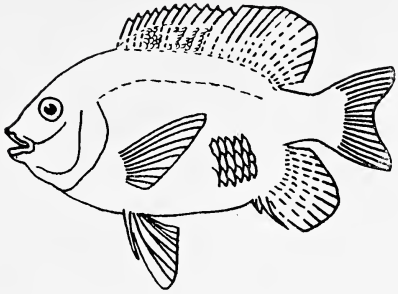
Microspathodon Günther, 1862

Key to Port-au-Prince Bay Species

A. Sides brown, sometimes with small bluish spots on head and dorsal surfaces, tail yellow or orange, or the same color as the rest of the body.. *chrysurus*
AA. Sides with conspicuous bluish-white spots, about the size of a scale. *niveatus*

Yellow-tailed, Soft-toothed Demoiselle

Microspathodon chrysurus (Cuvier and Valenciennes)



References: *Glyphisodon chrysurus*, Cuvier and Valenciennes, 1830, Hist. Nat. Poiss., V, p. 476.
Microspathodon chrysurus, Meek and Hildebrand, 1925, Marine Fishes of Panama, II, p. 706.

Field Characters: Small, deep, compressed, brownish fishes with small terminal mouth, and with small, close-set movable teeth in upper jaw; dark brown, sometimes with an orange or yellow tail.

Description: Our specimens are quite typical.

Size and Weight: Grows to six inches. A 115 mm. fish weighed 76 grams, and a 100 mm. fish 53 grams.

Color: The life colors of a 100 mm. fish were as follows: Dusky brown with a golden sheen; fins black; opercle dull golden; tail abruptly cadmium yellow; iris dusky brown, silvery in the antero-inferior fourth.

A 115 mm. specimen, which preserved agrees wholly with the description of *chrysurus*, is close to *niveatus* in color, and was described in the field as follows: Brownish black, with yellowish centres to scales below, and with small blue spots on some above. Three blue spots along the lateral line, and many below the eye and along the dorsal fin. A strong, yellowish tinge to the distal part of the caudal.

General Range: West Indies and Panama.

Distribution in Port-au-Prince Bay: Widely distributed on reefs.

Abundance: A common species, often brought into the markets.

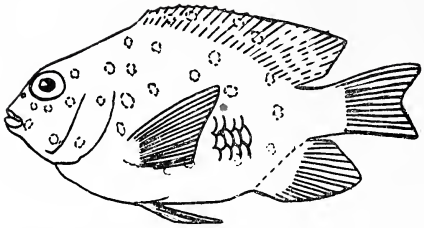
Method of Capture: We took it almost entirely by dynamite, and it was by far the commonest fish to rise to the surface after an explosion.

Food: Stomach contents of a number of fish contained mostly large quantities of chewed algae and bottom debris, with an occasional entomostracan.

Spawning Season: A 100 mm. fish captured during the beginning of March had well developed eggs.

Eggs: The ovaries in the fish mentioned above measured 36 by 6 mm. the eggs being oval, averaging .7 mm. in diameter, the estimated number being 9200 in each ovary.

Study Material: Color Plate, H71; Photograph, 3908; Specimens, 6; 75–115 mm., Nos. 6932 and 7165.



White-spotted, Soft-toothed Demoiselle
Microspathodon niveatus (Poey)

REFERENCES: *Pomacentrus niveatus*, Poey, 1875, Enumeratio, p. 102.
Microspathodon niveatus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1567.

FIELD CHARACTERS: Small, deep, compressed fish with small, movable teeth; blackish, the sides with sky blue spots about the size of a scale.

NOTE: This species was not taken by us, but 8 to 10 individuals from 4 to 6 inches long were seen while diving. Breder on the basis of materials collected on the Bingham Oceanographic Expedition, synonomyzes this species with *chrysurus*, stating that he considers it to be one of immature color phases of the latter species.

However, as we saw specimens of apparently typical *niveatus* larger than those he possessed, and as Silvester, in Porto Rico, speaking of *niveatus*, states that "Many specimens of this beautiful fish were seen swimming among the corals of the western end of Rojas de la Parda; they varied in length from about 2 to 4 inches." we consider it, for the time being, valid. However, it is of interest to note that some of our large, undoubted specimens of *chrysurus* possessed blue spots on the head and along the dorsal surfaces and fin. These spots seemed to be smaller and concentrated on the places mentioned, and not widely distributed over the sides, as in Silvester's plate of *niveatus*, and in the individuals seen by us.

It is possible that these two forms represent color-phases of the same species, but until further evidence is secured we are treating them as separate species.

GENERAL RANGE: Cuba, Isle of Pines, Haiti and Porto Rico.

DISTRIBUTION IN PORT-AU-PRINCE BAY: Found only on reefs.

ABUNDANCE: Rather rare, not seen in markets.

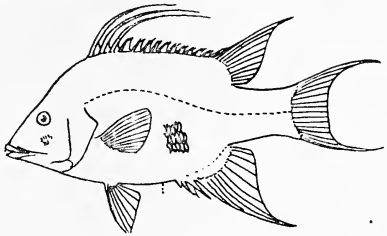
Family LABRIDAE; WRASSES

Key to Port-au-Prince Bay Genera

A. Anterior canines strong; spinous dorsal not enveloped in scales.
B. Dorsal spines 13 or 14, the first three or four falcate, produced into long streamers ..... *Lachnolaimus*
BB. Dorsal spines 11 or 12, rarely 13, with no long filaments; soft dorsal and anal fins with a scaly sheath at the base; soft dorsal and anal elevated, produced behind ..... *Bodianus*
AA. Anterior teeth small, bluntish, not canine-like; dorsal and anal fins enveloped in scales ..... *Clepticus*

Lachnolaimus Cuvier and Valenciennes, 1839

Hogfish
Lachnolaimus maximus (Walbaum)



References: *Labrus maximus,* Walbaum, 1792, Artedi Piscium, p. 261.
Lachnolaimus maximus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1579.

Field Characters: A large reddish wrasse resembling a Serranid or sea-bass; anterior spines of dorsal fin greatly prolonged; a dark spot on base of posterior rays of soft dorsal.

Description: Our single specimen is typical in every way.

Size and Weight: Reaches a length of two feet and a weight of 15 pounds. Our fish was 341 mm. (13½ inches) long and weighed 3 pounds.

Color: At death the general color was pinkish red, with yellow edges to the scales; the iris was reddish orange.

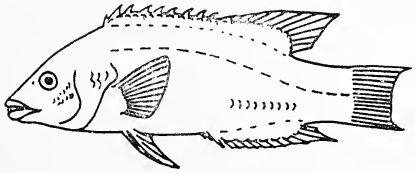
General Range: Bermuda, Key West and the West Indies.

Occurrence in Port-au-Prince Bay: A single specimen taken on March 3rd at the fish market.

Study Material: Specimen, 1; 341 mm., No. 6979.

Bodianus Bloch, 1790

Lady-fish
Bodianus rufus (Linné)



References: *Labrus rufus,* Linné, 1758, Syst. Nat., Ed. X, p. 284.
Harpe rufa, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1583.
Bodianus rufus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 711.

Field Characters: Small to medium sized wrasses with 11 or 12 dorsal spines; soft dorsal and anal with a scaly sheath at base, elevated and produced behind; violet red above and anteriorly; yellow or orange behind and below, the two colors in strong contrast to each other.

Size and Weight: The species reaches a length of two feet. Our male of 173 mm. weighed 136 grams.

General Range: Florida and Bermuda to Brazil.

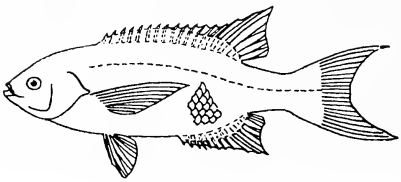
Occurrence in Port-au-Prince Bay: Seen by us only occasionally in the fish market.

Abundance: We secured only two specimens, a male and a female.

Spawning Season: Neither sex showed any signs of breeding activity.

Study Material: Color Plate, H65, Female, No. 7045; Specimens, 2; male 173 mm., No. 6956; female 177 mm., No. 7045.

Clepticus Cuvier, 1829



Purple-tailed Wrasse; Creole
Clepticus parrae (Bloch and Schneider)

References: *Brama parrae*, Bloch and Schneider 1801, Syst. Ichth., p. 100.
Clepticus parrae, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1586.

Field Characters: Medium-sized robust, compressed fish; head and vertical fins enveloped in small scales; teeth weak; head and irregular anterior two-thirds of body deep purple and violet; tail fin rich maroon; remainder of body including ventrals, anal, posterior soft dorsal, belly and peduncle, bright yellow mottled with violet and purple.

Description: Purchased from a fisherman. The entire mouth of our only specimen was torn away, making identification by teeth impossible, but the spines and rays, the basal sheath of scales on the vertical fins, scales and especially the coloration leave no doubt as to the species.

Size and Weight: A 12 inch specimen has been recorded. Ours measured 163 mm. (6½ inches), and weighed 124 grams.

Study Material: Color Plate, H84, No. 7140; Specimen, 1; 163 mm., No. 7140.

Family Coridae; Wrasses

Key to Port-au-Prince Bay Genera

A. Lateral line complete and continuous, with an abrupt downward curve posteriorly.
B. Dorsal spines 9; dorsal enlarged, without scaly sheath; posterior canine well developed on both sides..... *Halichoeres*
BB. Dorsal spines 8; a low sheath of scales at the base of the dorsal fin; no posterior canines..... *Thallasoma*
AA. Lateral line interrupted posteriorly, beginning again on the level of the axis of the body; posterior canine present; first three dorsal spines longest and with filamentous appendages; scales large..... *Doratonotus*

Halichoeres Rüppell, 1835

Key to Port-au-Prince Bay Species

A. Sides without a vertical blackish band, caudal fin without continuous blue bands.
B. A black spot, partly surrounded by blue behind the eye, anal fin pinkish with two series of bluish spots..... *caudalis*
BB. No black spot behind eye; anal fin divided into three more or less equal horizontal bands of color..... *radiatus*
AA. Sides with a vertical band from beginning of soft dorsal downward; short narrow dark lines from eye upward; a few small dots on nape; caudal fin with narrow vertical semicircular bands of blue..... *garnoti*

Pink-finned Wrasse
Halichoeres caudalis (Poey)

References: *Julis caudalis*, Poey, 1860, Memorias, II, p. 213.
Iridio caudalis, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1599.

Field Characters: Small, elongate, compressed, brilliantly colored wrasse; dorsal and caudal fins pink with bluish spots; body mottled olive green with numerous blue lines on head and spots on body.

Size and Weight: A 120 mm. fish weighed 35 grams.

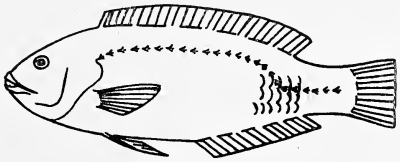
General Range: Cuba and Haiti.

Occurrence in Port-au-Prince Bay: Generally distributed, both near shore and down to 8 fathoms.

Abundance: Fairly common. Seen frequently in diving. Ten specimens collected.

Study Material: Color Plates, H14, No. 6854; H35, No. 6882; Specimens, 10; 79–126 mm., including Nos. 6854, 6882, and 6915.

Variegated Wrasse; Pudding Wife
Halichoeres radiatus (Linnaeus)



References: *Labrus radiatus*, Linne, 1758, Syst. Nat., Ed. X, p. 288.
Halichoeres radiatus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 717.

Field Characters: Medium-sized wrasse exhibiting astonishing variation in proportions of body, fins, color and pattern from young to adult. The anal fin seems always to be divided longitudinally into three bands of color of equal width. Until we know more of the anatomy and life history of this

species, Meek and Hildebrand's characterization must suffice; "Dark lateral band disappearing with age, when present rather narrow, never extending beyond base of caudal; head in adult with several bluish lines; a narrow one, about the width of pupil, extending from eye to nape; dorsal plain yellowish red in young; in adult with a narrow blue stripe at base, above with many blue spots."

Size and Weight: The sizes and weights of three individuals are as follows:

68 mm. length	4 grams
139 mm. length	55 grams
325 mm. (12.75 in.) length	907 grams (2 lbs.)

General Range: North Carolina southward, including Panama and West Indies and Brazil.

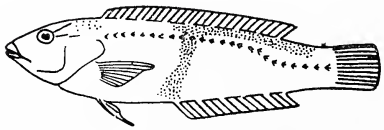
Occurrence in Port-au-Prince Bay: Seen on every dive among the coral reefs, along shore, and taken in traps eight fathoms deep.

Abundance: One of the commonest of the wrasses.

Method of Capture: Taken in seines, traps, and on hooks.

Food: The young fish feed on floating bits of dead food, small crustaceans, etc., while the older individuals are browsers, taking sponge, coral, or other organic debris.

Study Material: Color Plates: H25, 70 mm. specimen; H66, 230 mm.; H49, 325 mm., No. 6966; Specimens, 45; 65–325 mm., including 6864, 6885, 6952, 6966, 7108 and 7133.



Coral Wrasse

Halichoeres garnoti (Cuvier and Valenciennes)

References: *Julis garnoti*, Cuvier and Valenciennes, 1839, Hist. Nat. Poiss., XIII, 390.

Iridio garnoti, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1593.

Field Characters: Small, rather elongate wrasses with nine dorsal spines, complete lateral line, with posterior canine well developed on both sides; color varying, but with a conspicuous wide vertical band on middle of sides, the upper part of body anterior to this yellowish or greenish in general color, posterior to this line the body is bluish or purplish red; caudal fin with narrow curved, vertical bluish lines; narrow, short black lines from eye upward and backward; small dark spots on nape.

Size and Weight: Grows to about eight inches. A 140 mm. fish weighed 53 grams.

Color: Exceedingly variable in general color and pattern, the ground color varying anteriorly from various shades of brown and green to yellowish, posteriorly to purplish red or bluish. The fish is conspicuous in the field by the striking difference of color anteriorly and posteriorly.

General Range: West Indies.

Distribution in Port-au-Prince Bay: Found on all coral reefs.

Abundance: Very common, to be seen at almost any time on the reefs.

Method of Capture: Hooks and lines, traps and dynamite.

Food: Omnivorous; small crustaceans, sea-urchins, spines and all, and mollusks and their shells.

Study Material: Color Plates, H45, H129, No. 7133; Photographs: 3921, 3922; Specimens, 43; 73–147 mm., Nos. 7086 and 7133.

Thalassoma Swainson, 1839

Key to Port-au-Prince Bay Species

A. Head bluish or greenish followed usually by two black or very dark blue bands separated by a pale blue band, the two darker bands sometimes coalescing, posterior part of body green..... *bifasciatus*

AA. A lateral band, usually broken up into large spots..... *nitidus*

Bicolored Wrasse

Thalassoma bifasciatus (Bloch)

References: *Labrus bifasciatus*, Bloch, 1792, Syst. Ichthy., p. 131, pl. 283.
Chlorichthys bifasciatus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1609.

Field Characters: Small, elongate wrasses, with 8 dorsal spines and no posterior canines, head blue, body green, two vertical black bands on sides behind head, sometimes somewhat merged, between which is a paler bluish band.

Descriptions: The relations of this species are discussed under *nitidus*.

Size and Weight: The largest Haitian fish, 115 mm., weighed 30 grams.

General Range: West Indies.

Distribution in Port-au-Prince Bay: Widely distributed on the reefs.

Abundance: Rather common on some reefs. Brought occasionally to the markets.

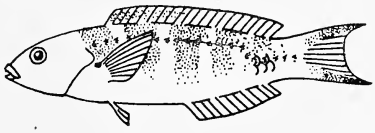
Method of Capture: Traps, under-water guns.

Food: All of the specimens examined had devoured polychaete worms.

Study Material: Color Plate, H23, No. 6886; Specimens, 16; all males, 85–115 mm., including No. 6886.

Shining Wrasse

Thalassoma nitida (Günther)



References: *Julis nitida*, Günther, 1862, Cat. Fishes Brit. Museum, IV, 190.
Chlorichthys nitidus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1608.

Field Characters: Small, elongate wrasses with continuous lateral line, 8 dorsal spines, no posterior canines; greenish with a lateral band which in larger individuals is broken up into a series of large blotches.

Description: Breder 1927 (Bull. Bingham Ocean. Coll., Vol. 1, No. 1) suggests, as a result of investigating a series of small specimens, that *nitidus* is the same as *bifasciatus*, but does not synonomyze the two species on the ground that "It is quite conceivable that there may be existing in closely adjacent but different environments two such species in which one matures to a very different fish from its young, whereas the other almost or quite indistinguishable when small, matures without losing its juvenile characters."

Our 6 Haitian specimens of *nitidus*, 73–93 mm. long, some of which are as large as those considered by Breder in his series to be adult "blue-heads," are all females, and the 16 specimens of *bifasciatus*, 84–115 mm. are all males. Considering these circumstances and Breder's suggestion as to the identity of the young, it is very probable that these two species are the same, and that the females (*nitida*) retain a considerable amount of the generalized color pattern of the young; while the males (*bifasciatus*) lose this pattern and attain their striking adult coloration. The data from the present series is considered consistent enough to make this a definite suggestion. In the field in Haiti, the two species are found in exactly the same surroundings, and are equally wary and inquisitive. The females (*nitidus*) were somewhat less plentiful, as far as visual observation is concerned, than the males (*bifasciatus*).

However, we are not synonomyzing the two species until other collections can be examined or until the fishes can be studied in the field. If the two forms prove to be differentiated merely by sex, both must be known as *Thalassoma bifasciatus*.

Size and Weight: A small species, at least as far as our Haitian experiences are concerned, the largest specimen captured measuring 93 mm. and weighing 16 grams.

General Range: Jamaica and Haiti.

Distribution in Port-au-Prince Bay: Found on all coral reefs.

Abundance: Uncommon, but usually one or two specimens to be seen while diving on the richer coral reefs.

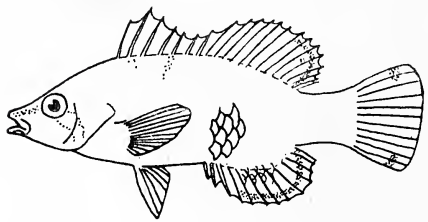
Method of Capture: Mainly by traps, dynamite.

Food: Carnivorous,—worms and crustaceans.

Eggs: The eggs of the 93 mm. fish averaged .22 mm. in diameter.

Study Material: Specimens, 6; 73–93 mm. all females, including No. 7084.

Doratonotus Gunther, 1862



Tall-finned Pygmy Wrasse; Baucket

Doratonotus megalepis Günther

References: *Doratonotus megalepis*, Günther, 1862, Cat. Fish Brit. Museum, IV, p. 125.

Doratonotus megalepis, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 731.

Field Characters: A small wrasse (2½ inches), head long and low, snout long and pointed, dorsal fin elevated in front; general color greenish, variegated with dull red on fins.

Description: Our two small specimens are typical in every way. The smallest individual is 13 mm. and in markings and development of fins shows no difference from those of maximum size. It seems quite certain that the young fish figured by Breder (Bull. Bingham Ocean. Coll., I, 1, p. 64) as typical of his 61 specimens from 8.5 to 13 mm., cannot be this species. The shape of the head and snout and dorsal fin and the size of the diminutive ventrals and the coloration all set it apart from the individuals in our collection.

Size and Weight: Our largest specimen measured 23 mm.

Method of Capture: Taken in Thalassia weed in shallows near shore, Lamentin Reef.

Study Material: Specimens, 2; 13–23 mm., No. 7279.

Family Scaridae; the Parrot-Fishes

Key to Port-au-Prince Bay Genera

A. Teeth not forming continuous plates; anterior teeth enlarged, often more or less canine-like; median suture of jaws not evident externally. ..... *Cryptotomus*

AA. Teeth in jaws fully coalesced, forming continuous plates; the median suture of the jaws evident externally.

B. Dorsal spines flexible; lower jaw included in the upper when mouth is closed; cheeks with two or more rows of scales; lower pharyngeals much longer than broad.

C. Teeth pale ..... *Scarus*

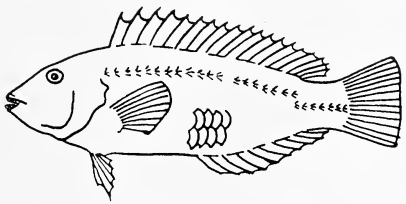
CC. Teeth bluish or green ..... *Pseudoscarus*

BB. Dorsal spines stiff, pungent; upper jaw included in the lower when mouth is closed ..... *Sparisoma*

Cryptotomus Cope, 1871

Scorched Parrotfish

Cryptotomus ustus (Cuvier and Valenciennes)



References: *Callyodon ustus*, Cuvier and Valenciennes, 1839, Hist. Nat. Poiss., XIV, p. 286. Plate CCCCV.

Cryptotomus ustus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 733.

Field Characters: Small, elongate, compressed, dull-colored parrot-fish with teeth not fully coalesced; the two rows of teeth of the lower jaw overlapping slightly on the sides.

Size and Weight: Our 131 mm. specimen weighed 42 grams.

General Range: South Carolina to Brazil.

Occurrence in Port-au-Prince Bay: Found on coral reef at twenty feet depth.

Abundance: A single individual taken during our four months stay. Not seen at the markets.

Method of Capture: Taken with dynamite.

Food: Vegetable matter.

Study Material: Specimen: 1; 131 mm.

Scarus Forskal, 1775

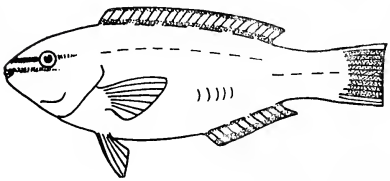
Key to Port-au-Prince Bay Species

A. Upper jaw with canines posteriorly; cheeks with 2 or 3 rows of scales.

B. Dorsal and anal fin greenish blue at base, then a broad band of orange and tipped with a broad bluish band. No spots on either fin. Caudal fin with a narrow black band on upper and lower edge, the rays immediately inside the black edge orange, remainder of caudal bluish..... *taeniopterus*

BB. Dorsal and anal fin bright green at base and tip, mesially orange, the orange of dorsal sometimes with a bluish line, that of the anal with a line of bluish spots; caudal bright greenish blue, the inner rays with their membranes orange..... *punctulatus*

AA. Upper jaw without canines; cheeks with 2 rows of 5 or 6 equal sized scales and a third partial row of 3 or 4 scales; sides with two brownish longitudinal bands; a small dull colored species..... *croicensis*



Painted-tailed Parrotfish
Scarus taeniopterus Desmarest

References: *Scarus taeniopterus*, Desmarest, 1831, Dict. Classique, XV, 244, Plate 12.

Scarus taeniopterus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1646.

Field Characters: Small to medium sized parrotfish, orange-brown above, changing to blue below; two horizontal green stripes on head, the interspace yellowish brown; dorsal and anal fins greenish blue at base, then a broad band of orange, and tipped with a rather broad bluish band; no spots in the

orange of either fin; caudal fin with outer rays orange, the upper and lower edge with a narrow black band.

Description: One of our specimens has two posterior canines on each side of the upper jaw.

Size and Weight: A 180 mm. fish weighed 150 grams.

General Range: West Indies.

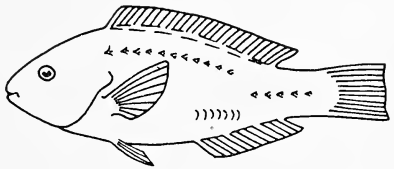
Occurrence in Port-au-Prince Bay: Found on all reefs, our specimens from Port-au-Prince market.

Abundance: Rather rare, and seldom seen in the markets.

Study Material: Color Plate, H87, No. 7132; Specimens, 2; 180–205 mm., including No. 7132.

Punctulated Parrotfish

Scarus punctulatus Cuvier and Valenciennes



References: *Scarus punctulatus*, Cuvier and Valenciennes, 1839, Hist. Nat. Poiss., XIV, p. 195.

Scarus punctulatus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 737.

Field Characters: Small parrotfishes with pale teeth, the lower jaw included in the upper when mouth is closed; mesial band of orange in dorsal fin with a blue line and that of the anal with blue spots.

Size and Weight: A 93 mm. fish weighed 17 grams.

Color: In some of our fish the yellow longitudinal band is rather indistinct. However, they agree in all other respects.

General Range: West Indies, Venezuela.

Occurrence in Port-au-Prince Bay: Found on all of the deeper reefs, and often seen in the markets.

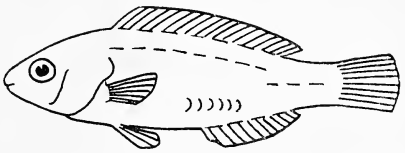
Abundance: Common.

Method of Capture: Seines, hooks and lines and traps.

Study Material: Color Plate, H29; Specimens, 68; 80–150 mm., including No. 6883.

Brown Parrotfish

Scarus croicensis Bloch



References: *Scarus croicensis*, Bloch, 1790, Naturg. Ausl. Fische, IV, p. 27, Plate CCXXI.

Scarus croicensis, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 741.

Field Characters: Small, brownish parrotfish with lower jaw included in

upper, and with longitudinal stripes along sides, these stripes alternately dark brown and whitish yellow, varying considerably in intensity.

Size and Weight: Grows to 7 inches.

General Range: Key West to Brazil.

Occurrence in Port-au-Prince Bay: Found by us mainly along shore over shallow reefs. Small specimens were abundant on the shallow weed-covered areas along shore, where they lived among the fronds of Thalassia. When diving we often saw specimens on the deeper outside reefs.

Abundance: One of the commonest parrotfish of Port-au-Prince Bay, and although small, often brought into the market.

Method of Capture: Most commonly taken in traps; occasionally with seines.

Food: Algae, small crustaceans, etc.

Study Material: Photographs, 3781, 3907; Specimens, 40; 50–100 mm.

Pseudoscarus Bleecker, 1861

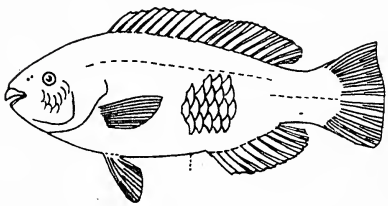
Key to Port-au-Prince Bay Species

A. Posterior canines absent, or, sometimes in *coelestinus*, one present on each side.

B. Olive green, with more or less ill-defined markings on head; lower parts brownish ..... *guacamaia*

BB. Bright blue, the edges of the scales brownish; tubes of lateral line branched. *coelestinus*

AA. Posterior canines present, 2 to 6 in number; color black and green; sides below pectorals green ..... *pleianus*



Green Parrotfish; Guacamaia

Pseudoscarus guacamaia (Cuvier)

References: *Scarus guacamaia*, Cuvier, 1829, Règne Animal, Ed. II, II, 265.
Pseudoscarus guacamaia, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 744.

Field Characters: Large parrotfish with green teeth; no posterior canines on upper jaws. Olive green with more or less ill defined green markings on head; lower parts more or less reddish (often dark brown in preserved specimens) vertical fins brownish orange, all edged with deep blue.

Description: Our large specimens are typical.

Size and Weight: Grows to two or three feet. A 500 mm. fish weighed 8½ pounds.

Color: A 180 mm. specimen (formalin) is exceptionally dark, this color extending to all the fins, the ventrals being especially dark.

General Range: West Indies, north to Florida Keys, south to Rio de Janeiro.

Occurrence in Port-au-Prince Bay: Seen occasionally while diving on reefs.

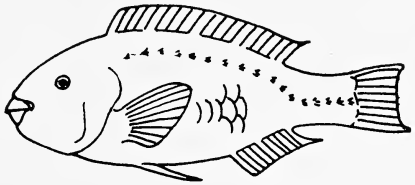
Abundance: Not especially common, seen occasionally in the markets. The 8½ pound fish cost 60 cents, American money.

Method of Capture: Hook and line.

Study Material: Color Plate, H90, No. 7136; Specimens, 2; 180–500 mm., including No. 7136.

Blue Parrotfish

Pseudoscarus coelestinus (Cuvier and Valenciennes)



References: *Scarus coelestinus*, Cuvier and Valenciennes, 1839, Hist. Nat. Poiss., XIV, p. 180.

Pseudoscarus coelestinus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1655.

Field Characters: Large parrotfish with green teeth; bright blue; dorsal, caudal and anal fins black, narrowly edged with blue; middle rays of caudal tipped with blue.

Description: The single specimen preserved agrees with the description of this species given by Jordan and Evermann, except that it lacks the posterior canines, and the color of the fins in life was somewhat different; dorsal, anal and caudal being black narrowly edged with blue, the middle rays of the caudal being tipped with blue.

This specimen runs close to Bean's *plumbeus*, but differs in color. While we were diving, this species was commonly observed, and the many specimens seen were consistently bright blue in color.

Size and Weight: Reaches two or three feet. Our 460 mm. fish weighed 7 pounds.

General Range: West Indies.

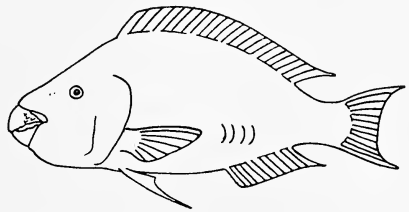
Occurrence in Port-ay-Prince Bay: Commonly found on reefs, and often seen in markets.

Abundance: Common.

Study Material: Color Plate, H130, No. 7083; Specimen, 1; 460 mm., No. 7083.

Green and Black Parrotfish

Pseudoscarus pleianus (Poey)



References: *Scarus pleianus*, Poey, 1861, Memorias, II, p. 393.
Scarus pleianus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1656.

Field Characters: Very large parrotfish with green teeth; 2 to 6 canines on upper posterior part of upper jaw; coloration black and green, posterior part of body greenish as well as isolated scales on anterior part of sides; sides below pectorals green.

Description: A single specimen (number 7200), 640 mm. long, is assigned to this species. In the key to the species of *Pseudoscarus*, given by Jordan and Evermann (l. c.) it runs straight to this species. Compared with the description, it agrees very well in form, and in color, if the colors mentioned are those of a preserved specimen, which seems more than likely. The presence or absence of numerous canines seems to be a fairly valid character, not entirely dependent upon age, by which to differentiate this species from some others of the genus. However, it is not a wholly reliable one, mainly because of variation. The specimen at hand has two posterior canines on the left hand side and six on the right. The right hand teeth are situated at various levels, and there are possible indications of a few more.

The dimensions of our fish are as follows:

Length	640 mm.
Depth	267 "
Head	231 "
Eye	24 "
Length of pectoral fin	154 "
Length of ventral fin	144 "
Lateral line scales	25

Size and Weight: Grows to 25 inches standard length and possibly larger. Our 25 inch fish weighed 20 pounds.

General Range: Known from St. Thomas.

Occurrence in Port-au-Prince Bay: Captured by native fisherman on fairly deep reef.

Abundance: Rare, a single specimen seen in four months.

Study Material: Specimen, 1; 640 mm., No. 7200.

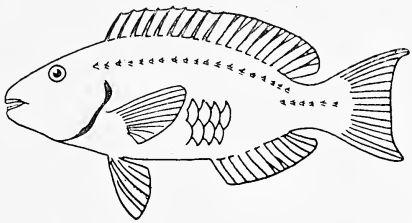
Sparisoma Swainson, 1839

Key to Port-au-Prince Bay Species

A. Upper jaw with one or more lateral canines.
B. General color dark red or brown; no pale streaks along sides; scales along back with dark edges; margin of opercles black.... *abildgaardi*
BB. Color paler, reddish brown or greenish; margin of opercles not black.
C. Pectoral fin with a black spot at its base, or with its base somewhat dusky.
D. Black spot at base of pectoral fin very prominent; bluish green, with center of dorsal, caudal and anal fins reddish, bases of dorsal and anal bluish, each of these fins narrowly tipped with blue.... *chrysopterum*
DD. Pectoral fin dusky at base; a golden orange spot on and below the fifth scale of the lateral line, its upper portion blackish; caudal fin with black tips..... *aurofrenatum*

CC. Pectoral fin without a black spot at base.
E. Canines 1 or 2 on each side; top of head and streak back from eye brownish; caudal fin with a red crescent separated by a green band from the transparent posterior portion..... *viride*
EE. Canines 1 to 4 on each side; tubes of lateral line much branched; body and fins mottled reddish brown..... *radians*
AA. Upper and lower jaw without lateral canines.
F. Pectorals with a very evident jet black spot at base of upper rays.
G. Caudal fin with irregular bars and spots..... *squalidum*
GG. Caudal fin clear peach red, its posterior border bluish (our Haitian specimen possesses no lateral canines)..... *brachiale*
FF. Pectoral without a black spot at base of upper rays; body robust, not very much compressed..... *flavescens*

Red Parrotfish; Parroquette
Sparisoma abildgaardi (Bloch)



References: *Sparus abildgaardi*, Bloch, 1791, Naturg. Ausl. Fische, V, p. 22, Plate CCLIX.
Sparisoma abildgaardi, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 748.

Field Characters: Small to medium-sized parrotfish with upper jaw included in lower, and with a small posterior canine on upper jaw; brownish or greyish above, the edges of the scales dark; lower parts bright red; membranous edge of opercle black; dorsal and anal fins dark; intensity and deposition of color variable.

Description: Our specimens are typical.

Size and Weight: A 167 mm. specimen weighed 132 grams and a 193 mm. specimen 235 grams.

Color: Very variable, but all of our specimens when fresh, were within the range of variation shown by Dr. Townsend in his plate of this fish (Bulletin, N. Y. Zoological Society, 1927).

General Range: West Indies and Brazil.

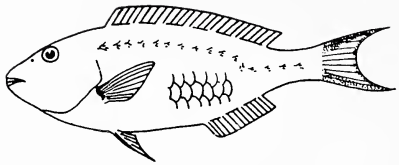
Occurrence in Port-au-Prince Bay: Widely distributed over the bay, both on the coral reefs and on the mud and sand banks.

Abundance: A common species, always seen in the markets.

Method of Capture: Taken mainly in wicker traps placed on bottom.

Food: Unrecognizable detritus found in alimentary tract.

Study Material: Photograph, 3909; Specimens, 19; 83 to 193 mm., including Nos. 6937 and 6942.



Blue Parrotfish; Vieja
Sparisoma chrysopterum (Bloch and Schneider)

REFERENCES: *Scarus chrysopterum*, Bloch and Schneider, 1801, Syst. Ichth., p. 286, Plate LVII.
Sparisoma chrysopterum, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 753.

FIELD CHARACTERS: Medium sized parrotfish, with teeth of lower jaw extending beyond the upper. Bluish-green, with center of caudal fin, dorsal and anal fins reddish, base of dorsal or anal bluish, each of these fins narrowly tipped with blue. Pectoral fin with a black spot at its base; iris pinkish.

DESCRIPTION: Our three specimens agree very well with the descriptions of this species. Posterior canine teeth are present in all, but the number present varies. Their distribution is as follows:

	Posterior canines		*Anterior canines*	
Length	*Right*	*Left*	*Right*	*Left*
235 mm.	0	2	1	0
252 mm.	3	2	1	0
277 mm.	4	4	1	1 (faint indication)

SIZE AND WEIGHT: Grows to a little more than a foot.

COLOR: Our specimens are typical, except that the edge of the opercle just anterior to the base of the pectoral is tinged with yellow. Iris pinkish.

GENERAL RANGE: West Indies to Brazil.

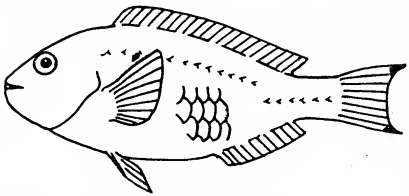
OCCURRENCE IN PORT-AU-PRINCE BAY: Over coral reefs.

ABUNDANCE: Rare, seen occasionally in the markets.

METHOD OF CAPTURE: Our three specimens were taken in traps.

FOOD: Vegetable matter.

STUDY MATERIAL: Color Plate, H57, No. 7014; Specimens, 3; 235–277 mm., including No. 7014.



Vermillion-banded Parrotfish
Sparisoma aurofrenatum (Cuvier and Valenciennes)

REFERENCES: *Scarus aurofrenatus*, Cuvier and Valenciennes, 1839, Hist. Nat. Poiss., XIV, p. 191.
Sparisoma aurofrenatum, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1634.

Field Characters: Small to medium sized parrotfishes with pale upper jaw included in lower, and with one posterior canine tooth on each side of upper jaw; purplish above, becoming reddish on sides and vivid green below; a reddish line from mouth under the eye almost to top of gill opening; a yellow spot surmounted with black on anterior sides; tail with outer angles tipped with black.

Size and Weight: Grows to 8½ inches and possibly larger. A 128 mm. fish weighed 53.5 grams and a 130 mm. fish 60 grams.

General Range: West Indies.

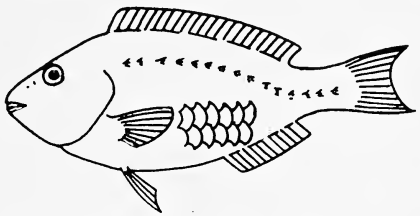
Occurrence in Port-au-Prince Bay: Taken by native fisherman on reefs generally.

Abundance: Uncommon.

Method of Capture: Mainly traps.

Study Material: Color Plate, H63, No. 7039; Photograph, 3904; Specimens, 7; 128–139 mm., including Nos. 6938, 7039, 7360, 7361, 7362 and 7363.

Dark-green Parrotfish
Sparisoma viride (Bonnaterre)



References: *Scarus viridis*, Bonnaterre, 1788, Enc. Meth., X, p. 96.
Sparisoma viride, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1638.

Field Characters: Small to medium sized parrot-fish with upper teeth included. Greenish with brown edges to the scales; head with brownish top and lines along side; a small yellow spot on opercle and a large one on caudal peduncle; caudal fin with a subterminal orange crescent, outside of which is a bluish crescent; dorsal and anal fins pinkish red, the latter with a bluish terminal band.

Size and Weight: A 240 mm. fish weighed 416 grams.

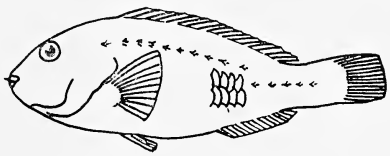
General Range: West Indies.

Occurrence in Port-au-Prince Bay: Commonly found on reefs 20 to 40 feet deep.

Abundance: Fairly common.

Study Material: Color Plate, H44, No. 6949; Specimens, 5; 125–240 mm. including Nos. 6949, 7353, 7354, 7355 and 7356.

Short-snouted Parrotfish
Sparisoma radians (Cuvier and Valenciennes)



References: *Scarus radians*, Cuvier and Valenciennes, 1839, Hist. Nat. Poiss., XIV, p. 206.
Sparisoma radians, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 750.

Field Characters: Small parrotfish with 1 to 4 canines on each jaw; reddish brown; no black spot at base of pectoral fins; body and fins mottled with darker.

Description: The four small specimens assigned to this species have the procurrent canines much more in evidence than any other of the Haitian Scarids.

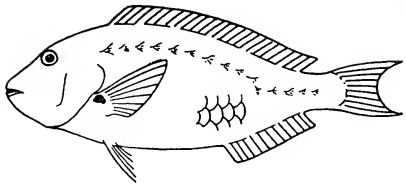
General Range: Florida south to Brazil.

Occurrence in Port-au-Prince Bay: All of our specimens were purchased at Port-au-Prince market.

Abundance: Uncommon.

Method of Capture: Traps.

Study Material: Specimens, 4; 88–108 mm., including No. 7387.



Gray Parrotfish
Sparisoma squalidum (Poey)

References: *Scarus squalidus*, Poey, 1860, Memorias, II, p. 218.
Sparisoma squalidum, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 755.

Field Characters: Small to medium sized parrotfish without posterior canines on upper jaw and with upper jaw included in lower, snout somewhat long, interorbital space slightly concave; preserved specimens brownish gray; pectoral with a conspicuous black spot at base of upper rays; caudal fin with obscure markings.

Size and Weight: A 163 mm. fish weighed 117 grams.

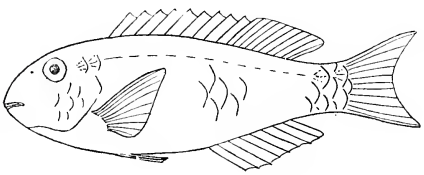
General Range: Bahamas, through West Indies to Venezuela.

Occurrence in Port-au-Prince Bay: Found on all reefs, and brought commonly to the markets.

Abundance: Common.

Method of Capture: Mainly by traps.

Study Material: Color Plate, H76, No. 7368; Specimens, 12; 157–297 mm., including Nos. 6878, 6942, 6950, 7364, 7365, 7366, 7368, 7369 and 7370.



Stocky Parrotfish
Sparisoma flavescens (Bloch and Schneider)

References: *Scarus flavescens*, Bloch and Schneider, 1801, Syst. Ichth., p. 290.
Sparisoma flavescens, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 758.

Field Characters: Small to medium, robust, rather stockily built parrotfish, without lateral canines, and with upper jaw included in lower; no spot at base of pectoral.

Description: Our three specimens are conspicuously different from the other Haitian parrotfish in being less compressed and much more stockily built.

Size and Weight: A 205 mm. fish weighed 217 grams.

General Range: Key West to Rio de Janeiro.

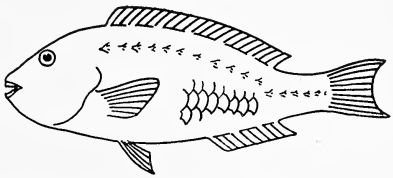
Occurrence in Port-au-Prince Bay: Taken from traps near shore on old coral reef.

Abundance: Uncommon.

Method of Capture: Traps.

Study Material: Color Plate, H72; Specimens, 3; 163–205 mm., including Nos. 7349, 7350, 7351.

Red-tailed Parrotfish
Sparisoma brachiale (Poey)



References: *Scarus brachialis*, Poey, 1861, Memorias, II, p. 345.
Sparisoma brachiale, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1641.

Field Characters: Medium sized parrotfish without lateral canines; and with upper jaw included in lower; pectorals with a very distinct black spot at base; green in life, the center of the caudal fin clear peach red.

Size and Weight: A 154 mm. fish weighed 102 grams.

General Range: Cuba, Jamaica, Haiti, Porto Rico and Curacoa.

Occurrence in Port-au-Prince Bay: A single fish taken at Port-au-Prince market.

Abundance: Rare.

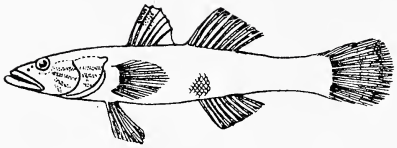
Study Material: Specimen, 1; 154 mm., No. 6951.

Family Eleotridae; Sleepers

Key to Port-au-Prince Bay Genera

A. Vomer with teeth; jaws with bands of pointed teeth; gill openings extending forward to below the eye..... *Gobiomorus*
AA. Vomer without teeth.
B. Dentary bones not expanded and not meeting under the chin; head broad; eyes lateral..... *Dormitor*
BB. Dentary bones broad, expanded, meeting under posterior angle of mouth, leaving an oval-shaped, naked patch at the chin..... *Leptophilypnus*

Gobiomorus Lacépède, 1806



Sleeper; Guavina
Gobiomorus dormitor Lacépède

REFERENCES: *Gobiomorus dormitor*, Lacépède, 1798, Hist. Nat. Poiss., II, p. 599.
Philypnus dormitor, Jordan and Evermann, 1898, Fishes of North and Middle America, III, p. 2194.

FIELD CHARACTERS: Large-sized gobies with ventral fins separated from each other, rays 1–5; vomer with teeth; brownish with an interrupted lateral band, sometimes absent, fins dusky and mottled.

DESCRIPTION: The dorsal count on two Haitian fish is VI–11 and the anal I–10. In all other respects the fish are quite typical.

SIZE AND WEIGHT: Reaches a length of two feet. A 165 mm. fish weighed 71 grams.

COLOR: Specimen 7175 (102 mm.) is very conspicuously marked, being dark brown above and pale yellow white below. The irregularly dark brown band from pectoral is very dark in this fish, and extends across the side of the head to the eye, and from the anterior part of the eye to and onto the mandible. Tip of lower jaw dark. Side of head below lateral bar, much mottled with brown. Upper portion of spinous dorsal with a broad blackish brown bar; soft dorsal and caudal fins mottled with brown; all other fins plain.

A second specimen (165 mm.) is much paler in color, and resembles closely the figure given by Jordan and Evermann. In neither specimen is the dorsal margined with black.

GENERAL RANGE: Streams of the West Indies and Atlantic shores of Central America, Mexico and Surinam.

OCCURRENCE IN PORT-AU-PRINCE BAY: Found in streams emptying into the Bay, one specimen being found close to the sea at Bizoton. The conspicuously marked fish mentioned above, was captured at Source Mariani and the paler one was taken in a small stream emptying into Etang Saumatre, the brackish lake in the Cul de Sac Plain. This species, plus a gar which we were not able to capture, represent the only marine forms that we were able to find in or near this dying lake. All other fish taken by us at Etang Saumatre and the surrounding streams were either Cichlids or Poecilids.

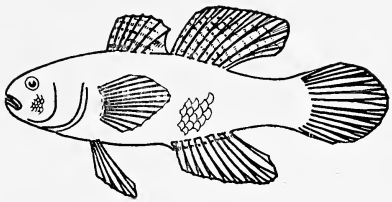
ABUNDANCE: Uncommon.

METHOD OF CAPTURE: Seines and traps.

FOOD: Contents of the alimentary tract in one fish revealed an ant and the coiled spiral of a mollusk.

STUDY MATERIAL: Specimens, 3; 102–165 mm., Nos. 7056 and 7175, Stream at Maneville, Etang Saumatre, and Source Mariani.

Dormitator Gill, 1862



Common Spotted Sleeper; Guavina Mapo

Dormitator maculatus (Bloch)

References: *Sciaena maculata*, Bloch, 1790, Syst. Ichth., pl. 299, fig. 2.
Dormitator maculatus, Regan, 1906, Biol. Centr. Americana, Pisces, p. 8.

Field Characters: Small, robust-bodied gobies, head flattened; dark brown mottled and spotted with lighter; scales large, ctenoid, 30–33; outer teeth movable; dorsal count VII–8, anal I–9; in fresh or brackish water.

Measurements of a 33 mm. Specimen:

Head: 9.7 (3.4)
Depth: 9 (3.7)
Eye: 2.3 (4.2)
Interorbital: 2.8 (3.5)
Snout: 2.1 (4.6)
Maxillary: 2.3 (4.2)

Dorsal fin: VII–9
Anal fin: 10
Pectoral length: 7.5
Ventral length: 8.3
Ocular angle: Vertical
Mouth angle: 40° down
Scales 30

Size and Weight: Reaches a length of two feet. Our largest specimen measured only 36 mm.

Color: The color of our young fish was typical of adults.

General Range: Both coasts of America; on the Atlantic from South Carolina and the West Indies to Panama and Para.

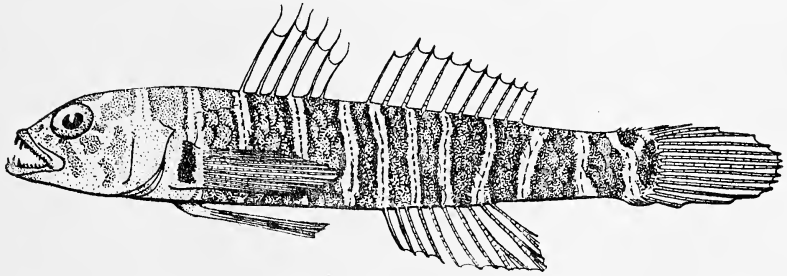
Occurrence: We found it in the brackish water of Etang Saumatre.

Abundance: Apparently rather rare as we took only three specimens.

Study Material: Specimens, 3; 33 to 36 mm., No. 7466.

Many-fanged Goby

Leptophilypnus crocodilus new species



Type: No. 7467. Length 22 mm. Lamentin Reef, Port-au-Prince Bay, Haiti.

Field Characters: Small, compressed, elongate gobies, with dark, vertical bands from eye to caudal, and a fine dark line down center of interspaces; a large black spot in front and on base of rays of pectoral; teeth in several rows, the outer of few, distant, enlarged canines.

Measurements and Counts:

Length: 22 mm.
Depth: 4. (5.5)
Head: 5.4 (4.1)
Eye: 1.5 (3.6)
Interorbital: .37 (4 in eye)
Snout: .97 (5.6)
Maxillary: 1.7 (3.2)

Dorsal fin: VI–10
Anal fin: I–9
Pectoral length: 5.4
Ventral length: 6.2
Ventral rays: I–5
Ocular angle: 30° up
Mouth angle: 20° down
Scales: 30

Description:

Body: Elongate, compressed, deepest at opercle.

Anterior profile: Gently curved from dorsal to eye, more steeply from eye to snout.

Head: Fairly deep.

Interorbital: Very narrow, 4 in eye, slightly concave.

Snout: Blunt, lower jaw projecting slightly.

Eye: Large, cutting profile, set rather obliquely.

Mouth: Rather large, oblique.

Maxillary: Reaching to pupil.

Teeth: Several bands of small, villiform teeth in each jaw, the outer series larger and wider spaced; in front are four widely-spaced sharp and very large canines, and six in lower jaw.

Opercular margin: Curved, smooth.

Gill openings: Broad, isthmus opening far behind eye.

Scales: Large, ctenoid, absent from head, nape and along first five dorsal spines.

Dorsal fins: Separate, rather low.

Color: (preserved specimen) Body with broad, dark brown, vertical bands, the first two extending down from the eye over the cheeks, the third on the nape breaking into large irregular spots on the opercles, a broken one on mid-peduncle and the last very dark and on the base of caudal. The pale interspaces on the body have a thin, dark, threadlike line down their centers. A very dark spot on base of pectoral.

Comparison: Differs from *latifrons* in color, and in form.

Study Material: Specimen, 1; 22 mm., No. 7467.

Type Name and Location: Named from the many-fanged character of the dentition. Type is in the Collection of the Department of Tropical Research of the New York Zoological Society.

Family Gobiidae; the Gobies

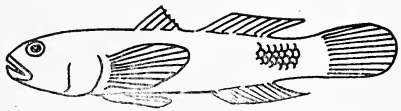
Key to Port-au-Prince Bay Genera

A. Body either completely scaled or with scales on some part of the body.
B. Scales not confined to the lower posterior sides.

C. Pectoral fins with free silk-like rays above; tongue anteriorly with an evident notch.....*Bathygobius*
CC. Pectoral fins without free silk-like rays above.
D. Two or three fleshy flaps on the anterior edge of the gill arch, projecting into the gill cavity.....*Chonophorus*
DD. No dermal fleshy flaps projecting into the gill cavity.....*Gobius*
BB. Scales confined to the lower posterior sides: elongate, eel-like fishes living in sponges.....*Evermannichthys*
A. Body scaleless.....*Gobiosoma*

Bathygobius Bleeker, 1878

Sleeper
Bathygobius soporator (Cuvier and Valenciennes)



References: *Gobius soporator*, Cuvier and Valenciennes, 1837, Hist. Nat. Poiss., XII, p. 56.
Bathygobius soporator, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 867.

Field Characters: Medium sized gobies with united ventral fins free from the abdomen; body compressed posteriorly, the head depressed; pectoral fins with upper rays filamentous and silk-like.

Color various, from plain dark brown, to pale straw color; with or without cross bars; dorsal and caudal fins with dark spots or cross-bars.

Size: Grows to six inches.

Color: The three specimens in our collection are uniformly pale, but possess the usual markings of the species.

General Range: Known from all tropical seas.

Occurrence in Port-au-Prince Bay: Taken by us only along shore over sandy beaches.

Abundance: Fairly common.

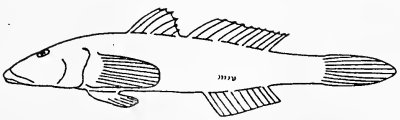
Method of Capture: Mainly with small seines.

Food: Carnivorous, two of our specimens contained small blennies, one being identifiable as *Auchenopterus fajardo*.

Study Material: Specimens, 3; 56–72 mm., including Nos. 6917 and 7274.

Chonophorus Poey, 1860

Fringe-shouldered Goby; Guavina; Saga
Chonophorus taiasica (Lichtenstein)



References: *Gobius taiasica*, Lichtenstein, 1822, Berl. Abhandl., p. 273.
Awous taiasica, Evermann and Marsh, 1902, Fishes of Porto Rico, p. 297.

Field Characters. Medium sized to large, scaled gobies with united ventral fins free from the belly, simple teeth, and with two fleshy flaps on the inner edge of the shoulder girdle. 60 to 70 scales in the lateral line. Pale olivaceus or yellowish, sides blotched with darker.

Size and Weight: Grows to a foot or more. An 84 mm. fish weighed 9.5 grams.

Color: Head and upper half of body pale greenish yellow, variegated with irregular markings of dark brown. Dorsal and caudal fins light greenish yellow, crossed by several narrow dark brown bands. Belly flesh color. A black line starts half way between eye and pectoral and extends backward and obliquely half way over the fleshy part of pectoral. Iris golden.

General Range: Fresh waters of West Indies; Mexico to Brazil; lower California to Panama.

Distribution in Port-au-Prince Bay: Taken in brackish streams, in fresh water at Source Mariani, and near the Agricultural Station at Grande Riviere.

Abundance: Fairly common.

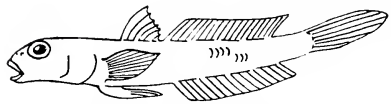
Method of Capture: Mainly with seines.

Study Material: Specimens: 4; 84–190 mm., including Nos. 6962 and 7174. Grande Riviere and Source Mariani.

Gobius Linnaeus, 1758

Key to Port-au-Prince Bay Species

A. Scales larger, 30 in a longitudinal series..... *fasciatus*
AA. Scales smaller, 64 to 75 in a longitudinal series..... *oceanicus*



Gill's Banded Goby
Gobius fasciatus (Gill)

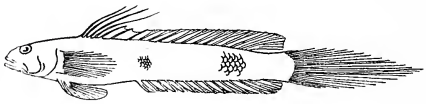
References: *Ctenogobius fasciatus*, Gill, 1858, Fishes of Trinidad, p. 378.
Gobius fasciatus, Jordan and Evermann, 1898, Fishes of North and Middle America, III, p. 2222.

Field Characters: Small, elongate gobies; scales large, ctenoid, absent on nape and breast; body yellowish with four oblong, dark blotches along sides, and dark spot at base of tail.

General Range: Trinidad and Haiti.

Occurrence: We took six specimens in the brackish waters of Etang Saumatre.

Study Material: Specimens, 6; 16–37 mm., No. 7067.



Emerald-tongued Goby; Esmerelda
Gobius oceanicus Pallas

References: *Gobius oceanicus*, Pallas, 1770, Spicil. Zool., I, Fasc. VIII, p. 4.
Gobionellus oceanicus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 877.

Field Characters: Very elongate, compressed gobies, with united ventral fins forming a large sucking disk; tail very long, sometimes half the length of the body; scales small, 64 to 75; anterior dorsal spines filamentous; opercle with a patch of scales above.

Description: Our fish resembles the illustration given by Evermann and Marsh (Fishes of Porto Rico) of *Gobionellus bayamonensis*, and also agree in possessing the same number of scales. In other characters such as head and length, etc., they are closer to *oceanicus* and agree completely with the description of that species given by Meek and Hildebrand, 1925. It is very possible that *bayamonensis* is not valid.

Size and Weight: Grows to a foot in length. A 112 mm. fish weighed 15.5 grams.

Color: Both fish in the collection are more or less colorless, possessing only the faintest indication of the color pattern. One fish was noted in life as being uniform dark brown.

General Range: South Carolina to Texas; Panama, West Indies.

Occurrence in Port-au-Prince Bay: Our specimens were both taken in fairly shallow water along shore.

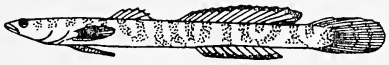
Abundance: Rather uncommon.

Method of Capture: Seines.

Study Material: Specimens, 2; 112–122 mm., Nos. 7118, 7188.

Evermannichthys Metzelaar, 1919

Giant-scaled Sponge Goby
Evermannichthys metzelaari Hubbs



References: *Evermannichthys spongicola*, Metzelaar, 1919, Over Tropisch Atlantische visschen, p. 139, figs. 39 and 40.
Evermannichthys metzelaari, Hubbs, 1923, Occ. Papers, Univ. of Mich., No. 144.

Field Characters: Very small, elongate, eel-shaped gobies with united ventral fins; scales present on lower, posterior portion of body only, where they are large and equipped with strong spines. Greenish with vertical dark cross bands, some of which are united on the lower sides and form saddle-shaped patterns, with a milky white spot in center, two wide red bands on tail, two narrower red bands on dorsal and anal fins.

Description: On the posterior surface each side of the anal fin, is a series of 9 or 10 enormous, ctenoid scales, each scale isolated and with the spines considerably raised from the skin surface. The series begin at the last third of the anal fin. There are four similar scales in the center of the lower part of the caudal peduncle.

The pectoral fins are very long, and the webs are torn to ribbons, most likely by attrition on the silicious sponge substance.

All of these characters, in addition to the elongate eel-like body and small head, mark this species as admirably adapted to the peculiar habitat that it has chosen for itself.

Size and Weight: The largest specimen taken so far, is that of Metzelaar, measuring 26 mm. The largest Haitian fish is 19 mm. long.

Color: (In life) General color pale yellowish to dusky white, the head somewhat darker than rest of body. Eight to ten saddle-like, dark brown blotches along back, with milky-white spot in center of each blotch. In Metzelaar's illustration these blotches are shown as bands which meet on the lower part of the sides. In between the saddle-like connected bands there is often a single vertical dorsal band ending at the middle of the sides. Caudal fin with two wide reddish bands, most conspicuous superiorly. Dorsal and anal fins each with two narrow pinkish lines, the one nearest the body slightly wider than the other.

General Range: Known from Curacoa and Haiti.

Occurrence in Port-au-Prince Bay: Seven of these remarkable fishes were taken from the galleries of enormous sponges, where they lived in company with snapping shrimps and small crabs.

Abundance: Uncommon.

Method of Capture: Taken only by searching among galleries of sponges.

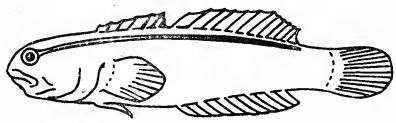
Study Material: Drawings, H114, No. 7228; Photographs, 4233; Specimens, 7; 16 to 19 mm., including Nos. 7228 and 7251.

Gobiosoma Girard, 1859

Key to Port-au-Prince Bay Species

A. A sharply-defined bluish-white line from eye to tail along upper sides. *horsti*

AA. Sides of body and head with narrow vertical dark lines. *macrodon*, new species



White-lined Sponge Goby
Gobiosoma horsti Metzelaar

References: *Gobiosoma horsti*, Metzelaar, 1922, Bijdr. Dierk. Amsterdam, 22, p. 133.

Field Characters: Small, scaleless gobies with a conspicuous, sharply defined bluish-white line from eye along dorsal surface to base of caudal. Upper surfaces dark, becoming paler below.

Description: The Haitian specimens agree well with the original description and figure of this species. The vertical fins, however, are considerably higher and some of the posterior rays are almost filamentous at their extremities. The lower rays of the pectorals, as is the case also in sponge living blennies, are considerably worn.

Size and Weight: Grows to 2½ inches in length.

Color: The colors of a 37 mm. fish were as follows: Upper half of head and body dark brown, shading gradually on sides into the colorless greyish white of ventral areas. This color extends almost to the snout, ending in a broad rounded area in front of the eyes, in the center of which is a small, round turquoise spot. The upper fourth of the iris is bluish white, and this is continued back halfway between the back and the upper edge of the opercula and pectoral insertion, and on to the upper third of caudal as a straight, narrow, very distinct turquoise line. On brown coral 4 ft. down this is very conspicuous.

The brown area below this becomes narrowed just back of the eye, and extends into the iris as the same color, the whole lower three-fourths of the eye being of this color, except for an area of gold at the very bottom.

A narrow line of red runs along the base of the pectoral and the colorless opercles are made rosy from the underlying gills. A small patch of concentrated red pigment lies just beneath the eye. Vertical fins somewhat dusky, especially along the edges. The dark lateral body pigment extends almost halfway to the tip of the caudal.

The smallest specimen (22 mm.) lacked all pigment on the back and upper sides, so that the dark brown is reduced to a broad, low, lateral band and the blue line extends through a colorless area.

In preservative the ground color varies considerably, the white line being always discernable, and usually very conspicuous. In typical specimens the upper surfaces are bluish to purplish brown, while the lower parts of head and body are brownish. Both of these colors may fade out almost entirely. The dark color of the upper side is concentrated at the base of the caudal fin into a blackish spot, which often continues on the central rays of the caudal.

In a 13 mm. (alcoholic) fish, the darker coloration is present mainly as a dark band from the eye, descending slightly until it reaches the middle of the sides, and thence to the tail where the black spot at caudal is especially prominent.

General Range: Known from Curacao, Dutch West Indies; and Haiti.

Occurrence in Port-au-Prince Bay: Almost all the Haitian fish were taken from tall tubular sponges, the great majority living on reefs from 15 to 20 feet deep. The gobies are not confined to the sponges, but came out during daylight, and were often seen resting on the bottom. A few were taken along sandy shores and near broken-up shallow coral reef bottoms.

Abundance: Common: Found in about half of the tall, tubular sponges of the reefs.

Method of Capture: Usually taken by stuffing cotton into the mouths of tube sponges, and sending the sponges to the surface where the fish are extracted. A few taken with bait seines.

Habits: These little gobies are quite fearless, and slide and slither over the coral close to one's feet. I tried to catch two on brain coral at Sand Cay but they were too agile and cunning. They must be protected either by their agility or by nauseous flesh, and most likely by the former, for their prominent, large eyes must see everything that comes near.

When I put a sponge containing one of the fish in an aquarium it came out and swam about for a minute, then seemed to climb the trunk of the sponge

under the surface and actually climbed out of the water to wriggle over the rim and back into the bottom of the animal chimney.

After death the naked skin gave out a solid coating of thick, almost opaque slime, which was easily removed in a sheet.

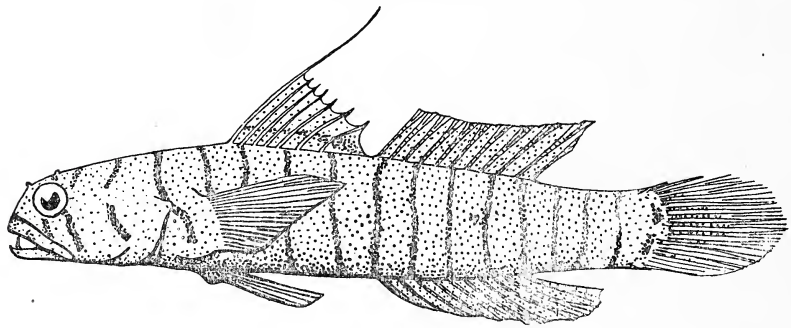
At night the dark back (as in the small specimens) pales until it becomes almost as pale as the under parts.

When the gobies are kept in a small aquarium and begin to feel the want of oxygen they begin a peculiar movement which is probably related to their normal environment. This, near the bottom and in crevices of coral, is where they have often need of water in movement. About every four seconds they balance on the ventral fin and begin a vigorous movement of the pectorals, both dorsals and the posterior third of the body and caudal. The object is apparently to drive a current of water back over the gills, and is stopped as soon as the water is changed. The outer ray or rays of the pectoral and the ventral cup form the fixed grip while the others drive the water past. (W. B.)

Study Material: Color Plate, H36; Photographs, 4054, 4056, 4057, 4181; Specimens, 42; 13–50 mm., including Nos. 6870, 6914, 6986, 7074, 7115, 7138, 7180, 7197, 7278, and 7279.

Large-toothed Scaleless Goby

Gobiosoma macrodon new species



Type: No. 7462. Length 29 mm. Lamentin Reef, Port-au-Prince Bay, Haiti.

Field Characters: Very small, elongate, compressed, scaleless gobies, with ventrals forming a sucking disk; two dorsal fins, the first ray of the anterior fin long and filamentous; sides of body and head with about sixteen narrow vertical dark lines.

Measurements and Counts:

Length: 29 mm.
Head: 7.3 (4)
Depth: 6 (4.85)
Eye: 1.2 (6.1)
Interorbital: .6 (2)
Snout: 1.8 (4)
Maxillary: 4 (1.8)

Dorsal fin: VII–11
Anal fin: 10
Pectoral length: 7.5
Ventral length: 5.4
Ocular angle: 20° up
Mouth angle: 30° down

DESCRIPTION:

Body: Elongate, compressed.

Anterior profile: Sloping gently downward to posterior margin of eye, then more abruptly curved to the snout.

Head: Moderate, compressed.

Interorbital space: Narrow, slightly concave.

Snout: Short.

Mucus pores: In numbers on head, in the form of lines of papillae and tubes; after death the entire head and body covered with a thick sheet of opaque white mucus.

Eye: Moderate, well below profile.

Mouth: Medium, oblique, terminal.

Maxillary: Reaches beyond eye.

Teeth; In several rows; the outer row above consists of eight teeth enlarged successively backward, the fourth on each side being very large and canine-like; the outer row below small, but with a single, greatly enlarged, sharp canine on each side of the truncate lower jaw.

Opercular margin: Smooth, rounded.

Gill openings: Broadly attached to isthmus.

Scales: Absent.

Dorsal fin: First spine elongate, greater than depth of body; the rest about same length as soft rays.

Anal fin: Beginning slightly back of origin of soft dorsal.

Caudal fin: Rounded, not quite equal to head.

Pectoral fins: Rather long, a little shorter than head.

Ventral fins: United, rather long.

COLOR: (In formalin) Grayish brown formed by minute punctulations, with a series of twelve narrow, brownish lines on the body from pectoral to caudal, becoming slightly narrower and closer together posteriorly, three more dark lines in front of pectoral, more angular than the rest, the posterior one starting at the nape, passing under the posterior part of gill flap and across the pectoral base; the second considerably angled, starting on the nape and crossing the preopercle; a third shorter line from nape toward the eye not quite reaching the orbit; two short brown lines downward and backward from eye; small dark brown spots on head; two small spots at base of caudal lobes.

COMPARISON: Closest to *multifasciatus;* our Haitian fish differs in its greater depth, smaller eye, longer maxillary, presence of canines, filamentous first dorsal spine, and different pattern and coloring.

STUDY MATERIAL: Specimen, 1; No. 7462.

TYPE NAME AND LOCATION: Named from the large size of the canines. Type in the Collection of the Department of Tropical Research of the New York Zoological Society.

Family ECHENEIDIDAE; THE REMORAS; SHARK-SUCKERS

Echeneis Linnaeus, 1758

Short-disked Shark-sucker

Echeneis naucrates (Linnaeus)

References: *Echeneis neucrates* (misprint for *naucrates*), Linnaeus, 1758, Syst. Nat., Ed. X, p. 261.
Echeneis naucrates, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 896.

Field Characters: Medium-sized fishes with oval sucking disk on top of head composed of 23 or 24 laminae; a black band from snout through eye; dorsal and anal dark brown, with distal part of anterior rays pale.

Size and Weight: Grows to 38 inches. A 297 mm. fish weighed 80 grams.

General Range: Cosmopolitan in warm seas.

Occurrence in Port-au-Prince Bay: Four specimens taken, two of them by hook. A 297 mm. fish spent two days circling about the ship's launch and attaching itself to the boat.

Abundance: Fairly common, seen now and then in the markets.

Method of Capture: Mainly taken by hook and line.

Food: Part of a chicken in the stomach of our largest fish.

Study Material: Specimens, 4; 235–640 mm., including Nos. 6858 and 7119.

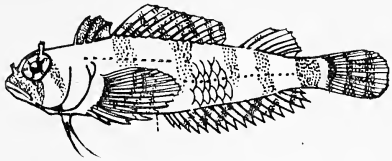
Family Clinidae; Blennies

Key to Port-au-Prince Bay Genera

A. Lateral line present, arched anteriorly over the pectoral fin, becoming posteriorly median in position or else obsolete.
B. Scales ctenoid, very rough; dorsal fin divided into three parts; an ocular cirrus present ..... *Gillias*
BB. Scales cycloid; dorsal fin not divided into three parts.
C. Dorsal with six to twenty soft rays.
D. Males with 1st anal spine not differentiated from remainder of fin. Color pattern not as in DD.
E. Nape with a comb of filaments on each side.
F. Jaws with a single row of strong teeth only; mouth small; dorsal fin notched ..... *Malacoctenus*
FF. Jaws each with a band of villiform teeth behind the row of outer teeth; mouth large ..... *Labrisomus*
EE. Nape with a single filament on each side; mouth small; jaws with a narrow band of teeth behind the strong teeth ..... *Acteis*
DD. Males with the 1st anal spine thickened and separated from the rest of the fin. Color brown, mottled with darker; a series of dark spots along the back, extending on the dorsal fin; two blotches especially conspicuous at the base of the tail; a wide light bar on cheek extending backward from the eye and breaking up on the opercle into two lines; head rather large ..... *Brannerella*
CC. Dorsal with one short soft ray only, often difficult to find, or without, the fin more or less deeply notched behind the third spine; 1st three dorsal spines stiff, wide-set, not remote from rest of fin behind the dorsal notch ..... *Cremnobates*
AA. Lateral line absent; very small, elongate blennies with dorsal fin formed entirely of spines ..... *Auchenistius*

Gillias Evermann and Marsh, 1899

Rough-scaled Blenny
Gillias jordani Evermann and Marsh



References: *Gillias jordani,* Evermann and Marsh, 1899, Report U. S. Fish Comm., 1899, p. 357.
Gillias jordani, Evermann and Marsh, 1902, Fishes of Porto Rico, p. 307, fig. 95.

Field Characters: Very small blennies with three dorsal fins; scales ctenoid; a tentacle over each eye; vertical dark bars on the body, the one on the caudal peduncle most intense on larger specimens.

Description: Two small fishes of 12 and 14 mm. are apparently of this species. They differ in size of head, which is 2.86 instead of 3.5, and in eye which is 2.8 instead of 2.5, in having a spoon-shaped entire tentacle over the eye instead of a bifid one; and slightly in color. In both of our specimens the vertical dark bars of the body are very intense, so much so that the bar on the caudal peduncle, so marked in Evermann and Marsh's examples, is of the same degree of conspicuousness as the rest. The diagonal bars on the anal fin are also well marked in the Haitian fish. The edges of the dorsal and caudal fins are broken in our fish and the shape of these fins is somewhat doubtful.

While our specimens are somewhat different from *jordani,* the differences may be assigned to age, and for that reason we are placing the Haitian fish under this species until larger individuals can be obtained.

General Range: Porto Rico and Haiti.

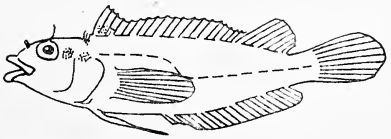
Occurrence in Port-au-Prince Bay: Taken among broken coral on Lamentin Reef.

Abundance: Rare.

Study Material: Photograph, 4496; Specimens, 2; 12–14 mm., No. 7278, Lamentin Reef, Port-au-Prince Bay.

Malacoctenus Gill, 1860

Cope's Two-spotted Blenny
Malacoctenus biguttatus (Cope)



References: *Labrisomus biguttatus,* Cope, 1873, Trans. Amer. Philos. Soc. Phila., 473.
Malacoctenus biguttatus, Jordan and Evermann, 1898, Fishes of North and Middle America, III, p. 2360.

Field Characters: Small, compressed, scaled blennies with complete lateral line; teeth in a single series in each jaw; a fringe of tentacles on nape;

7 or 8 dark quadrate blotches on sides; a black blotch on anterior two membranes of dorsal fin; two brownish spots behind the eye.

DESCRIPTION: The single specimen assigned to *biguttatus* agrees fairly well with the meager description of proportions and fins given by Cope, and quite well as to color. The dorsal however has XIX, 10 instead of XIX–I, 11, and the anal II–19 instead of II–16. In view of the few specimens which have been taken, this variation may well be within specific lines.

The following description of our specimen is given: Specimen No. 7275

Length: 36.5 mm.
Depth: 9.5 (3.84)
Head: 11 (3.3)
Eye: 3.1 (3.66)
Snout: 3.9 (2.8)
Maxillary: 4 (2.7)

Dorsal fin: XIX–10
Anal fin: II–19

BODY: Elongate, considerably compressed, the head slightly less so than the body; upper and lower profiles about equally curved.

ANTERIOR PROFILE: Straight to above the anterior half of eye, thence after an abrupt angle, straight to the upper lip.

HEAD: Medium, 3.3 in length.

INTERORBITAL SPACE: Narrow, slightly wider than ½ the eye, almost flat but with a very slight depression.

SNOUT: Conical, the lips, especially the upper, rather thick and heavy, entering the profile.

EYE: 3.66 in head, placed rather high, its upper border not quite entering the dorsal profile.

MOUTH: Small, horizontal, the maxillary reaching the anterior margin of the orbit.

TEETH: Strong, pointed, in a single series in each jaw, those of the lower jaw larger; teeth present on the vomer and palatines.

LATERAL LINE: 46 pores; straight from upper angle of gill opening, decurved over origin of anal fin, thence straight on center of sides to caudal fin.

SCALES: Medium in size, absent on head.

CIRRI: A simple cirrus on anterior nostril, two cirri above eye, and a group of five cirri arising from a single base on each side of the nape.

DORSAL FIN: Continuous, arising over the origin of the lateral line, the 1st spine higher than the next three or four, but not higher than posterior spines; the penultimate spines lower than the ultimate spine. Soft portion of fin higher than spinous portion.

ANAL FIN: Arises under center of spinous dorsal, the posterior rays longer than the anterior ones.

PECTORAL FINS: Elongate, rounded at end, equal to ¾ length of head.

PELVIC FINS: Elongate; arising in front of the pectoral base, the tips extending to the 2nd anal ray.

CAUDAL FIN: Broken, but apparently rounded.

COLOR: (alcoholic specimen) Pale greyish brown, with traces of 8 large vertical blotches on sides, these somewhat broken, and not forming continuous bars in all cases; a black spot on membrane between the first and third dorsal

spines; two very distinct brownish spots behind the eye, slightly more than ½ the eye in diameter, the posterior on the operculum. Lower head with traces of lighter bars.

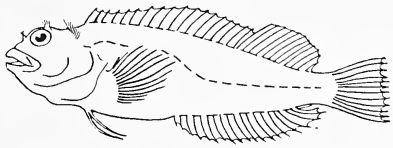
Size and Weight: Grows to 2¼ inches.
General Range: St. Martins; Bahamas and Haiti.
Occurrence in Port-au-Prince Bay: Our fish was taken close along shore in shallow water near Lamentin Reef.
Abundance: Rare.
Method of Capture: Scoop net among weeds.
Food: Minute crustaceans and organic detritus too comminuted to identify.
Study Material: Specimen, 1; 36.5 mm., No. 7275.

Labrisomus Swainson, 1839

Key to Port-au-Prince Bay Species

A. Scales small, 68 to 80 in the lateral line.....*nuchipinnis*
AA. Scales larger, 42 to 45 in lateral line.
B. Dorsal XX–11, anal fin II–20. Color mottled brown. No light spot below eye posteriorly.....*haitiensis* new species
BB. Dorsal XVIII–10, Anal II–18, brownish with a conspicuous light spot on cheek below the eye posteriorly, bordered above and below by darker. *albigenys*, new species

Fringe-naped Blenny
Labrisomus nuchipinnis (Quoy and Gaimard)

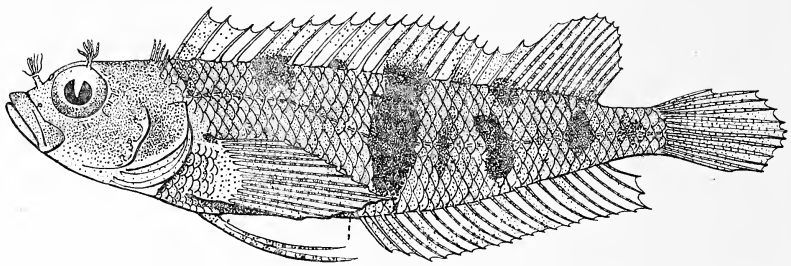


References: *Clinus nuchipinnis*, Quoy and Gaimard, 1824, in Freycinet, Voy. Uranie et Physicienne, Zool., p. 255.
Labrisomus nuchipinnis, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 936.

Field Characters: Small, scaly blennies with complete lateral line; teeth in an outer large series and an inner, smaller villiform group; a fringe of tentacles on the nape; brownish with indistinct cross-bars and blotches; fins brownish with darker spots forming cross-bars; scales small, 68 to 80 in lateral line.
Description: The Haitian specimens are quite typical.
Color: Our two specimens are rather pale, but agree well with the description given by Meek and Hildebrand.
General Range: Florida to Brazil.
Occurrence in Port-au-Prince Bay: Rather widely distributed on the reefs and along shore.
Abundance: A common species, seen often on the reefs.
Method of Capture: Taken mainly with traps, set on bottom near shore.
Study Material: Photograph, 4014; Specimens, 2; 90–101 mm., including No. 7065.

Haitian Spotted Blenny

Labrisomus haitiensis new species



Type: No. 7170, 52.5 mm. long, Bizoton, Port-au-Prince Bay, Haiti, March 15, 1927, Captured in small trap in four feet of water.

Field Characters: Small scaly blennies with complete lateral line; teeth in an outer large series and an inner villiform band of small teeth; fringe of tentacles on the nape. Scales large, about 45 in the lateral line. Brownish with conspicuous darker spots.

Measurements and Counts of Type:

Length: 52.5 mm.	Dorsal fin: XX–11
Depth: 12.5 (4.2)	Anal fin: II–20
Head: 14.9 (3.5)	Pectoral fin: 13
Eye: (2.9)	Scales: 45

Description:

Body: Elongate, compressed, the dorsal and ventral profiles, exclusive of the anterior profile, similar.

Anterior profile: More or less straight from origin of dorsal fin to over middle of the eye, then angled and straight to the snout.

Head: 3.5 in length, compressed.

Interorbital Space: Narrow, slightly concave, its width about ⅓ the diameter of the eye.

Snout: Very short, a little more than ½ the eye in length.

Eye: Large, 2.9 in head, placed well forward in the head, its upper edge reaching almost to the dorsal profile.

Mouth: Terminal, slightly oblique.

Maxillary: 2 in head, reaching beyond anterior border of pupil but not quite to center of eye.

Teeth: In both jaws with an outer row of large conical teeth,—about 10 large graduated teeth anteriorly, with 10 smaller equal sized teeth on each side. Behind these anteriorly is a villiform band of small teeth.

Opercles: Unarmed.

Lateral line: Complete, the anterior portion straight, with a long low arch, beginning under the 9th spine of the dorsal.

Scales: 45 in lateral line, medium in size, covering the entire body except the head.

Cirri: Anterior nostril with a multifid cirrus (8 tentacles on right and 4 on

left,—possibly injured); eye with a 5 or 7 branched tentacle on its upper, slightly posterior border; a five fingered tentacle on nape.

Dorsal Fin: Long, the 3rd and 4th spines slightly shorter than the 1st and 2nd, the 17th, 18th and 19th becoming progressively shorter, the 20th as long as the 16th or 17th, the spines free at their tips; the soft dorsal considerably higher than the spinous dorsal.

Caudal Fin: Rather long, the end roughly rounded.

Anal Fin: Rays lower than the dorsal rays, increasing in length slightly posteriorly.

Pectoral Fins: Width of base 3 in head; the fin not quite as long as the head.

Ventral Fins: Rather long, close together, composed of 1 spine and 2 rays.

Color: (preserved specimen) Brownish gray, much paler on the lower surfaces, with darker mottlings. Three very dark brown, vertical spots on the posterior sides, the first spot confluent with a dark spot at base of and extending on the dorsal fin. Between these spots are vague indications of others. Five dark spots on the body at the base of the spinous dorsal, half of each spot being on the fin, these spots continued upward through the fin as grayish bars. Two small spots on the body at the base of the soft dorsal. Head dark brown, marbled slightly with lighter, the opercle especially dark. Anal with alternate dark and light bars. Soft dorsal, caudal, pectoral and ventral fins with small brownish spots on the rays, forming bars.

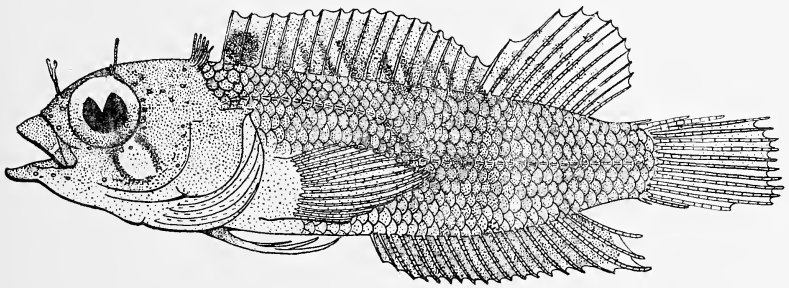
Comparison: This species differs mainly from *nuchipinnis* because of its larger scales, from *herminier* by its larger eye and different fin count, from *bucciferus* by its larger eye and shape of dorsal, from *macrolepidotus* by its larger eye and larger scales, from *heilneri* because of larger eye and shorter maxillary, and from *lentiginosus* by its larger eye and small snout, and because of the longer pectoral and ventral fins. In coloration it almost duplicates the description given for *nuchipinnis* by Meek and Hildebrand, but the much larger scales of *haitiensis* immediately separate the two species.

Study Material: Specimen, 1; the type, No. 7170.

Type Name and Location: Named for the island of Haiti. Type in the collections of the Department of Tropical Research of the New York Zoological Society.

White-cheeked Blenny

Labrisomus albigenys new species



Type: No. 7372, Length 16 mm., Lamentin Reef, Port-au-Prince Bay, Haiti. Taken among broken coral in two feet of water on inside of reef. May 9, 1927.

Field Characters: Very small, scaly blennies, with complete lateral line; a pair of three to five-fingered comb cirri on nape, ocellus on anterior dorsal web, and a large, white, black-bordered spot on cheek.

Measurements and Counts of Type:

Length: 16 mm.
Head: 5.9 (2.7)
Depth: 4.3 (3.7)
Eye: 1.6 (3.4)
Interorbital: .8 (2)
Snout: 1.2 (4.5)
Maxillary: 1.6 (3.4)

Dorsal fin: XVIII–10
Anal fin: II–18
Pectoral length: 5.8
Ventral length: 4
Ocular angle: 20° up
Mouth angle: 50° down
Scales: 42
Lateral line pores: 42

Description:

Body: Elongate, compressed.

Back: Scarcely elevated.

Anterior profile: Evenly curved from dorsal to snout.

Head: Pointed.

Interorbital: Concave, with a furrow down the center.

Snout: Short, lips thick.

Nares: Posterior nares near eye, almost sessile, anterior nares in tube, between posterior and lips.

Cirri: Narial cirri, two elongated tentacles from same base, extending up from posterior half of each narial tube, four times the height of the tubes; ocular cirrus, a long, slender, round, fleshy finger, giving off a short, external branch near base, half as long as eye; nuchal cirri, two oblique combs of five slender fingers (in two smaller paratypes there are only three fingers), one mm. in front of dorsal, the finger tips reaching back to base of dorsal.

Eye: Large, not quite cutting profile.

Mouth: Moderate, oblique, terminal.

Maxillary: Reaching past first quarter of eye.

Teeth: Several rows of villiform teeth, outer row enlarged; a single row on vomer and palatines.

Preopercular margin: Rounded.

Opercular margin: Rounded.

Scales: Large, rounded.

Lateral line: Anteriorly following line of back, lying half way between back and pectoral base; at vertical of 12th dorsal spine, curved abruptly down to midline; arched part considerably shorter than straight.

Dorsal Fin: Spines considerably shorter than soft rays.

Anal Fin: Lower than dorsal.

Ventrals: 1–3.

Color: Brown, mottled irregularly with darker, head almost uniform, the solid brown appearance caused by minute pigment dots; a broad, rectangular patch of whitish extending obliquely down and back from eye, across cheek and preopercle, broadly banded on each side with black; dorsal mottled with

two shades of brown, with a large black ocellus on the first and second webs, between the first and third spines; the elongated distal half of the soft rays pearly white, with three irregular lines of large, brown spots; end of peduncle pale, followed by a narrow black band on base of caudal; anal mottled with brown; pectoral pale mottled toward tip. The paratypes are not as brilliantly colored.

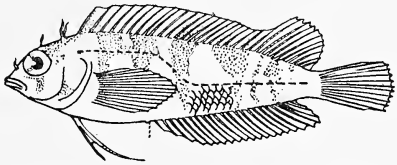
Comparison: This species is nearest *nuchipinnis* but differs in smaller dorsal count, shorter snout, larger eye, short maxillary, difference in character of cirri, and especially in the much larger scales.

Study Material: Photographs, 4498 and 4506; Specimens, 4; 13–16 mm. type and three paratypes, Nos. 7372 and 7372a.

Type Name and Location: Named from the white patch on the cheeks. Type in the Collection of the Department of Tropical Research of the New York Zoological Society.

Acteis Jordan, 1904

Moore's Blenny
Acteis moorei (Evermann and Marsh)



References: *Malacoctenus moorei*, Evermann and Marsh, 1899, Rept. U. S. Fish Comm., p. 358.
Malacoctenus moorei, Evermann and Marsh, 1900, Fishes of Porto Rico, p. 309, fig. 97.

Field Characters: A small, scaled blenny with complete lateral line; teeth with an outer larger row and a group of inner smaller villiform teeth; a single tentacle on nape; first dorsal spine longer than others; brownish with cross-bands of darker.

Description: Four small fish, the largest 18 mm. long, are assigned to this species. Two of them have 22 dorsal spines and one has 47 lateral line scales.

Size: Grows to 2¼ inches.

Color: The coloration of our fishes, is less definitely marked than in specimens described by other authors. The vertical bands are broken up to a greater extent, forming almost horizontal bands of irregular spots, each spot with a lighter center. The bars or spots continue more or less on the dorsal fin, and that fin may be described as mottled with dark brown. Anal fin with a dusky shade towards the edge.

General Range: Porto Rico, Haiti and Tortugas.

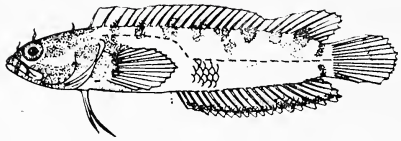
Occurrence in Port-au-Prince Bay: In shallow water along shore near Lamentin Reef.

Abundance: Uncommon.

Method of Capture: By scoop nets, and searching among weeds and broken coral.

Study Material: Specimens, 4; 15–18 mm., Nos. 7373, 7278.

Brannerella Gilbert, 1900



Marbled Blenny
Brannerella culebrae (Evermann and Marsh)

REFERENCES: *Malacoctenus culebrae*, Evermann and Marsh, 1899, Rep. U. S. Fish Comm., Dec. 19, 1899, p. 357.
Malacoctenus culebrae, Evermann and Marsh, 1902, Fishes of Porto Rico, p. 308, fig. 96.

FIELD CHARACTERS: Small, brownish scaled blennies with complete lateral line; males with 1st anal spine detached and covered with rather thickened skin. Body mottled with dark brown, a series of dark spots on the back, extending sometimes on the dorsal fin; two blotches especially conspicuous at the base of the tail; a wide light bar on the cheek, often breaking up into two posteriorly and forming a Y-shaped figure.

DESCRIPTION: Evermann and Marsh described this fish in 1899 from three specimens of about equal size, the type, taken from a reef outside of Culebra harbour, Porto Rico, being 1.38 inches long.

A series of specimens from Port-au-Prince Bay agree excellently well in form and coloration with the description and plate given by them and upon dissection all were found to be females. Agreeing equally well in color, considering the well-marked pattern of this species and the variations mentioned and described under Color, are another series of Port-au-Prince Bay specimens, all possessing, however, the detached first anal spine which Gilbert (1900) made a distinguishing character of his genus *Brannerella*. All of these specimens were males, as proven by dissection. The Porto Rican specimens upon which the species was based were evidently, therefore, all females.

Evermann and Marsh mention of their specimens that they possess a single row of teeth in each jaw. Our specimens have the outer rows of cardiform teeth and inner band of villiform teeth mentioned by Gilbert for *Brannerella*. In view of the difficulties of dissecting these small fishes and of the fewness of specimens it is possible that the inner teeth of the Culebra specimens were overlooked. It is of interest to note that Evermann and Marsh recognized that their three specimens were different from other Porto Rican specimens of *Malacoctenus*, as they say "A rather plainly marked species of different aspect from other Porto Rican species of *Malacoctenus*, but not differing widely in any important characters and as yet known only from Porto Rico."

SIZE: Our largest specimens are about 32 mm. in length. The type of *culebrae* was 1.38 inches (34.5 mm.).

COLOR: Our preserved (alcoholic and formalin) specimens vary considerably in intensity of coloring, but agree in possessing all of the essential patterns mentioned in the original description. The following description is based on Evermann and Marsh's description and our specimens:

Body brownish, with lighter rivulations and mottled everywhere with dark brown blotches. A series of 8 to 10 dark blotches, rather regularly arranged

on the body along the base of the dorsal fin, extending on the lower portion of the fin, where occasionally each one divides and forms two black blotches; these blotches sometimes join with blotches on the body to form broken vertical bars on the sides. A similar series of dark blotches along the base of the anal fin, not evident in all specimens. Head nearly plain below but with some darker spots on the chin and on the isthmus; two pale streaks from the eye across the cheek, divided posteriorly on the opercle so as to form an irregular Y-shaped figure; opercle dark brown; top of head colored same as body; lips with brown and pale stripes; posterior half of the maxillary pale; dorsal fin rather dark, sometimes with a conspicuous dark spot on the membrane between the 1st and 2nd spines and occasionally with pale tips to the spines. Caudal fin uniform gray or faintly barred; anal fin similar to the dorsal in color, the rays with pale tips forming a white edge, sometimes with a dark narrow subterminal band, joined here and there to the spots at the base of the body; pectoral fin same as caudal; two or three small dark spots at base of pectoral; ventrals pale. Two dark spots near the base of the caudal fin are very conspicuous in practically all of our fish.

A 10.6 mm. fish in the collection most likely belongs to this species, although the pattern on the head is different from the older ones. The rather narrow light line passing upward and back from the eye, as shown in the illustration in the "Fishes of Porto Rico" is, in this fish, very wide and continues backward over the nape to meet its fellow. It is bordered below by broken brown spots. The top of the head from this line forward to a line above the middle of the eyes is dark brown. The following patterns are also found; a broad band of brown from the eye to the maxillary and a few odd spots of brown on the lips. Two dark brown spots on the base of the pectoral. Sides with three series of vertical rectangular brown spots, the uppermost extending onto the dorsal fin, the lowermost not reaching the anal base. Wherever space is available on the body, these rectangles send downward or upward as the case may be, an attenuated band of chromatophores. Dorsal fin with a series of spots, mostly following the rays. Anal fin with nine spots of blackish. Pectoral, ventral and caudal fins clear.

General Range: Porto Rico, Curacoa and Haiti.

Occurrence in Port-au-Prince Bay: Found along shore and on the various shallower reefs, especially among low weeds and in broken coral.

Abundance: Quite common.

Study Material: Photograph, 4487; Specimens, 18; 10.6–32 mm., including Nos. 7066, 7086, 7151, 7261a and 7278. Sand Cay, Bizoton Reef, and Lamentin Reefs, Port-au-Prince Bay.

Cremnobates Günther, 1861

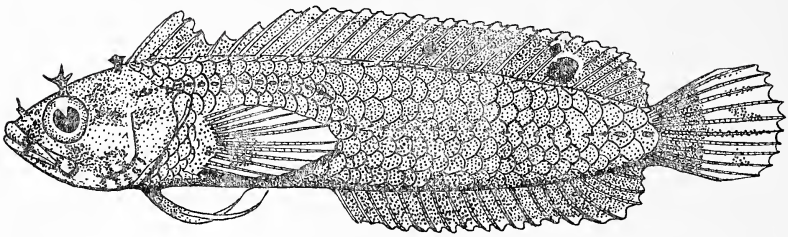
Key to Port-au-Prince Bay Species

A. Basal third of caudal dark, dorsal fin with 3 ocelli. . . . *argus* new species

AA. A bar on body at base of caudal, but not extending on fin; reddish with darker vertical bars extending on the fin, a single ocellus on dorsal fin. *fajardo*

Tri-ocellated Blenny

Cremnobates argus, new species



Type: No. 7375, Length 22 mm., Lamentin Reef, Port-au-Prince Bay, Haiti. Found among coral debris in shallow water on inside of reef.

Field Characters: Very small, compressed, elongated blennies, brown body and fins mottled with darker; three ocelli on dorsal, posterior two-thirds of caudal whitish; narial cirri simple truncate flap, ocular cirrus branched, nuchal cirri flat, leaf-like.

Measurements and Counts:

Length: 22.5 mm.
Head: 6.7 (3.3)
Depth: 4.8 (4.7)
Eye: 1.7 (4)
Interorbital: 1 (6.7)
Snout: 1.2 (5.5)
Maxillary: 3 (2.2)

Dorsal fin: III–XXVII
Anal fin: II–17
Pectoral length: 5
Ventral length: 4.3
Ocular angle: 20° up
Mouth angle: 30° down
Scales: 34
Lateral line pores: 34

Description:

Body: Elongate, compressed.

Back: Very slightly elevated.

Anterior profile: Gently curved from snout to dorsal.

Head: Depth less than three-fifths of length.

Interorbital: Flattened; slightly more than half of eye.

Snout: Very slightly convex.

Nares: Posterior nares in slightly raised rim, close to antero-superior edge of eye; anterior nares in elevated tubes nearer lips than to anterior nares.

Cirri: Narial cirrus a simple truncate flap rising from posterior half of anterior nasal tubes, equal to the tubes in height; ocular cirri close to postero-superior rim of eye, each a transverse, flat flap narrowing to an elongated point, with two internal branches, the uppermost the larger; nuchal cirri rising on a short narrow stem, expanding at once into a broad, triangular leaflike shape, topped with three slightly marked points. The two anterior pairs of cirri are pale mottled brown, the nuchals are black, with a wide white border like the vertical fins.

Eye: Large, not cutting profile, iris pink.

Mouth: Rather large, oblique.

Maxillary: Not quite reaching the posterior border of the eye.

Teeth: Several rows of villiform bands, narrowing to one row along the sides; vomer with horseshoe shaped patch of very small teeth.

Preopercular margin: Almost straight and vertical, curved below.

Opercular margin: Smooth, extending obliquely backward, a deep bay at the top ending in a blunt spine.

Scales: Large, smooth, rounded, with thin fleshy rims which curl outward on drying.

Lateral line: Well marked, following the dorsal outline, and curving steeply downward to the mid-line at the extremity of the pectoral; the pores lie in the center of deep notched scales.

Dorsal Fin: Spines only; relative length of anterior seven spines—2.1, 2.1, 1.5, 1.3, 1.9, 2.2, 2.4, mm., and so on to end; the extent of the membrane of the anterior part of the dorsal as follows—membrane of 3rd spine attached halfway up on 4th, 4th halfway up 5th, 5th two-thirds up 6th, remainder attached at tips.

Caudal Fin: Rounded, shorter than depth of body.

Color: Body brown, mottled with darker along sides and below; vertical fins darker than body, mottled with black, and with a wide, white margin; dorsal with three ocelli, a small one centered on the 16th spine (total dorsal count), another three times as large and white-ringed between the 23rd and 25th spines, a third equal in size to the anterior one close to the antero-superior border of the large ocellus; caudal dark brown for basal third, then a clear zone, followed by a wider area mottled along the rays, and a wider, white terminal band; pectoral light, with a large, dark, sub-basal patch on lower half; ventrals dark on basal half, white for the rest; head mottled in two shades of brown, three wide, irregular bands extending up and back from the eye across nape and opercles; snout and chin with many large dark spots.

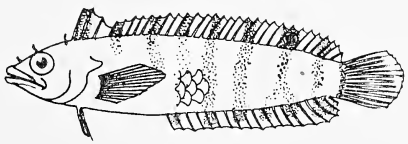
Comparison: This fish is nearest to *albicaudatus*, named by Evermann and Marsh from a single specimen taken in Porto Rico. Our Haitian specimen differs in the less depth, shorter snout and narrower interorbital, in the spotting and banding of the head, in the presence of three dorsal ocelli, the deeper notch between dorsal fins, differently colored caudal, and in the wholly different character of cephalic cirri.

Study Material: Photographs, 4501, 4502 and 4502a; Specimen, 1; Type No. 7375.

Type Name and Location: Named on account of the three dorsal ocelli. Type in the Collection of the Department of Tropical Research of the New York Zoological Society.

Fajardo Blenny

Cremnobates fajardo (Evermann and Marsh)



References: *Auchenopterus fajardo*, Evermann and Marsh, 1899, Rep. U. S. Fish Comm., p. 361.

Auchenopterus fajardo, Evermann and Marsh, 1902, Fishes of Porto Rico, p. 313, pl. 47.

Field Characters: Small, compressed scaled blennies with a single ray only in the dorsal fin in addition to the spines; lateral line complete. Reddish, mottled, with darker cross bars extending on the dorsal and anal fins. An ocellus present on the dorsal in some specimens.

Size: Grows to 1.6 inches.

Color: This species, judging by the specimens in the Haitian collection, varies considerably, the variation being mainly in the intensity of color, especially in the vertical bars which extend from the body onto the dorsal and anal fins.

Our specimens agree better with the description given by Evermann and Marsh than with their figure. But as they had but a single specimen a certain amount of latitude is allowable. In the Haitian fish the sides are usually mottled, often with pale pinkish or whitish spots. All possess the vertical bars on the body which extend onto the dorsal and anal fins, the intensity of this pattern, varying, however, to such an extent that in some the bars are scarcely visible, while in the most vividly colored (alcoholic) fish, the bars are bright brown anteriorly becoming darker posteriorly and finally black, all of the bars on the anal fin being black. Conspicuous in this specimen is the last body bar, placed at the base of the caudal, which is black. The dorsal ocellus is not present in all specimens. It varies in intensity of color. Its absence may possibly be laid to preservation.

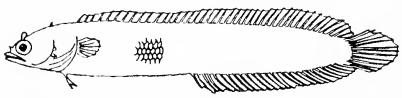
General Range: Known from Porto Rico, Bahamas and Haiti.

Occurrence in Port-au-Prince Bay: Found by us in shallow water among weeds and small coral masses.

Abundance: Uncommon, but always to be found when especially searched for.

Study Material: Photographs, 4493, 4494; Specimens, 11; including Nos. 6852, 7254 and 7279.

Auchenistius Evermann and Marsh, 1899



Green Thalassia Blenny
Auchenistius stahli Evermann and Marsh

References: *Auchenistius stahli,* Evermann and Marsh, 1899, Rept. U. S. Fish Commission, p. 359.
Auchenistius stahli, Evermann and Marsh, 1902, Fishes of Porto Rico, p. 316, fig. 102.

Field Characters: Very small, greenish, scaled, blennies without lateral line. Dorsal fin composed entirely of spines, the spines becoming smaller posteriorly. Membrane of dorsal and anal connected with caudal. Pectoral fin small. Green, a golden spot behind and below eye.

Description: 32 specimens are assigned to this species, the only difference, outside of color which is mentioned below, between our specimens and the figure and original description being that the lips in a few of the Haitian fish are larger, and more swollen, and the maxillary sometimes extends beyond

the eyes. This is especially true of the more brilliantly colored specimens, and it is possible that it may be a sexual or age character. In all other characters, including teeth, these specimens agree fully. It may be mentioned here that Metzelaar's (1919) new genus and species, *Histioclinus veliger*, resembles this species closely. Very dark specimens of our blennies practically duplicate the color pattern of his fish, the only difference being that *Histioclinus* does not possess the small inner teeth of the upper jaw and the vomerine teeth of *Auchenistius*, and that the dorsal fin has rays instead of spines. Metzelaar's figure shows considerably smaller scales than *Auchenistius*, although the number of rows according to the description is practically the same (58–60). The measurements given in his description do not coincide with his drawings and the two drawings appear to be of different fish.

The supra-orbital tentacle in our fishes, except in the smaller specimens, is paddle-shaped.

Color: In life clear yellow green. A short, oblong patch of gold, back and down from eye halfway to preopercular margin. Iris golden.

The preserved specimens vary considerably in color, especially in the distribution of the chromatophores. The general body color is gray or faded yellowish, a few having a reddish tinge. A constant feature in all our specimens is a yellowish or whitish bar below and in back of the eye, this being golden in life. This is bordered above and below by brownish, the extent of which varies considerably, sometimes being suffused over the entire cheek, and at other times concentrated into a short dark bar immediately above and below the golden bar. This pattern is well shown in Metzelaar's figure of *Histioclinus veliger*.

There is also considerable variation in general body coloration. Some or most or all of the following patterns may be present,—pigment spots, black and brown, irregularly placed on body, in one case forming apparent cross-bars; 1, 2, or 3 cross-bars on ventral fins; spots on anal fin, especially near the tips of the posterior rays; caudal fin with pigment spots; lower jaw with a series of spots; dorsal and anal fin with a terminal black band, in one specimen this band is subterminal.

General Range. Known heretofore only from Porto Rico and the Bahamas.

Occurrence in Port-au-Prince Bay: Widely distributed over the shallower coral reefs and also in the weed (*Thalassia*) on the beaches along-shore, a fact which caused us in the field to name this fish the Green Thalassia Blenny.

Abundance: Common, always to be found when searched for among corals and weeds.

Method of Capture: Mainly by searching carefully among coral debris brought up from bottom, and from weed beds dug up bodily and brought to the surface.

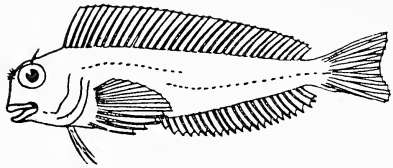
Study Material: Color Plate, H75, No. 7085a; Photographs, 4231, 4232; Specimens, 33; 12.5 to 24 mm., including Nos. 7085a, 7112, 7151, 7261, 7278, 7279.

Family Blennidae; Blennies

A. Teeth comb-shaped, in a single row in each jaw, behind which on each side is a single canine. Snout very short..... *Rupiscartes*

AA. Jaws each with 4 strong canines in front; a hooked posterior canine below. *Ophioblennius*

Rupiscartes Swainson, 1839



Rock-hopping Blenny
Rupiscartes atlanticus (Cuvier and Valenciennes)

REFERENCES: *Salarias atlanticus*, Cuvier and Valenciennes, 1836, Hist. Nat. Poiss., XI, p. 321.
Rupiscartes atlanticus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 948.

FIELD CHARACTERS: Small, compressed, naked blennies, with extremely short snout (pug-nosed); teeth on front jaws movable; a large posterior canine on each side inside of anterior row of teeth; vomer toothless; dorsal fin continuous.

DESCRIPTION: Our single fish has the dorsal fin count of XI–20, and the anal 22. In all other respects this fish agrees with the published descriptions of the species. The Haitian fish had none of the peculiarities of coloring that Sylvester's *Alticus macclurei* of similar size showed. Fowler (1920) considers *macclurei* to be a young stage of this species.

GENERAL RANGE: Atlantic, West Indies to Brazil and Ascension Island; Pacific, Mazatlan to Ecuador and Chatham Island.

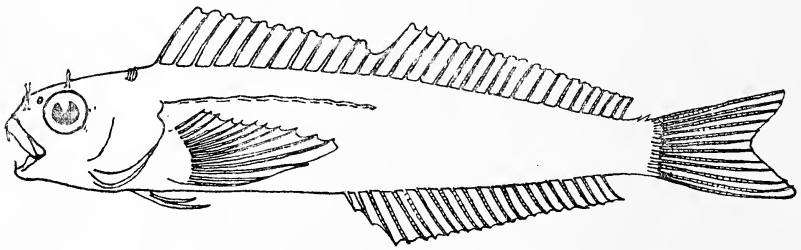
OCCURRENCE IN PORT-AU-PRINCE BAY: Our single fish was taken at Sand Cay by trap.

FOOD: The alimentary canal contained organic detritus only, apparently of both animal and vegetable origin.

STUDY MATERIAL: Photograph, 4492; Specimen, 1; 68.5 mm., No. 6888.

Ophioblennius Gill, 1860

Haitian Snake Blenny
Ophioblennius ferox new species



TYPE: No. 7152. Length 43 mm. Taken at light alongside schooner, at night, near Bizoton, Port-au-Prince Bay, Haiti, April 6th, 1927.

Field Characters: Small, elongate, strongly compressed, scaleless blennies, with incomplete lateral line; snout very short; jaws with four large, recurved fangs in front, above and below, two more halfway back on mandibles, and a row of elongate movable teeth on sides of upper jaw.

Measurements and Counts:

Length: 43 mm.
Head: 10.6 (4)
Depth: 8.3 (5.1)
Eye: 3 (3.5)
Interorbital: 2 (1.5)
Snout: 3 (3.5)
Maxillary: 3.7 (2.8)

Dorsal fin: XII–20
Anal fin: II–21
Pectoral length: 11 mm.
Ventral length: 6 mm.
Ocular angle: Vertical
Mouth angle: 30° down
Scales: None

Description:

Body: Low, much elongated, compressed.

Back: Scarcely elevated.

Anterior profile: Straight from dorsal to forward part of eye, thence curved to snout.

Head: Large, almost as deep as long.

Interorbital: Convex.

Snout: Short, abruptly curved downward, very convex.

Nares: Posterior with slight rim, anterior twice diameter of the other and with short tube.

Cirri: Narial cirrus, a flat, six-fingered, handlike tentacle, with the wrist arising from inner side of nasal tube; ocular cirrus a simple, tapering tentacle, less than half diameter of eye; nuchal cirrus, two short tentacles arising close together, halfway between dorsal fin and eye.

Eye: Large, below profile.

Mouth: Moderate, oblique, terminal.

Maxillary: Reaching to first fifth of eyeball.

Teeth: Four large teeth close to premaxillary symphysis, the inner pair directed obliquely toward each other, the outer pair recurved, fanglike; lateral teeth elongate, palisade-like, movable; four teeth in front of lower jaw, the inner pair curved back almost into a semicircle, the outer pointing low, sideways, along the line of the jaw; halfway to gape on the mandible, two isolated recurved teeth, the posterior one much the largest tooth in the mouth.

Opercular margin: Smooth, curved, a small bay at the top.

Scales: Absent.

Lateral Line: Incomplete; beginning at postero-superior edge of opercle, and following line of back to vertical of 14th dorsal element.

Dorsal fin: Long, the spines slender, separated by slight notch from soft rays.

Caudal: Forked.

Color: The preserved specimens are almost colorless, one paratype showing traces of ten, vertical dark bands down the sides; there is considerable dark pigment along the dorsal fin base, on the top of the head and the lips; several faint bands radiate from the eye back over the opercles.

Comparison: Differs from *webbii* in longer head, two fangs on mid-mandible,

in shape and position of anterior fangs, presence of nuchal tentacles, in pigmentation, and greater number of dorsal and anal elements.

From *trinitatis* it may be distinguished by a lesser depth of body, wholly different coloration, much fewer dorsal elements and much narrower interorbital space.

Study Material: Photographs, 4497 and 4499; Specimens, 3; 40–43 mm. Type and two paratypes, Nos. 7152 and 7152a.

Type Name and Locality: Named from the large, recurved fangs. Type is in the Collection of the Department of Tropical Research of the New York Zoological Society.

Family Emblemariidae [1]

Acanthemblemaria Metzelaar, 1919

Key to species

(A. A few villiform teeth behind the front row in the lower jaw only; color olivaceous with traces of dusky crossbands, finely punctulate with innumerable brown dots.....*spinosa* Metzelaar, extralimital)

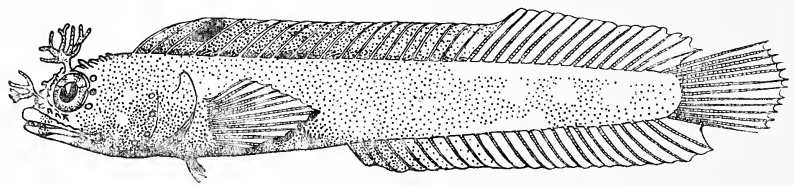
AA. Small teeth behind the outer in both upper and lower jaws.

B. Profile evenly curved from snout to dorsal fin. A conspicuous black spot on membranes between the third and fourth dorsal spines. Supraocular tentacle very large and with many branches; center of top of head not spined.....*arborescens* new species

BB. Profile straight from dorsal fin to above eye, than angled and descending straight to snout. Color variegated; no black spot on dorsal fin. Supraocular tentacles small, with very short branches if any. Top of head scaled almost to nape.....*variegata* new species

Bushy-headed Spiny Blenny

Acanthemblemaria arborescens new species



Type: No. 6923, 22 mm. length, Lamentin Reefs, Port-au-Prince Bay, February 22, 1927.

Field Characters: Very small, scaleless blennies with front of the head covered with small spines; a large multifid tentacle over the eye and another on the snout; a conspicuous black spot on membranes between the 3rd and 4th dorsal spines.

[1] The genera *Acanthemblemaria* and *Stathmonotus* are assigned to the families *Emblemariidae* and *Chaenopsidae* respectively in this paper, following Jordan's "Classification of Fishes." We are not at all certain that this is correct, but we are letting the genera remain so until further studies can be made.

Measurements and Counts of the Type:

Length: 22 mm.	Dorsal fin: XX–15
Depth: 3.2 (6.9)	Anal fin: II–23
Head: 6 (3.66)	Pectoral fin: 13
Eye: 1.23 (4.85)	Ventral fin: 3
Snout: 1.23 (4.85)	Scales absent
Maxillary: 2.8 (2.14)	Lateral line absent

Description:

Body: Elongate, compressed, tapering and becoming more compressed from the posterior portion of the head backward; greatest depth at the origin of the dorsal fin; upper and lower profiles of trunk similar.

Profile of Head: Upper surface (exclusive of spines) descends in a gradual curve from the origin of the dorsal fin to the snout.

Head: 3.66 in length, more heavily built than the trunk, almost as broad as high. The difference in depth of head, body and tail shown in Metzelaar's *spinosa* not apparent in our fish.

A series of short, strong, forward-pointing spines on the head, exclusive of the cheeks, opercles and occipital regions, these strongest on the supraorbital ridge, and continued in a short triangular patch backward and above the eye. The spines are also found around the eye on its anterior border, on the snout and below the eye. On the posterior border of the eye the spines are absent but their place is taken by a broad bony ridge.

A large multifid tentacle over the eye, its length greater than the diameter of the orbit. A smaller multifid tentacle on the anterior nostril, its length about equal to eye.

Interorbital space: Concave, because of supraorbital ridges, slightly greater in width than half the diameter of the orbit.

Snout: Short, equal to eye when protuberant lip is measured.

Eye: 4.85 in head, situated in anterior part of the head, fairly high.

Mouth: Terminal, slightly oblique; the lips, especially the upper somewhat swollen; maxillary reaches beyond eye, 2.14 in head.

Teeth: (Paratype dissected) Upper jaw with a band of strong, pointed, inwardly-directed teeth, strongest anteriorly and becoming progressively shorter on the sides. Inside of this row anteriorly there is a band of much smaller pointed teeth. Mandible with a similar series of teeth, the inner teeth in a band anteriorly. Vomer and palatines strongly toothed.

Opercles: Smooth; a series of widely spaced pores on the preopercle.

Dorsal Fin: Continuous, the last ray connected to the caudal fin by a large delicate membrane, the fin originating about an eye's diameter back of the eye, immediately in back of the occipital region; the rays slightly longer than the spines. Space between the 3rd and 4th spines wider than remaining spaces.

Metzelaar's figure of *spinosa* the only other species of this genus, and his description show only rays in the dorsal and anal fins. In damaged specimens of *arborescens* and *variegata*, the spines are difficult to differentiate and might easily be called rays. Evidently the same condition is to be found in the related genus *Emblemaria*, as reference to Jordan and Evermann's "Fishes of North and Middle America" show that some of the species are supposed to possess

spines and others have only rays. It is felt that reexamination of some of these species will reveal that spines are present, although they are weak and flexible.

Anal Fin: Arises under 13th dorsal spine, rather low anteriorly, the rays longer posteriorly and connected to the caudal fin by a thin membrane.

Pectoral Fin: 13 to 14 rays, originating close to the opercle, its base with a slightly backward slant below; length of fin 1.6 to 1.7 in head.

Ventral Fins: Very small, I–2, inserted anterior to pectoral base.

Caudal Fin: Rather elongate, equal to slightly more than ½ the head in length; roughly truncate, the outer rays but little shorter than the middle ones.

Color: (In life) General color of body tan, becoming paler posteriorly, and changing to dull blackish brown on lower anterior sides, especially on lower sides of head; the entire body heavily punctate with small black and reddish chromatophores, more marked anteriorly. A series of small whitish spots on cheeks and anterior part of the body. Supraocular and nasal tentacles as well as the spines on the head yellowish, the tentacles with minute black dots. Anterior portion of lips yellowish, with an indistinct vertical band of black dots followed by a white band on the middle of the lips. Dorsal fin membrane yellowish as far back as the 20th spine, the spines with vertical orange spots here and there, the membrane heavily pigmented basally and with a black semi-ocellus between the 3rd and 4th spines, the ocellus bordered below by a narrow white band beneath which is a broader pinkish one. Remainder of dorsal fin, the pectoral, caudal and anal rays pinkish, the anterior five membranes of the anal fin punctate.

(Alcoholic specimen) Olivaceous, pale and almost immaculate posteriorly, with small brownish punctations increasing in number anteriorly until the belly and most of the head, especially the lower parts, are closely pigmented. No traces of cross bands. Dorsal fin heavily pigmented anteriorly, especially the base, the fin with a pale margin. Posterior half of dorsal, and all other fins hyaline.

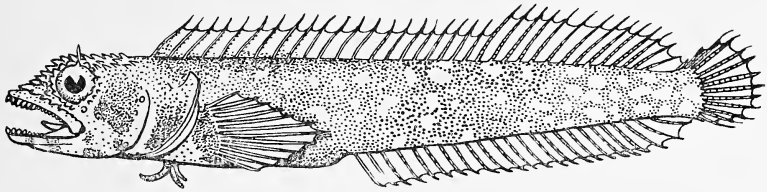
Comparison: This species differs from *spinosa*, the only species of the genus described heretofore, in teeth, smaller eye and greatly in color. It can be separated from the following species most easily by the presence of its large conspicuous, multifid supraocular tentacle, as well as in color, and in the shape of the anterior profile.

Study Material: Color Plate, H42 (the type in life); Photographs, 4482, 4484; Specimens, 4; all from same locality;—No. 6923, type, Lamentin Reef, Port-au-Prince Bay, February 22, 1927; 1 paratype, No. 7201, 20 mm., April 22, 1927; 2 paratypes, No. 7278, May 9, 1927.

Type Name and Location: *arborescens*,—in allusion to the remarkable nasal and supra-ocular tree-like tentacles. Types and paratypes in the collections of the Department of Tropical Research of the New York Zoological Society.

Variegated Spiny-headed Blenny

Acanthemblemaria variegata new species



Type: No. 7464, 25.2 mm. long, Lamentin Reef, Port-au-Prince Bay, May 8, 1927. Taken from inner side of reef in two feet of water.

Field Characters: Very small, scaleless blennies with top and front of head covered with short spines; a single simple cirrus over eye; brown mottled with lighter; lower jaw and chin with black spots.

Measurements and Counts of Type:

Length: 25.2 mm.
Depth: 4.1 (6.15)
Head: 7 (3.6)
Eye: 1.5 (4.65)
Snout: 1.5 (4.65)
Maxillary: 3 (2.3)
Interorbital space: 1.8 (3.9)

Dorsal fin: XXI–14
Anal fin: II–22
Pectoral fin: 13
Ventral fin: 3
Scales absent
Lateral line absent

Description:

Body: Elongate, the trunk compressed, dorsal and ventral outlines similar, but abdomen rather heavy, a distinct angle at the vent.

Anterior profile: Horizontal from origin of dorsal fin to over middle of eye, then curved and descending in a straight line to the snout.

Head: 3.6 in length, about as wide as deep. Top of head to almost as far back as origin of dorsal fin, snout, suborbital region and region immediately posterior to eye, covered with short, strong, forward-pointing spines. These spines form a ring around the eye, the posterior ones shorter and blunter than the others. A very short blunt cirrus over each eye. Nuchal tentacles absent.

Interorbital Space: Concave, because of circumorbital spines, densely covered with spines, its width (including spines) slightly greater than diameter of eye.

Snout: Short, about equal to diameter of eye.

Eye: 4.65 in head, placed forward and high, but not entering the dorsal profile.

Mouth: Terminal, slightly oblique, the maxillary not quite reaching the posterior border of the eye.

Teeth: Both jaws with an outer row of strong inwardly-pointing teeth, the anterior ones much stronger and larger than the others. Inside of the large row in both jaws there is a band of smaller teeth anteriorly. Posterior to the group of smaller teeth the outer row of each side come closer to each other; they then gradually separate again. The general appearance of the lower jaw when viewed from above is that of an old fashioned key-hole.

Opercles: Smooth, rounded, the preopercular margin with a series of mucus pores.

Dorsal Fin: (XX–13 to XXI–15 in paratypes), the spines slightly shorter than the rays, the fin arising over the insertion of the preopercle. Posteriorly it is connected to the caudal peduncle by a membrane which barely touches the caudal rays.

Anal Fin: (II–21 to II–23 in the paratypes) similar to dorsal, arising beneath the space between the 12th and 13th dorsal spines.

Caudal fin: Short, equal to snout and eye, rather high and broadly rounded.

Pectoral Fins: 13 rays, its base broad, equal to snout and one third the eye.

Pelvic Fins: Small, placed under center of the opercle.

Color: In life, opercles pinkish cinnamon, dotted less densely above but becoming almost solid snuff brown below. Posterior edge of preopercle and whole of opercle sparsely stained with bluish white. Short area behind the nape pinkish cinnamon, dotted with snuff brown, this color also extending on the gill covers below. Three dark cross bars across the lower jaw.

Body complexly colored, but in general the ground color is greenish yellow, almost wholly obscured by brownish dots. Along the base of the dorsal are, from nape to caudal, about 12, fairly well marked, large spots of rufus; ten somewhat larger ones along the belly and an irregularly indicated band along the mid sides, all rufus or ferrugineus. The body, from the opercles including the pectoral pad to the anal fin, is sparsely stained with white. The posterior half of the body shows irregular areas rather paler than the rest of the ground color. The anterior 3 or 4 dorsal spines are golden green, the remainder rufus, the anterior 8 or 9 spines being dotted with brown. Pectoral and anal fins greenish, caudal colorless, but with 3 small black spots on upper and lower margins.

The type, in alcohol, is colored as follows: Entire trunk and head heavily covered with brown chromatophores, the chromatophores being found in irregularly-shaped patches, leaving the pale yellowish ground color and producing a mottled effect, these mottlings more marked along the base of the anal fin, leaving a series of more or less regularly spaced yellowish spots. The opercles are more completely covered with chromatophores, and possess an especially well-marked patch behind the eye on the preopercle. Lower jaw with three transverse, conspicuous brown bands; a brown spot on the branchiostegal rays. All fins hyaline, the rays with a few dark punctulations. Caudal fin with three small black spots near the tips of the rays, on its upper and lower margins.

Variation: The nine paratypes vary very slightly in form. In color, as might be expected among fishes that live inside of crevices and holes in coral, our specimens vary greatly, and the one extreme specimen was at first set aside to be described as a new species.

The type, the largest specimen of the series, is also the most brilliantly colored. The paratypes differ in that the mottled coloration of the sides has taken a more definite form, and is present in some specimens as a series of vertical dark bands, each two of which are roughly connected dorsally and ventrally. In others, the color is concentrated in a series of spots along the base of the anal, along the middle of the sides and sometimes at the base of the dorsal. The spots and lines on the lower jaw are always present to some degree, while the small spots on the upper and lower rays of the caudal are

sometimes absent. The myomeres are often marked with dark lines of pigment.

The one extreme specimen, mentioned above, agrees in proportions, disposition of spines, profile, etc. but its body is deep uniform blackish brown in color, with the spots on the caudal fin quite marked. In this specimen pigment is present along the dorsal and anal rays to such an extent that the rays appear to be thickened. However, a few of the other paratypes approach this condition, and as the specimen is not separable on other grounds we are considering it as a melanistic specimen of a variable species.

Comparison: Differs from *arborescens* in degree of armature of the head, the dorsal profile and markedly in color. From *spinosa* it differs in being less deep, in having simpler supraocular cirri, shorter rounded caudal fin and, comparing equal sized specimens, in color.

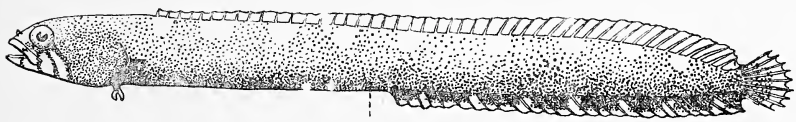
Study Material: Photographs 4483, 4500; Specimens, 10; 1, type, No. 7464, Lamentin Reef, Port-au-Prince Bay, May 8, 1927, and 9 paratypes, 14–23 mm. long, including Nos. 7098, 7195 (melanistic specimen) 7261, 7261a, 7278, 7278a, 7454,—all from worm-holes, coral and from among the branches of *Halimeda*-like coral, Sand Cay and Lamentin Reef, Port-au-Prince Bay, March 24 to May 9th, 1927.

Family Chaenopsidae

Stathmonotus Bean, 1885

Coral Scaleless Blenny

Stathmonotus corallicola new species



Type: No. 7463, 21 mm. length, Lamentin Reef, Port-au-Prince Bay, April 22, 1927, taken from worm holes in old broken coral submerged about a foot.

Field Characters: Very small, longate, scaleless blennies, with long continuous dorsal fin composed of spines only; pectoral and ventral fins very small; a series of black and white bars on chin; anal fin with regular white vertical bars, the fin with a narrow pale border.

Measurements and Counts:

Length: 21 mm.
Depth: 2.1 (10)
Head: 3.4 (6.)
Eye: .78 (4.35)
Snout: .45 (7.8)

Dorsal fin: XLVII
Anal fin: II–25
Pectoral: 5 to 6
Scales absent
Lateral line absent

Description:

Body: Rather long, considerably compressed, especially posteriorly, dorsal and ventral profiles about equally curved.

Anterior Profile: Straight from dorsal fin to above eye, then gently curved to snout.

Head: Rather small, 6.2 in the length.

Interorbital Space: Narrow, flat, less than ½ the width of the eye.

Snout: Conical, shorter than eye.

Eye: Small, 4.35 in head, placed far forward and high in the head, but not entering the dorsal profile.

Mouth: Slightly oblique; jaws equal: the maxillary reaching to posterior border of the pupil.

Teeth: Upper jaw with two rows of pointed teeth, the outer enlarged, the anterior ones largest. Lower jaw with two rows of teeth, the outer enlarged. A few teeth on the vomer.

Opercles: smooth.

Anus: Under 18th dorsal spine.

Dorsal Fin: XLVII, long, continuous, formed entirely of spines which are short anteriorly and become longer posteriorly, beginning over the posterior tip of the pectoral fin, and joined to the caudal fin by membrane.

Anal fin: II, 25, the posterior rays slightly longer. The two spines are as long as the anterior rays and are included in the membrane of that fin, not short and separated as in the illustration of *hemphilli*.

Caudal Fin: Rounded, equal in length to depth of fish.

Pectoral Fin: Extremely small and short, situated at posterior border of opercle, and consisting of about 5 rays.

Ventral Fins: Extremely short and small; situated anterior to pectoral base, consisting of 1 spine and 2 rays.

Color: (Alcoholic specimen) Grayish brown with indications of about 10 indistinct pale areas on the upper surfaces, extending about ⅓ way down the sides. Scattered through the gray brown are very small pale dots, largest and most conspicuous on the cheeks. (These dots are formed by the absence of the darker chromatophores and those on the body are not discernable without a lens.) Snout and anterior part of head pale. Four radiating dark lines extend downward and backward from the eye, meeting their fellows from the opposite side of the head on the lower part of the head. Dorsal fin hyaline. Bases of caudal, pectoral and ventral fins dark. Anal fin dark with 7 white squarish spots, and with its lower edge pale.

Comparison: This species differs mainly in color, and slightly in fin count and proportions from *hemphilli*.

Study Material: Photographs, 4491, 4495; Specimens, 1; 21 mm., No. 7463, Lamentin Reefs, Port-au-Prince Bay, April 22, 1927.

Type Name and Location: *corallicola*, in allusion to the fish being found inside of coral.

Type in the collection of the Department of Tropical Research of the New York Zoological Society.

Family Ophidiidae; the Cusk-Eels

Lepophidium Gill, 1863

Black-finned Cusk Eel
Lepophidium brevibarbe (Cuvier)

References: *Ophidion brevibarbe*, Cuvier, 1829, Regne Animal, Ed. 2, Vol. II, p. 358.
Lepophidium brevibarbe, Nichols and Breder, 1922, Proc. Biol. Soc. Wash., 35, p. 13, fig. 1.

Field Characters: Elongate, somewhat compressed, tapering, eel-like fish with dorsal and anal fins confluent around the tail; head scaly as far as forehead; snout with a decurved hook; gill rakers 4 in number; scales very small; dorsal and anal fin with a black margin.

Description: A single 209 mm. fish is placed under this species, differing from Nichol's and Breder's redescription of the species in having longer ventral filaments, 2.4 in head. It agrees well in all other characters.

Size and Weight: A 209 mm. fish weighed 48 grams.

General Range: West Indies, Gulf of Mexico and Brazil.

Study Material: Specimen, 1; 209 mm., No. 7059.

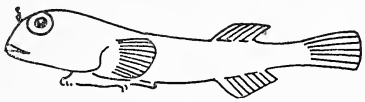
Family Gobiesocidae; the Cling-Fishes

Key to Port-au-Prince Bay Genera

A. Incisors of lower jaw with entire edges.....*Gobiesox*
AA. Incisors of lower jaw tricuspid or serrate.....*Arbaciosa*

Gobiesox Lacépède, 1799

Large-eyed Clingfish
Gobiesox macrophthalmus Günther



References: *Gobiesox macrophthalmus*, Günther, 1861, Cat. Fishes Brit. Museum, III, p. 502.
Gobiesox macrophthalmus, Jordan and Evermann, 1898, Fishes of North and Middle America, III, p. 2335.

Field Characters: Small, rather elongate fishes, broad and depressed in front; a large sucking disk on ventral surface, formed of part of the body as well as the ventral fins. Incisor teeth without serrations. Coloration reddish.

Description: Seven very small fish (8–14 mm. long) are placed under this species, but with considerable hesitation. In most of our fish the teeth are not evident, and even when they are the determinations are extremely doubtful. The status of the Haitian Gobiesocids must be left until larger specimens are secured, and until the West Indian species are worked over.

General Range: St. Thomas, Haiti.

Occurrence in Port-au-Prince Bay: Taken from coral heads in Lamentin Reef in water two to three feet deep.

Abundance: Uncommon.

Method of Capture: Taken by lifting old coral and coral heads into seines, breaking up the coral and searching through the debris.

Study Material: Specimens, 7; 8–14 mm., No. 7279.

Arbaciosa Jordan and Evermann, 1896

Key to Port-au-Prince Bay Species

A. Color yellow-green with dark vertical bands on sides.....*rupestris*
AA. Color red.....*sp.*

Rock-living Clingfish
Arbaciosa rupestris (Poey)

References: *Gobiesox rupestris*, Poey, 1861, Memorias, II, p. 283.
Arbaciosa rupestris, Jordan and Evermann, 1898, Fishes of North and Middle America, III, p. 2341.

Field Characters: Small fish with anterior part of the body depressed; under surfaces with a conspicuous sucking disk formed of part of the body as well as the ventral fins. Incisor teeth with serrations along their edges. Greenish, with vertical brownish bands on sides.

Description: The single Haitian fish, 12 mm. long, had 6 rays in the anal fin.

Size: Grows to 1½ inches.

Color: General color pale yellow green, upper surface of head with brownish reticulations, inside of which are paler greyish spots. Sides of body with nine vertical, irregular brownish bands thickly dotted with blackish chromatophores. The first and second, and the third and fourth bands are joined superiorly. The brown of these bands is continued across the upper surface as a broken line of dots. A rather wide brown band from eye to snout; a broad brown band directly below eye on suborbital, three additional brown bands radiating from eye to base of pectoral. Head with many black chromatophores, especially prominent along edges of brown lines. Belly and under sides white. Pectoral, anal, ventral and caudal fins, plain, translucent. Dorsal fin with a group of small black chromatophores on base of anterior rays and membranes.

General Range: Cuba, Bahamas and Haiti.

Occurrence in Port-au-Prince Bay: Taken in coral debris.

Abundance: Rare.

Method of Capture: Searching among weeds and broken coral.

Study Material: Specimens, 1; 12 mm., No. 7258.

Red Clingfish
Arbaciosa sp.

Note: Two specimens, 9.5 and 11 mm., differ from *rupestris* in color and

form. The incisors of the lower jaw are denticulated, but too slightly developed for adequate counting, while the teeth of the upper jaw are not visible.

Coloration in Preservative: Covered everywhere with a fine peppering of minute scarlet dots, except for two wide, pale, vertical bands in front of and behind the dorsal. Dorsal and anal fins each with three scarlet bars and two plain interspaces. Caudal with four scarlet bars and three plain interspaces.

Study Material: Specimens, 2; 9.5 and 11 mm., Nos. 7234 and 7255. Lamentin Reef, Port-au-Prince Bay.

Family Balistidae; the Trigger-Fishes

Key to Port-au-Prince Bay Genera

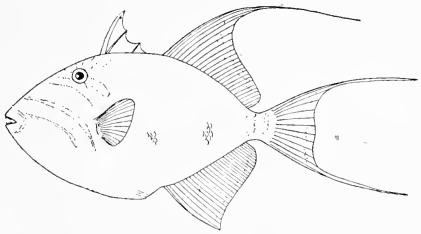
A. Gill opening with a number of enlarged bony plates or scutes behind it; eye with a groove before it; lateral line developed, not conspicuous, undulating ..... *Balistes*

AA. Gill opening without bony plates or scutes behind it; no groove before eye; lateral line absent..... *Canthidermis*

Balistes Linnaeus, 1758

Queen Trigger-fish; Old Wife; Old Wench; Bouze

Balistes vetula Linnaeus



References: *Balistes vetula*, Linnaeus, 1758, Systema Natura, p. 329.
Balistes vetula, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1703.

Field Characters: Medium-sized, compressed fish with small mouths; skin leathery but the scales very evident; dorsal fins separate, the 1st of 3 spines; the first spine much the longest and heaviest; dorsal and caudal fins with filamentous tips in the adult; cheeks with two broad curved bands of blue, and a series of smaller narrower bands above these.

General Range: Tropical parts of the Atlantic, occasionally north in the Gulf Stream to Woods Hole.

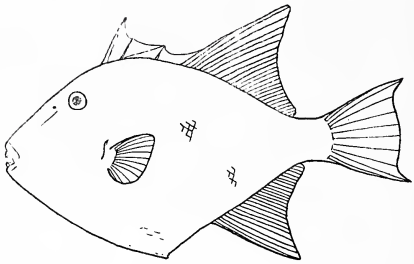
Size and Weight: Grows to 15 inches. A 166 mm. fish weighed 171 grams.

Abundance: Uncommon.

Food: Alimentary canal contained remains of *Thalassia* and small crustaceans.

Study Material: Specimens, 2; 166–300 mm., No. 7093.

Canthidermis Swainson, 1839



Ocean Trigger-fish; Sobaco
Canthidermis sobaco Poey

REFERENCES: *Canthidermis sobaco*, Poey, 1861, Memorias, II, p. 324.
Canthidermis sobaco, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1705.

FIELD CHARACTERS: Compressed, rather deep, leathery-skinned fishes, the scales of the trunk each with a median keel or spine; dark brown, the vertical fins dusky. Small specimens are mottled, green, and black, and yellow; the membrane of the spinous dorsal intense black.

DESCRIPTION: This species is included on the basis of one specimen, 29 mm. long, taken under Sargassum weed, on April 29th, 1927, in Port-au-Prince Bay. In the confused state of our knowledge of young specimens of *Canthidermis*, or for that matter of the adults, it is extremely difficult to identify them as accurately as is desired. The present specimen fits into *sobaco* slightly better than anything else. It bears comparison with a 67 mm. fish AMNH 3585 collected and identified by Mr. John T. Nichols as *sobaco*.

The relative dimensions of our 29 mm. fish are as follows:

Depth 1.5, head 2.4, eye 3, snout 1.9, dorsal fin III–26, anal fin 25.

SIZE AND WEIGHT: Grows to two feet.

GENERAL RANGE: West Indies, occasionally north in the Gulf Stream.

OCCURRENCE IN PORT-AU-PRINCE BAY: Known to us by a single specimen captured under Sargassum weed.

STUDY MATERIAL: Specimens, 1; 29 mm., No. 7231, under Sargassum weed.

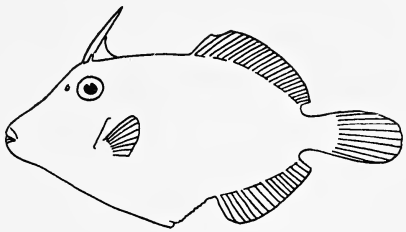
Family MONACANTHIDAE; THE FILE-FISHES

Key to Port-au-Prince Bay Genera

A. Pubic bone with a small spine at its end; gill opening short, nearly vertical.
B. Dorsal spine not barbed, its edge merely rough.....*Cantherines*
BB. Dorsal spine armed with strong retrorse barbs, usually in two series. *Monacanthus*
AA. Pubic bone without spine at its end; gill opening long, oblique; dorsal spine without barbs, inserted above the orbit, (very small fish may have barbs).....*Ceratacanthus*

Cantherines Swainson, 1839

Dusky Filefish; Lija Colorado
Cantherines pullus (Ranzani)



References: *Monacanthus pullus*, Ranzani, 1842, Nov. Comm. Acti. Sci. Inst. Bonon., V, p. 4, Plate 1.
Cantherines pullus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 800.

Field Characters: Small to medium, leathery-skinned, small mouthed fishes, with dorsal spine large, situated immediately above the eye, and without barbs on its posterior side; pelvic flap ending in a short spine; brown with dull orange spots and bands.

Description: Four Haitian fish of about the same size (123–132 mm.) have the following dimensions, differing somewhat from those given by other authors.

Depth at vertical from vent 2.4.

Head to upper angle of gill opening 3.36–3.6.

Color: Dark chocolate brown, the entire body thickly covered with small, round dull orange spots each with a dark center. On the breast toward the snout these spots become irregular wavy bands. Five narrow blue stripes from eye to snout. Dorsal and anal fins transparent orange brown, the spines golden. Tip of caudal bright yellowish green shading into orange at base. Iris dark brown variegated with cream.

In preservative, indications of the above patterns remain, and in addition the caudal peduncle has become very pale. In three of the specimens pale horizontal bars are present on the sides, the most conspicuous being one from the upper portion of the caudal peduncle and one from the lower part. One band is visible above and one below these two bands.

Size and Weight: Reaches a weight of 6 pounds. A 131 mm. fish weighed 72 grams.

General Range: Florida, West Indies and Brazil.

Occurrence in Port-au-Prince Bay: Four specimens obtained by explosion of depth bomb in 60 to 150 feet of water, Lamentin Bay, February 2nd, 1928.

Abundance: Rare.

Food: Stomach contents showed sponge spicules, minute crustaceans, and a portion of a sea-urchin.

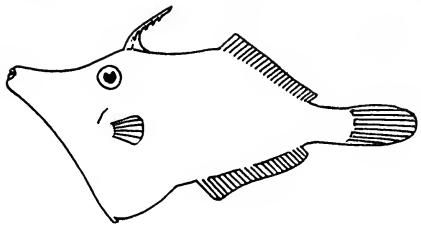
Study Material: Specimens, 4; 123–132 mm., No. 6814.

Monacanthus Cuvier, 1817

Key to Port-au-Prince Bay Species

(Based on Haitian Expedition specimens only.
See also key given by Breder, 1927.)

A. Dorsal rays 35; anal rays 36..... *tuckeri*
AA. Dorsal and anal rays 26 to 31.
B. Dorsal and anal rays 29 to 31, the ventral flap extending beyond the ventral spine, the margin convex; profile in young concave.... *ciliatus*
BB. Dorsal and anal rays 26 to 29 (usually 27 to 29 in both anal and dorsal, one specimen only having 26 in both fins). The ventral flap never extending beyond the ventral spine..... *oppositus*



Reticulated Filefish
Monacanthus tuckeri Bean

References: *Monacanthus tuckeri*, Bean, 1906, Proc. Biol. Soc. Wash., XIX, p. 33.

Field Characters: Leathery-skinned fish with long barbed dorsal spine over posterior part of eye; pelvic flap large and extending beyond the spine; about 35 dorsal rays and 36 anal rays.

Description: Our single specimen (68 mm.) agrees quite well with the original description, the depth of our specimen being somewhat greater, 2.39 instead of 3.1. The eye in our specimen is 3.5 instead of 3 in the head. These differences can perhaps be accounted for by difference in size.

Color: (From life) General color above bluish gray brown, the lower half of the sides brown. The general color is more reddish anterior to the eye and darkest on the upper sides just behind the eye. Pelvic flap with irregular yellowish lines, more abundant distally and with bluish markings basally. Lower sides with coarse, bluish reticulations (corresponding to the hieroglyphic-like bands of Bean's description). Lips orange. Dorsal, anal and pectoral fins orange pink. Caudal fin dusky with irregular brownish bands. Small black cirri on sides of body. The four dark bands on the dorsal fin mentioned by Bean in his description were absent.

Compared with the description of other authors of preserved, slightly smaller fish, our alcoholic specimen shows the following differences: the dark band from the eye to the caudal is not sharply demarcated dorsally. It merges with the body color, and is most intense near the eye. The ventral outline is not marked by a band. The caudal is dusky, and the vertical bands are extremely irregular. The two dark lines on the ventral flap are absent and the spot on spot at its base is not present.

Dimensions: Length 68 mm. standard measurement, 85 mm. total

Proportionate Measurements	
Depth	2.39
Head	3.1
Eye	3.5
Snout	1.26
Dorsal spine in head	1.39

General Range: Bermudas, Bahamas, Misteriosa Bank, Glover Reef, St. Eustatius, St. Martin and Porto Rico.

Occurrence in Port-au-Prince Bay: Our single specimen was taken on Sand Cay, a small sand and coral reef three miles from the nearest shore.

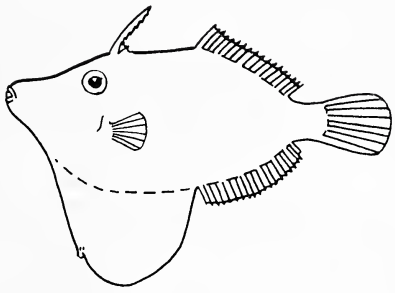
Abundance: Rare, a single specimen captured.

Method of capture: Dynamite.

Study Material: Specimens, 1; 68 mm., No. 7268.

Leather-fish; Lija

Monacanthus ciliatus (Mitchill)



References: *Balistes ciliatus*, Mitchill, 1818, American Monthly Magazine and Critical Review, March, 1818, p. 326.

Monacanthus ciliatus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1714, Plate CCLIX, fig. 634.

Field Characters: Small, leathery-skinned fishes with long pelvic flap, the outer margin of which is convex, and (in present Haitian specimens), with 29 to 31 dorsal rays.

Description: The Haitian specimens placed under this species differ from previous descriptions in having a consistently smaller fin count. All of our specimens have 29 to 31 anal rays. Previously described fin counts for the species have varied considerably and the following list shows a few of these variations:

	Dorsal Rays	*Anal Rays*
Jordan and Evermann, 1898	I–30	30
Metzelaar (Curacoa, St. Eustatius), 1919	I–30–32	31–33
Breder, 1927 (Florida, Bahamas, Isle of Pines)	I–31–35	31–35
Meek and Hildebrand, 1928, Panama	I–30–34	30–33
Haitian Expedition	I–29–31	28–31

Since the publication of Jordan and Evermann's "Fishes of North and Middle America," additional material has tended to raise the upper limit of the fin count to 35. The present specimens lower it. As the species is quite variable

and our fish cannot be separated from *ciliatus* in any other way, we conclude that the dorsal and anal rays of this species vary from 29 to 35.

It is however, important to emphasize that the variation in the fin ray in our material is small, and that the fin ray count averages consistently lower.

Examination of ten young from 11 to 13 mm. in length, revealed an average depth of 2.07.

In coloration they were somewhat different from similar sized *oppositus*,— in place of dots the green coloring is arranged in irregular spots and blotches. The webbing of the dorsal spine is almost free from pigment, wholly transparent except for a small round area of dense black pigment, close to and not far above the base of the spine, in the anterior central part of the web.

Size and Weight: Grows to 8 inches. A 50 mm. fish weighed 7 grams.

General Range: North Carolina to Brazil.

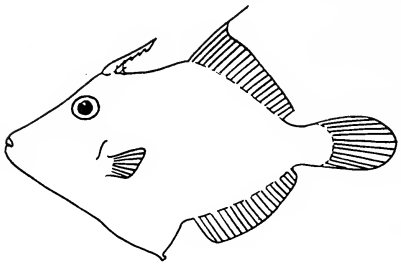
Occurrence in Port-au-Prince Bay: Found along shore mainly over weedy banks and at the surface, in the same situations as *oppositus*.

Abundance: Common.

Method of Capture: Seines and scoop-nets.

Food: Algae, small crustaceans, and other organic materials, all the result of browsing habits.

Study Material: Color Plate, H22; Photographs, 3771; Specimens, 37; 11 to 55 mm., including Nos. 6875, 7006, 7023, 7043, 7050, 7087, and 7185. Young taken at light, March 6th to April 20, 1927.



Poey's File-fish
Monacanthus oppositus Poey

References: *Monacanthus oppositus*, Poey, 1861, Memorias, II, p. 331.
Monacanthus oppositus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 798.

Field Characters: Small, leathery-skinned fishes with long, barbed spine over eye; dorsal and anal fins with 26 to 29 rays; pelvic flap short, never extending beyond the pelvic spine. Sides with longitudinal lines of small dark elongate spots.

Description: The Haitian material with the exception of one specimen which had 26 dorsal rays, instead of 27 to 29, answers perfectly the published descriptions of this species, both structurally, and in color.

Juveniles are readily separated from young *ciliatus*, even in specimens where the dorsal and anal fin counts are the same, by the greater depth of *oppositus*, and by the color. A series of *oppositus* captured at the surface at light at the same time as a similar series of *ciliatus* gave an average depth of 1.49 as

opposed to 2.07 for *ciliatus*. The average of the fin count was also lower, averaging D27.4, A27.6 for *oppositus*, and D30, A30 for *ciliatus*. In *oppositus* the profile from snout to dorsal is almost straight, only very slightly concave.

They differ also in color, a series of five young *oppositus*, 13 to 21 mm. are pale whitish, somewhat obscured by greenish, over which is scattered a number of large, very dark green dots, about 20 on the smallest specimen. The webbing of the dorsal spine is finely and evenly colored with minute green pigment.

Color: An 11.5 mm. fish had the body coppery gold with scattered dark pigment, more abundant above, and with faint indications of four broad, vertical bands.

Size and Weight: Grows to about 6 inches. A 116 mm. fish weighed 38 grams.

General Range: Cuba, Haiti, Panama, Colombia.

Occurrence in Port-au-Prince Bay: Found along shore especially on weed covered banks.

Abundance: Common, captured at practically every seining along shore near Bizoton, and elsewhere in the Bay. The young came in great numbers to our submerged lamps.

Method of Capture: Older fish captured by seines, the young mainly taken in scoop nets as they came to the light.

Food: Omnivorous, quartz pebbles, small crustaceans, algae, and organic detritus found in alimentary canal.

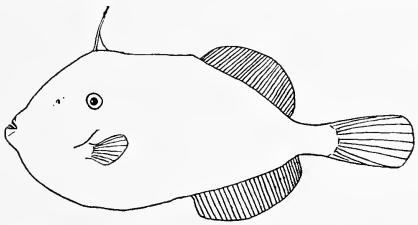
Study Material: Color Plate, H102, No. 7187; Specimens, 82; 11.5 to 116 mm., including Nos. 6852, 6997, 7006, 7022, 7054, 7097, 7107, 7113, 7125, 7152, 7153, 7157, 7187, 7195, 7209 and 7260.

Ceratacanthus Gill, 1861

Key to Port-au-Prince Bay Species

A. Dorsal rays 35 to 38, anal rays 39 to 41 ..... *schoepfi*
AA. Dorsal rays 45 to 47; anal rays 48 to 50 ..... *scripta*

Common File-fish
Ceratacanthus schoepfi (Walbaum)



References: *Balistes schoepfii* Walbaum, 1792, Artedi Piscium, p. 461.
Ceratacanthus schoepfi, Hildebrand and Schroeder, 1928, Fishes of Chesapeake Bay, p. 344.

Field Characters: Medium sized, ungainly, leathery-skinned fishes with small terminal mouth; dorsal fin consisting of a single spine followed after a wide space by the soft dorsal. Dorsal rays 35 to 38; anal rays 39 to 41.

Description: Our series of seventeen specimens show very unexpected

changes from young to adult in relative length and depth of body, the presence of four series of barbs on the dorsal spine, and their subsequent loss, a forward shifting of the dorsal spine from behind to in front of the eye, and a great reduction of the caudal fin.

The first character is demonstrated in the following six specimens:

Length	*Depth in Length*
21.5 mm.	4.5
34	3.8
55	3.5
97	2.8
175	2.3
398	1.9

Size and Weight: The extremes of our specimens were 21.5 mm. weighing .5 of a gram, and 430 mm. weighing 1134 grams (2½ lbs.).

Color: The colors varied not only in the species but from minute to minute in the same individual, changing swiftly and radically both in pattern and hue.

A 34 mm. fish usually had the head and body dark olive brown with silvery mottling on cheeks and anterior half of body, iris silvery, mottled with olive brown; base of vertical fins with three light zones and two dark ones, all of equal width. Spines with four series of strong, retrorse barbs.

The 430 mm. specimen was dark chocolate brown, densely covered with small, round, gold and orange dots; basal half of dorsal, anal and pectoral fins golden, distal half black, iris, tip of spine and edges of teeth clear gold.

General Range: Maine to Brazil.

Occurrence in Port-au-Prince Bay: Occasionally seen in the market. We took young at light after dark, in seines near the reefs and under sargassum weed. A 17-inch adult was killed by an airplane bomb.

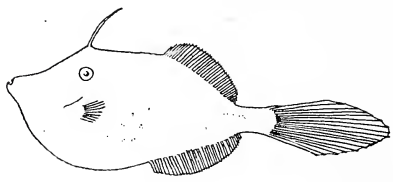
Abundance: Young common, adults more rarely seen.

Food: The alimentary tract of the largest fish was filled with algae similar to the common Sargassum weed, the small gaseous berry-like bladders being especially conspicuous. In smaller fish the contents of the long intestine were too comminuted to identify.

Young: Young fish of about two inches in total length swim by very rapid vibrations of the vertical fins, too fast for the eye to follow, the fins appearing as a rayless blur. The tail is kept closed and used only for fast turns, the pectorals functioning as balancers and for slow turns.

General Habits: I have recorded an interesting habit in my volume on the Haitian expedition "Beneath Tropic Seas," p. 154. (W. B.)

Study Material: Color Plate, H106, Drawings, 4117, 4119; Specimens, 17; 21.5–430 mm., including Nos. 6807, 6829, 7121, 7147, 7156, 7376, 7377, 7378



Scrawled File-fish

Ceratacanthus scripta (Osbeck)

References: *Balistes scriptus*, Osbeck, 1757, Iter. Chin., 1, p. 144.
Alutera scripta, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1719.

Field Characters: Elongate, compressed, ungainly, leathery fishes; a single separate dorsal fin of one spine followed, after a wide space, by the soft dorsal fin; dorsal rays 45–47; anal rays about 48–50; caudal fin elongate, with rounded angles.

Size and Weight: Grows to 2 or 3 feet. Our 83 mm. fish weighed 7 grams.

General Range: West Indies, South Carolina to Brazil.

Abundance: Rare. A single specimen brought to us by a native fisherman.

Study Material: Specimens, 1; 83 mm., No. 7217.

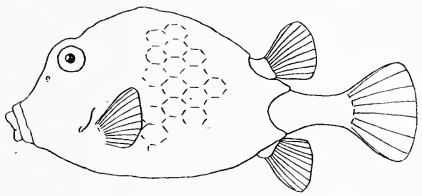
Family Ostraciidae; the Trunk-Fishes

Lactophrys Swainson, 1839

Key to Port-au-Prince Bay Species

A. Carapace without spines..... *triqueter*
AA. Carapace with spines, one pointing backward on each side of the ventral ridge being always present.
B. No spines in front and above eye.
C. Carapace closed behind the dorsal fin; body with round dark spots. *bicaudalis*
CC. Carapace open behind the dorsal fin; body mottled with paler... *trigonus*
BB. Frontal region with two strong spine-like horns..... *tricornis*

Trunk-fish; Rock Shellfish; Drunken-fish; Chopin; Plate-fish
Lactophrys triqueter (Linnaeus)



References: *Ostracion triqueter*, Linnaeus, 1758, Systema Natura, Ed. X, p. 330.
Lactophrys triqueter, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1722.

Field Characters: Fishes with body encased in a bony box; the carapace without spines anywhere. Dark brown, thickly studded with circular spots of yellowish white.

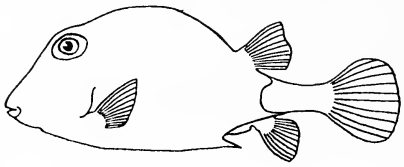
Size and Weight: Grows to over 10 inches. A 135 mm. fish weighed 127 grams.

General Range: West Indies north to the Bermudas, Key West to Pensacola, Bahia; very common in the Tropics.

Occurrence in Port-au-Prince Bay: Known to us only from two specimens brought in by native fisherman.

Abundance: Uncommon.

Food: Alimentary canal contained only comminuted vegetable matter.
Study Material: Specimens, 2; 105–129 mm., including No. 7142.



Chopin; Spotted Trunk-fish; Coffre
Lactophrys bicaudalis (Linnaeus)

References: *Ostracion bicaudalis*, Linnaeus, 1758, Systema Natura, Ed. X, p. 330.
Lactophrys bicaudalis, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1723, Plate, CCLXII.

Field Characters: Fishes with the body encased in a bony box; carapace with a flat triagonal spine on each ventral ridge, none in front of eyes; the carapace closed and continuous behind the dorsal fin. Yellowish, with numerous small, round, brown spots on carapace, tail and caudal fin.

Size and Weight: Grows to 16 inches. A 101 mm. fish weighed 63 grams.

General Range: West Indies to Bahia, Ascension Island.

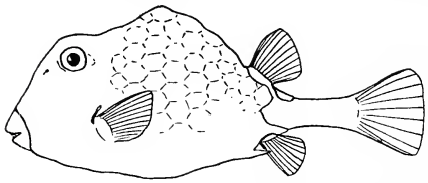
Occurrence in Port-au-Prince Bay: A single specimen taken as the result of an airplane bomb explosion in 100 feet of water.

Abundance: Rare.

Method of Capture: High explosive.

Food: Algae and unidentifiable material.

Study Material: Specimen, 1; 101 mm. No. 6813.



Common Trunk-fish; Chopin; Shellfish
Lactophrys trigonus (Linnaeus)

References: *Ostracium trigonus*, Linnaeus, 1758, Systema Natura, Ed. X, p. 330.
Lactophrys trigonus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1723, Plate CCLXIII.

Field Characters: Fishes with the body enclosed in a bony box; the carapace open behind the dorsal fin; ventral ridges ending in a large flat spine; no spines in front of eye.

Size and Weight: Grows to 9 inches. A 216 mm. fish weighed 316 grams.

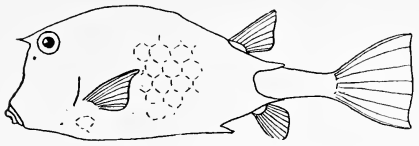
General Range: West Indies, very common as far north as Bermuda and Key West, occasionally to Massachusetts; south to Bahia.

Occurrence in Port-au-Prince Bay: One specimen brought in by fisherman. Occasionally seen in the fish markets.

Abundance: Uncommon.

Study Material: Specimen, 1; 216 mm., No. 7012.

Cow-fish; Cuckold; Toro
Lactophrys tricornis (Linnaeus)



References: *Ostracion tricornis*, Linnaeus, 1758, Systema Natura, Ed. X, p. 331.
Lactophrys tricornis, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1724.

Field Characters: Fishes with body enclosed in a bony case; the ventral ridges and frontal ridges with spines; color brown, yellow, blue or green, with irregular blue blotches.

Size and Weight: Grows to a foot or more. An 89 mm. fish weighed 37 grams, a 149 mm. fish 104 grams, and a 270 mm. fish 450 grams.

General Range: Tropical parts of the Atlantic, very common from Carolina to Brazil, ranging North in the Gulf Stream to Chesapeake Bay and rarely to Massachusetts.

Occurrence in Port-au-Prince Bay: Rather widely distributed in the bay.

Method of Capture: Seines, dynamite.

Abundance: Fairly common, seen quite often in markets.

Food: Alimentary canal of 72 and 100 mm. fish contained algae and remnants of sponge. The 260 mm. fish had eaten parts of algae, sponges and the spines of a small club-spined sea-urchin.

Study Material: Color Plates, H24, H111, H119; Photographs, 3765, 4118, 4122; Specimens, 8; 72–260 mm., including Nos. 6808, 6827 and 7212.

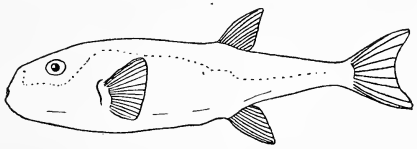
Family Tetraodontidae; the Puffers

Key to Port-au-Prince Bay Genera

A. Body comparatively elongate; dorsal and anal rays 12 to 15; nostrils not in a tube ..... *Lagocephalus*
AA. Body oblong, plump; dorsal and anal fins with 6 to 8 rays; nostrils on either side in a short tube ..... *Tetraodon*

Lagocephalus Swainson, 1839

Smooth Puffer
Lagocephalus laevigatus (Linnaeus)



References: *Tetrodon laevigatus*, Linnaeus, 1766, Systema Natura, Ed. XII, p. 411.
Lagocephalus laevigatus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1728. Plate CCLXVI, fig. 642.

Field Characters: Smooth-skinned fish capable of inflating the abdomen with air or water. Jaws beak-like, with a median suture. Belly covered with three rooted spines. Body elongate, the depth four and one half times the length. Olive green above, silvery white on sides and below.

Size and Weight: Grows to a length of two feet. Our 200 mm. fish weighed 244 grams.

General Range: Massachusetts to Brazil.

Food: Our single specimen was taken on a hook baited with a small fish.

Study Material: Specimen, 1; 200 mm.

Tetraodon Linnaeus, 1758

Key to Port-au-Prince Bay Species

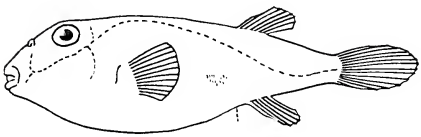
(Specimens over 20 mm. long)

A. Upper surfaces of body without conspicuous, more or less concentric, pale lines.

B. Snout, back and sides covered with honey-comb-like reticulations of fine, pale blue lines; a sparse scattering of large, dark spots within the reticulations. Body with evident membranous (not ossified) scales on sides, having free margins ..... *marmoratus*

BB. Sides with a conspicuous series of large blackish circular spots; membranous scales if present not possessing free margins; rather elongate, long headed puffers ..... *spengleri*

AA. Upper surfaces with light lines enclosing circular and elliptical areas and forming reticulations on the sides; sides and upper surface covered with small black dots ..... *testudineus*



Spiny-backed Puffer
Tetraodon marmoratus (Ranzani)

References: *Tetrodon marmoratus*, Ranzani, 1840, Novi Comment. Ac. Sci. Inst. Bonon., IV, p. 73, Plate X, fig. 1.
Sphoeroides marmoratus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 813.

Field Characters: Small fishes with rather loose skin, the belly capable of being inflated with air or water; mouth small, teeth nipper-like, with a median suture; sides of head and body prickly. Sides with pale blue reticulations enclosing large dark spots.

Description: Two small specimens 18 and 33 mm. come within the descriptions of this species, although the head in both is slightly larger than the specific average.

The blue reticulations are not visible on either of the preserved specimens, but this coloration was very conspicuous in the living fishes, marking them at once as different from the other Haitian Puffers.

A series of 22 small puffers, 6 to 14 mm. was taken at the surface at night, as they came to our submerged lamps. They are placed with some hesitation under this species. In form they resemble the 18 and 33 mm. specimens, being considerably heavier than the other Haitian species. In coloration they also are closest to *marmoratus*, possessing none of the conspicuous dorsal marks of *testudineus* or the large spots of *spengleri*. Of importance also is the fact that they have pale transparent caudal fins, agreeing with our slightly larger *marmoratus* and not with the other species.

An 11.5 mm. specimen of this series can be described as follows:

Head 2.3, depth 2.88; dorsal 8, anal 7, caudal 10 and pectoral 10.

Body rather robust, its greatest width and depth at the gill slit; head large; snout 2.5 in head; interorbital bone, 2.5 in eye; skin with conspicuous prickles from behind eyes to dorsal fin, and on sides and belly, those on the sides more flattened and scale-like; dorsal fin inserted posteriorly, the distance from snout to origin of dorsal fin 1.28 in length: the distance from origin of dorsal to tip of caudal 1.9 in length: anal fin similar to dorsal but lower: caudal fin truncate, the edges slightly rounded; upper rays of pectoral fin about twice as long as lower.

In color this fish agrees well with the others, and may be described as follows:

Entire dorsal surface (alcoholic specimens) and sides down to line of belly, dark brown, thickly peppered with small black spots. In a few specimens this coloration is continued on the belly. Lower surfaces pale yellow white. Lips and end of caudal peduncle pale yellowish. All other fins pale translucent.

Color: (33 mm. fish from life). Above olive brown or greenish, with snout, back and sides covered with honey-comb-like reticulations of fine, pale blue lines. An irregular sparse scattering of large dark spots always in the blue cells, increasing in distinctness and number on the sides; on the sides are 11 to 12 large spots bounded by white instead of pale blue, the white forming intervening spots. Below, ivory white becoming pale lemon from pectoral to anal fins. Caudal yellowish, unmarked. Iris gold at center changing to olive green on outer two-thirds.

Size and Weight: Our 33 mm. fish weighed 2 grams.

General Range: West Indies to Brazil.

Occurrence in Port-au-Prince Bay: Taken along shore over shallow, weed-covered banks, and at surface at night.

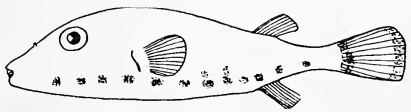
Abundance: Uncommon.

Method of Capture: Seines, traps and scoop nets at night.

Study Material: Specimens, 2; 18–33 mm., including 6897, and the following small specimens tentatively placed here; 22, 6–14 mm., all taken at surface at night, including Nos. 6963, 6984, 6997, 7027, 7054, 7087A, 7097D, 7125, 7152, 7243.

Southern Puffer

Tetraodon spengleri (Bloch)



References: *Tetrodon spengleri*, Bloch, 1785, Naturg. Ausl. Fische, I, 135, Plate CXLIV.

Spheroides spengleri, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 815.

Field Characters: An elongate, smooth-skinned, flat-keeled fish, dark mottled over white below, with about twelve large, round, dark spots extending along sides from mouth to tail. Caudal divided into thirds by three vertical bands, black, white and black.

Size and Weight: An 80 mm. fish weighed 13.5 grams.

General Range: Massachusetts to West Indies and Panama.

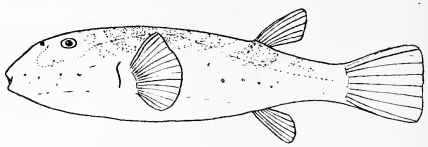
Occurrence in Port-au-Prince Bay: Observed near shore and in coral reef three miles out.

Abundance: Rare; two small specimens taken.

Method of Capture: Seined and taken on hook.

Study Material: Photograph, 4096; Specimens, 2; 80–84 mm., including Nos. 6896 and 7139.

Turtle-headed Globefish; Fou-fou sans piquant; Tambor
Tetraodon testudineus Linnaeus



References: *Tetraodon testudineus*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 332.
Sphoeroides testudineus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 817.

Field Characters: Small to medium fishes with rather loose skin, the belly capable of being inflated with air or water; mouth small, the teeth nipper-like, with a median suture; upper surfaces dark, with pale, narrow bands forming more or less concentric ovals and circles.

Description: The Haitian fish are quite typical.

Size and Weight: Grows to 9 inches. A 32 mm. specimen weighed 1.2 grams, and a 143 mm. fish weighed 73.5 grams.

General Range: West Indies, occasionally northward to the vicinity of New York.

Occurrence in Port-au-Prince Bay: Quite widely distributed and found along shore.

Abundance: Common.

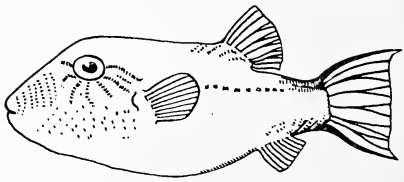
Method of Capture: Traps, seines, dynamite.

Study Material: Specimens, 24; 30–171 mm., including No. 6898.

Family Canthigasteridae

Canthigaster Swainson, 1839

Sharp-nosed Puffer
Canthigaster rostratus (Bloch)



References: *Tetrodon rostratus*, Bloch, 1782, Ichthyologia, Plate 146.
Canthigaster rostratus, Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1741.

Field Characters: Smooth-skinned puffer, snout elongated, body from the eye to the dorsal fin compressed and ridge-like, dorsal and ventral aspects of peduncle black; radiating lines around eye.

Size and Weight: Our 50 mm. specimen weighed 6.5 grams.

Color: General color of upper surfaces of head, body back to posterior portion of dorsal fin, and the chin, brownish. Sides and belly creamy white, the belly with a median, narrow bluish line. Head above, below and in front of eye, sides of head immediately in back of eye, dull orange, the orange continued as a narrow line on side of body as far back as posterior end of dorsal fin, the orange on the side of the head with many small bluish dots. A series of vertical blue lines on snout, the anterior ones continued onto the chin. A series of curved blue bands radiating outward from the eye,—four forward and downward, and four downward and backward. Upper edge of eye blue. Pectoral fin with a yellowish base. Dorsal fin yellow at base, then blackish and with a series of short bluish bands extending downward and forward on the body from the base of the fin. Caudal fin translucent with a slight yellowish tinge, the upper and lower edge black. This black continued onto the body and reaching almost to the posterior base of the dorsal. A few longitudinal bluish bands within the upper black patch, the lowermost continued forward on the sides as a series of small blue spots. Blue on lower patch in more oblique bands and smaller spots. Iris gold.

General Range: Florida, West Indies, Bermuda, and the Madeiras.

Occurrence in Port-au-Prince Bay: The only specimen taken was shot with a small harpoon from an air rifle at Sand Cay on February 25th. A second individual was seen day after day while we were diving at the same reef but was not secured.

Study Material: Color Plate, H46, No. 6958; Photograph, 3924; Specimen, 1; 50 mm., No. 6958.

Family Diodontidae; the Porcupine-Fishes

Key to Port-au-Prince Bay Genera

A. Dermal ossifications consisting of slender, stiff, pointed movable spines. *Diodon*

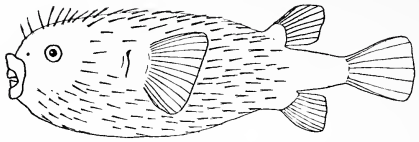
AA. Dermal ossifications consisting of short, stiff, immovable spines. *Chilomycteris*

Diodon Linnaeus, 1758

Key to Port-au-Prince Bay Species

A. Frontal spines equal to or shorter than the post-pectoral ones..... *hystrix*

AA. Frontal spines longer than the post-pectoral ones..... *holacanthus*



Short-spined Porcupine-fish; Foufou avec piquant
Diodon hystrix Linnaeus

REFERENCES: *Diodon hystrix*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 335.
Diodon hystrix, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 827.

FIELD CHARACTERS: Small to medium, short and robust fishes with body covered with sharp, erectile movable spines; belly capable of spherical inflation; spines of front of head shorter or almost as long as those behind the pectoral fin.

DESCRIPTION: The separation of the two West Indian species of *Diodon* is based chiefly upon the relative length of the frontal and post-pectoral spines. We have three young and two large adults which show the frontal spines distinctly short, and to this we follow Meek and Hildebrand in adding 22 specimens which have the spines in the two areas of equal length. In ontogenetic growth there is a relative increase in size of the snout and interorbital and a considerable decrease in size of the eye.

SIZE AND WEIGHT: A specimen of 56 mm. weighed 15 grams. Attains a length of three feet.

COLOR: There is considerable individual change of color, both under stress of emotion and by night and day. At night, those which were taken at the submerged light were pale grey with the dark patches barely discernable. Iris and fins often lemon yellow.

GENERAL RANGE: Recorded from all warm seas.

OCCURRENCE IN PORT-AU-PRINCE BAY: The young are very common among the weeds and wharves near shore and at the surface at night; seldom seen near coral reefs. Adults secured by airplane bombs and in market.

METHOD OF CAPTURE: Seining, dynamite.

FOOD: Bottom debris, crustaceans, sponges, algae, etc.

ENEMIES: Although apparently well protected by their armature of spines we found the following six species of fish feeding upon these puffers:

Haemulon plumieri.
Peprilus paru.
Lutianus analis.
Lutianus griseus (11 snappers had eaten 15 puffers).
Lutianus synagris (14 individuals had eaten 15 puffers).
Tylosurus raphidoma.

In a series of sixty small puffers, seven had external parasitic isopods on either fins or skin, as follows:

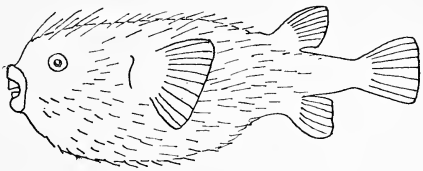
Specimen No. 1,—2 parasites on right pectoral.
Specimen No. 2,—2 parasites on left pectoral.
Specimen No. 3,—2 parasites on left pectoral.
Specimen No. 3,—1 parasite on right pectoral.
Specimen No. 3,—1 parasite on skin near anal.

Specimen No. 4,—1 parasite on left pectoral.
Specimen No. 4,—1 parasite on right pectoral.
Specimen No. 4,—2 parasites on dorsal.
Specimen No. 4,—2 parasites on caudal.
Specimen No. 4,—1 parasite on ventral.
Specimen No. 5,—3 parasites on right pectoral.
Specimen No. 5,—1 parasite on caudal.
Specimen No. 6,—1 parasite on left pectoral.
Specimen No. 7,—1 parasite on right pectoral.

General Habits: When picked up these fish inflate themselves immediately, and if thrown back, turn over and deflate in from three to five seconds. When inflating in the air, crackling sounds are given forth. Usually when taken out of the water they live for ten or fifteen minutes, without struggling, and then gradually swell up to full rotundity in about five seconds, and after five minutes they die. They may flatten or remain quite round in death. ("Beneath Tropic Seas," pp. 24–25.)

Study Material: Photographs 4021, 4022; Specimens, 77: 2; 290 and 312 mm. About 75 young, 55–65 mm.

Long-spined Porcupine-fish
Diodon holacanthus Linnaeus



References: *Diodon holacanthus*, Linnaeus, 1758, Syst. Nat., Ed. X, p. 335.
Diodon holacanthus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 829.

Field Characters: Small to medium, short and robust fishes with body covered with sharp erectile movable spines; belly capable of inflation; spines of front of head longer than those behind the pectoral fin.

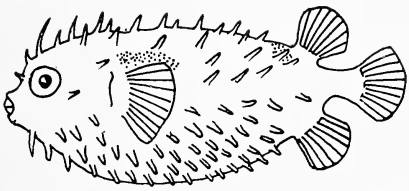
Description: The greater length of the frontal spines over those of the post pectoral ones, is the only consistent character. The data under *hystrix* applies equally to this species.

General Range: Recorded from all warm seas.

Study Material: Specimens. About 100 young 55–70 mm.

Chilomycterus Bibron, 1846

Cuvier's Burr-fish
Chilomycterus antennatus (Cuvier)



References: *Diodon antennatus,* Cuvier, 1818, Mem. Mus. Hist. Nat., Paris, IV, p. 131.
Chilomycterus antennatus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 832.

Field Characters: Small fishes with skin covered with short, stiff, more or less immovable spines; mouth small, transverse; body usually covered with small black spots; a larger black spot on nape, a kidney shaped black spot above each pectoral fin, and a dark spot surrounding the anterior part of the dorsal fin.

Description: The three specimens in the collection have the entire body and the caudal fin spotted with black, those on the fin small and few in number. On one of the fish the black nape spot is absent. The largest fish has very small spines about the head, and the supra-orbital spines and tentacle are represented only by their apparently much abraded bases.

Size and Weight: Grows to about eight inches. A 127 mm. fish weighed 160 grams.

General Range: West Indies southward. Recorded from Porto Rico, Haiti, Jamaica, St. Croix, Trinidad, Panama, and Cape of Good Hope.

Occurrence in Port-au-Prince Bay: One fish taken as the result of airplane bombing, and two seined along shore over weed covered shallows.

Abundance: Uncommon.

Method of Capture: Seines and explosive.

Food: Two specimens contained the remains of mollusks.

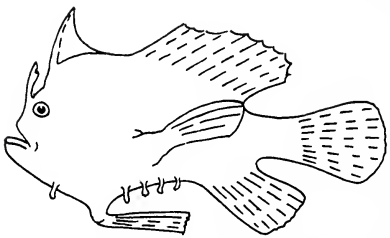
Study Material: Photographs, 3752, 3753; Specimens, 3; 111–127 mm., including Nos. 6826 and 6973.

Family Antennariidae; Frog-Fishes

Key to Port-au-Prince Bay Genera

A. Ventral fins well developed and long, often reaching nearly or quite to the origin of the anal fin..... *Histrio*
AA. Ventral fins short, never remotely reaching the base of the anal fins. *Antennarius*

Histrio Fischer, 1813



Common Frog-fish
Histrio gibbus (Mitchill)

References: *Lophius gibbus,* Mitchill, 1815, Trans. Lit. and Phil. Soc. N. Y., I, Pl. IV, fig. 9.
Histrio gibbus, Meek and Hildebrand, 1928, Marine Fishes of Panama, III, p. 1010.

Field Characters: Strange, small-sized, froglike fish, living among floating seaweed; body oval, robust, mouth almost vertical, a long fleshy tentacle on head, pectoral fin withe lbow, rays mobile, used like fingers, ventrals long, reaching to anal; color variegated, spotted with yellow and white and black like seaweed.

Description: Our specimens are typical.

Size and Weight: Our largest specimen of 63 mm. weighed 15 grams.

General Range: Panama, Key West and the West Indies.

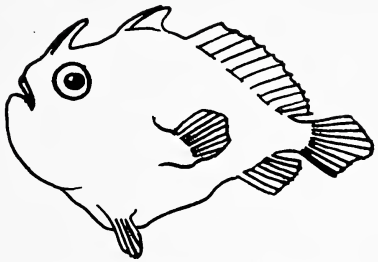
Occurrence in Port-au-Prince Bay: Not rare under masses of sargassum weed brought in by the tide.

Food: Shrimps and small fish; two individuals proved their cannibalistic nature by swallowing entire, smaller companions.

Study Material: Photographs, 4148 to 4153 inclusive, 4167, 4189 and 4226; Specimens, 14; 14 to 63 mm., Nos. 7104, 7155, 7195D, 7199, 7211 and 7223.

Antennarius Lacépède, 1798

Short-tentacled Frogfish
Antennarius inops Poey



References: *Antennarius inops*, Poey, 1881, Anal. Soc. Esp. Hist. Nat. X, p. 340.

Antennarius inops, Jordan and Evermann, 1898, Fishes of North and Middle America, III, p. 2718.

Field Characters: Typical frogfish, with three separate dorsal spines; the first short, translucent, arising from the stem of the second, ending in an oval, fleshy bait; color brown variegated with white, three very wide bands radiating from the eye, forward, backward and downward.

Description: Although our two specimens are very small, in measurements and spine structure they agree with the published descriptions.

General Range: Porto Rico and Haiti.

Occurrence in Port-au-Prince Bay: Two small specimens taken under sargassum weed.

Study Material: Specimens, 2; 12 and 14 mm., No. 7469.

Family Ogcocephalidae; the Bat-Fishes

Key to Port-au-Prince Bay Genera

A. Disk with frontal region elevated, snout more or less produced forward, the tail stout; eyes lateral ..... *Ogcocephalus*

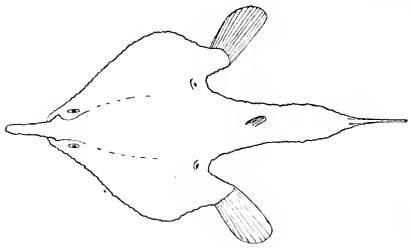
AA. Disk with the frontal region depressed, not elevated above the rest; snout rounded ..... *Halieutichthys*

Ogcocephalus Fischer, 1813

Key to Port-au-Prince Bay Species

A. Snout produced, the rostral process pointed, 6 to 10 in length of body..... *vespertilio*

AA. Snout shorter, the rostral process 12 to 15 times in length of body. *nasutus*



Long-snouted Batfish
Ogcocephalus vespertilio (Linnaeus)

References: *Lophius vespertilio,* Linnaeus, 1758, Syst. Nat., Ed. X, I.
Ogcocephalus vespertilio, Jordan and Evermann, 1898, Fishes of North and Middle America, III, p. 2737.

Field Characters: Small, bottom fish, body depressed, broad, triangular, studded with tubercles; head as long as the rest of the body; a projecting bony rostral process six to ten times in length of body; cavity of rostral tentacle higher than broad.

Description: Measurements of two specimens are as follows:

	No. 6823	*No. 6861*
Length	64 mm.	76 mm.
Depth	15 (4.3)	15 (5.1)
Width	35 (1.85)	42 (1.8)
Head	32 (2)	37 (2)
Eye	5 (6.4)	10.5 (3.5)
Rostral process (snout)	8 (8)	9.5 (8)
Pectoral length	16 (2)	18 (2)

Two small individuals come within the rostral measurements of *vespertilio,* but this very extension of the anterior part of the head has resulted in a lengthening of the tentacular cavity, making it longer than broad. The maxillary reaches a vertical line only half-way back across the eye. In life all the tubercles are tipped with waving filaments of brownish grey.

Size and Weight: The two specimens taken are two and one-half, and three inches in length. The latter weighed 17 grams.

Color: Upper parts monochrome brown, except face below eye, a patch on each side of mid-back, and armpits, which are covered with good-sized, round, dark-brown spots, each narrowly bordered with silver. Ventral surface reddish; pectoral brilliant yellow on under surface of basal half, remainder of lower surface of pectoral black; posterior half of caudal black. Iris silvery, reticulated and mottled with dark brown, except anteriorly where it is very finely peppered with dark; pupil irregularly heart-shaped.

General Range: West Indies to Florida, occasionally north in mid-summer to New York.

Occurrence in Port-au-Prince Bay: Widely distributed over bottom.

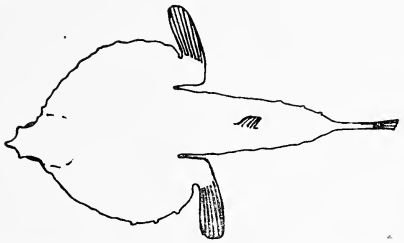
Abundance: Two specimens taken; six or eight others seen in market.

Method of Capture: Seines dragged along the bottom.

Study Material: Photographs, 3832, 3986 of living fish; Specimens, 2; 64–76 mm., both males, No. 6861 and 6823.

Short-snouted Batfish

Ogcocephalus nasutus (Cuvier and Valenciennes)



References: *Malthaea nasuta,* Cuvier and Valenciennes, 1837, Hist. Nat. Poiss., XII, p. 452.

Ogcocephalus nasutus, Jordan and Evermann, 1898, Fishes of North and Middle America, III, p. 2737.

Field Characters: Same as *Ogcocephalus vespertilio,* but rostral process shorter, twelve to fifteen times in length of body, cavity of rostral process not higher than broad.

Description: Measurements of two specimens are as follows:

	No. 7299	*No. 7040*
Length (upper jaw to caudal)	152 mm.	174 mm.
Depth	31 (4.9)	37 (4.7)
Width	82 (1.85)	103 (1.7)
Head	70 (2.2)	84 (2.1)
Eye	13 (5.4)	13 (6.5)
Rostral process (snout)	11.5 (13.3)	14.5 (12)
Pectoral length	34 (1.3)	43 (1.9)

Size and Weight: A specimen nearly seven inches long weighed 185 grams.

Color: Above a mingling of olive-buff, cinnamon-drab and glaucous blue, with irregular blotches of honey yellow, and groups of dark brown dots near the gill-openings and back of the eyes; the face and sides of the head, and much of the sides of the body are also dark brown. The entire ventral surface is deep red, changing from indian red to dragon's-blood; base of the anal fin, interior of the gill-openings and the inside of the lips and mouth are bright spectrum red. The tentacle, the tip of the caudal and the ventrals are pink; the base of the pectorals greenish yellow. The iris is variegated like the back, and the pupil, even after preservation, reflects the light as brilliant blue.

General Range: West Indies.

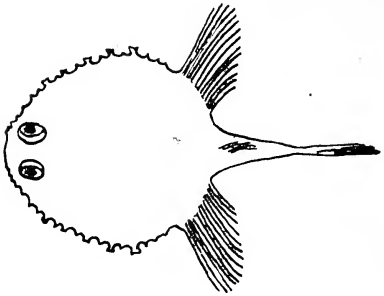
Occurrence in Port-au-Prince Bay: Found generally on the bottom of the Bay.

Abundance: Not rare; two specimens taken, others seen in the market.

Method of Capture: Seines drawn along the bottom.

Study Material: Color Plates, H30, H31, Dorsal, ventral, lateral and front views of 7040; Photographs, 3985, 4044, 4045, living fish; Specimens, 2; 152 and 174 mm., Nos. 7040 and 7299.

Halieutichthys Poey, 1863



Reticulated Batfish
Halieutichthys aculeatus (Mitchill)

References: *Lophius aculeatus*, Mitchill, 1818, Amer. Mon. Mag., II, p. 325.
Halieutichthys aculeatus, Evermann and Marsh, 1902, Fishes of Porto Rico, p. 338.

Field Characters: Very small, pale-colored batfish with conspicuous dark reticulations all over disk; pectoral fins pale bluish white, black and turquoise blue, at least in young.

Description: A typical specimen showed the following measurements:

Length: 17.6
Depth: 4 (4.4)
Width: 11.5 (1.5)
Head: 10.5 (1.68)
Eye: 2.1 (5)
Snout: .75 (14)
Width of mouth: 2.5
Interorbital: 1.1 (1.9)
Length pectoral rays: 5.5 (1.9)
Pectoral count: 18
Dorsal count: 5
Anal count: 4
Caudal count: 9

The width of the disk is slightly less than from snout to last dorsal ray; the bridge over the rostral cavity has a three-pointed spine above, and a similar one on each side; a large, simple spine between eye and nostril; a double-pointed spine on the supraorbital margin; three, low soft fleshy protuberances near the lower margin of eyeball.

Size and Weight: The longest individual taken was 21 mm. in length.

Color: Pale, cold gray with many fine, dark brown reticulations. Pectoral, gray and reticulated for the first eight rays, the reticulations tending into black, broad, cross-bars. The anterior elongated ten rays are bluish white for the basal third, the second third black with the spines golden, and the terminal third is pale turquoise blue with yellowish spines. Dorsal dark. Caudal bluish white, deepening to turquoise at tip, with four brown cross bars. The iris is like the body, the pupil both in life and long after preservation showing a vivid iridescence of deep blue to green.

General Range: Western Atlantic; West Indies; Gulf of Mexico, and Gulf Stream.

Occurrence in Port-au-Prince Bay: Observed only at surface light, at night.

Abundance: Twelve young individuals were taken on nine nights in March and April.

Method of Capture: Hand net at night, from schooner's gang-way.

Young: All specimens taken were young, under an inch in length.

General Habits: *Halieutichthys aculeatus* has only once been taken in water shallower than twenty-four fathoms, while one hundred miles off Cape Fear it came up from ninety-five fathoms. Elsewhere, species of the genus have been found living at a depth of one hundred and thirty-seven fathoms. *Aculeatus* is a typical member of its family, which in structure and known facts of habitat is essentially composed of bottom livers, restricted to deep coastal waters. It seems probable that this family originated in tropical coastal waters and became slowly distributed outward and downward.

It was an interesting surprise to find young *Halieutichthys* coming to the surface light, night after night, swimming easily and sustaining themselves without effort. The pectorals were constantly expanded to the widest extent and the propelling power was derived from the caudal, with some help from the dorsal and anal fins. The full pectoral expansion is equal to four-fifths of the entire dorsal surface of the body, so its sustaining power, given any forward impetus at all, is very considerable. Twice I saw these young fish come to the surface and cup their pectorals and actually float motionless, with the tips of the pectoral rays and the snout and eyes just out of water.

From 9 P. M. during nine separate nights, these young batfish came singly to the light, up from the black depths, and allowed themselves to be scooped up. The light was two thousand candle power and dropped just below the surface at the schooner's side, about two hundred yards from shore over a depth of six to ten fathoms.

These individuals, both in pectoral colors and more deep-seated characters, present a number of differences from typical *aculeatus*, but not greater than can be attributed to immaturity.

The bathymetrical activities of the young may be taken as an illustration of the somewhat discarded Von Baer's law. (W. B.)

Study Material: Color Plate, H61, No. 7042; Photographs, No. 3975, 3976, 3977, of living fish; Specimens, 12; averaging 17 mm., Nos. 7042a, b, c, 7097, 7182.

Marine Fish Recorded from Haiti and Santo Domingo

In addition to the fishes recorded in the preceding pages, the following species have been listed from the island of Haiti. In making this list we have ignored the political boundaries between the two countries composing the island, as has been customary with most authors.

The present list contains a single reference, not necessarily the first, to an account wherein the species is mentioned as found on the island. Combined with the Port-au-Prince Bay species, it forms a check-list of the known fishes of Haiti, exclusive of the fresh-water families *Cichlidae* and *Poecilidae* which will be treated in a later paper. We have attempted to make this list as complete as possible, but owing to the obscureness of some Haitian fish records, a few may have escaped us. The correction of such omissions will be gratefully received.

In certain cases where we are not certain of the status of a species, we have included it under the name by which it was originally published. This applies especially to some of the gobies.

Class ELASMOBRANCHII

Order Batoidea
Family Dasyatidae
Dasyatis say (Le Sueur)
Dumeril, A., 1865, Hist. Nat. Poiss., I, p. 603.

Class PISCES

Order Holostei
Family Lepisosteidae
? Cylindrosteus scabriceps Fowler
Fowler, 1910, Proc. Phil. Acad. Nat. Sci., 1910, p. 607.
(This record is very doubtful as, according to the describer of the fish, the Santo Domingan specimens may have been wrongly labelled.)
Order Isospondyli
Family Albulidae
Dixonina nemoptera Fowler
Fowler, 1910, Proc. Phila. Acad. Nat. Sci., 651.
Family Clupeidae
? Sardinella clupeola (Cuvier and Valenciennes)
Metzelaar, 1919, Over tropische Atlantische visschen, p. 11 (Identification uncertain).
Family Engraulidae
Anchoviella perfasciatus (Poey)
Günther, 1868, Cat. Fish. Brit. Mus., VII, p. 391.
Anchovia clupeoides (Swainson)
Fowler, 1915, Copeia, No. 24, p. 50.
Order Apodes
Family Muraenidae
Enchelycore nigricans Bonnaterre
Lönnberg, 1895, Oefvers. Svensk. Vet. Akad. Förh., 52, 657–663.
Gymnothorax ocellatus Agassiz
Fowler, 1915, Copeia, 24, p. 50.
Echidna catenata (Bloch)
Lönnberg, 1895, Oefvers. Svensk. Vet. Akad. Förh., 52, 657–663.

Order Iniomi
Family Synodontidae
Synodus dominicensis Fowler
Fowler, 1911, Proc. Phila. Acad. Nat. Sci., 1911, p. 564.
Order Synentognathi
Family Belonidae
Tylosurus timucu (Walbaum)
Fowler, 1915, Copeia, 24, p. 50.
Order Heterosomata
Family Achiridae
Achirus inscriptus Gosse
Jordan and Evermann, 1898, Fishes of North and Middle America, III, p. 2696.
Family Bothidae
Platophrys ocellatus (Agassiz)
Lönnberg, 1895, Oefvers. Svensk. Vet. Akad. Vorh., 52, 657–663.
Order Thoracostei
Family Syngnathidae
? Hippocampus longirostris Cuvier
Dumeril, A., 1865, Hist. Nat. Poiss., II, p. 518 (Identity uncertain).
Order Percomorphi
Family Mugilidae
Mugil brasiliensis Agassiz
Günther, 1861, Cat. Fish. Brit. Museum, III, p. 431.
Agonostomus percoides Günther
Günther, 1861, Cat. Fish. Brit. Museum, III, p. 464. (A doubtful species, probably identical with *monticola*.)
Joturus pichardi Poey
Fowler, 1915, Copeia, 24, p. 50.
Family Sphyraenidae
Sphyraena borealis De Kay
Fowler, 1903, Proc. Phila. Acad. Nat. Sci., 1903, p. 750. (This species and *picudilla* are possibly the same.)
Family Scombridae
Scomberomorus cavalla (Cuvier)
Günther, 1860, Cat. Fish Brit. Mus., II, 373.
Family Gempylidae
Gempylus serpens Cuvier
Fowler, 1904, Proc. Phila. Acad. Nat. Sci., 1904, p. 767.
Family Centropomidae
Centropomus parallelus Poey
Boulenger, 1895, Cat. Fish Brit. Mus., 2nd ed., I, p. 369.
Centropomus gabbi Fowler
Fowler, 1906, Proc. Phila. Acad. Nat. Sci., 1906, p. 423. (Same as *parallelus* according to Meek and Hildebrand, 1925.)
Family Epinephilidae
Mycteroperca tigris (Cuvier and Valenciennes)
Günther, 1859, Cat. Fish Brit. Mus., I, p. 112.
Epinephilus flavolimbatus Poey
Fowler, 1915, Copeia, 24, p. 50.
Alphestes lightfooti (Fowler)
Fowler, 1907, Proc. Phila. Acad. Nat. Sci., 1907, p. 258.
Family Lutianidae
Lutianus mahogani (Cuvier and Valenciennes)
Fowler, 1915, Copeia, 24, p. 50.
Lutianus buccanella (Cuvier and Valenciennes)
Fowler, 1915, Copeia, 24, p. 50.
Lutianus vivanus (Cuvier and Valenciennes)

Fowler, 1915, Copeia, 24, p. 50. (Deep-water form of the common red snapper.)

Lutianus megalophthalmus Evermann and Marsh
Metzelaar, 1919, Over tropische Atlantische Visschen, p. 67.

Family HAEMULIDAE

Haemulon eckmani Lönnberg
Lönnberg, 1895, Oefvers. Svensk. Vet. Akad. Vorh., 52, 657–663.

Family GERRIDAE

Diapterus olisthostomus (Goode and Bean)
Fowler, 1915, Copeia, 24, p. 50.

Diapterus plumieri (Cuvier and Valenciennes)
Fowler, 1915, Copeia, 24, p. 50.

Family SCIAENIDAE

Umbrina coroides (Cuvier and Valenciennes)
Fowler, 1915, Copeia, 24, p. 50.

Corvula subaequalis (Poey)
Fowler, 1915, Copeia, 24, p. 50.

Family BRANCHIOSTEGIDAE

Caulolatilus chrysops (Cuvier and Valenciennes)
Fowler, 1915, Copeia, 24, p. 50.

Family CHAETODONTIDAE

Chaetodon ocellatus Bloch
Cuvier and Valenciennes, 1831, Hist. Nat. Poiss., VII, p. 67.

Family CORIDAE

Iridio poeyi (Steindachner)
Fowler, 1915, Copeia, 24, p. 50.

Family SPARISOMIDAE

Cryptotomus auropunctatus Cuvier and Valenciennes
Cuvier and Valenciennes, 1839, Hist. Nat. Poiss., XIV, p. 290.

Sparisoma lorito Jordan and Swain
Jordan and Evermann, 1898, Fishes of North and Middle America, II, p. 1637.

Sparisoma rubripinne (Cuvier and Valenciennes)
Cuvier and Valenciennes, 1839, Hist. Nat. Poiss., p. 199.

Family ELEOTRIDAE

Sicydium vicente Jordan and Evermann
Jordan and Evermann, 1898, Fishes of North and Middle America, III, p. 2207.

Eleotris amblyopsis (Cope)
Hilgendorf, 1889, Sitz. Ges. Naturf. Berlin, p. 51–55.

Eleotris pisonis Gmelin
Regan, 1906–08, Pisces, Biol. Centr. Amer., p. 7.

Eleotris maltzani Hilgendorf
Hilgendorf, 1889, Sitz. Ges. Naturf. Berlin, p. 51–55.

Eleotris smaragdus Hil
Hilgendorf, 1889, Sitz. Ges. Naturf. Berlin, p. 51–55.

Sicydium buscki Evermann and Clark
Evermann and Clark, 1906, Proc. U. S. Nat. Mus., 30,854.

Evorthodus breviceps Gill
Hilgendorf, 1889, Sitz. Ges. Naturf. Berlin, p. 51–55.

Lophogobius cyprinoides (Pallas)
Günther, 1861, Cat. Fish Brit. Mus., III, p. 8.

Gobiosoma bosci (Lacépède)
Hilgendorf, 1889, Sitz. Ges. Naturf. Berlin, p. 51–55.

The following fossil species have been recorded from Haiti.

Shark remains of undetermined families.

Carcharodon megalodon
Moore, J. C., 1853, Quart. Journ. Geol. Soc. London, 9, 129–132.

Oxyrhina xiphodon
Moore, J. C., 1853, Quart. Journ. Geol. Soc. London, 9, 129–132.
Hemipristis serra
Moore, J. C., 1853, Quart. Journ. Geol. Soc. London, 9, 129–132.
Odontaspis dubius
Moore, J. C., 1853, Quart. Journ. Geol. Soc. London, 9, 129–132.

Family CICHLIDAE
Cichlasoma woodringi Cockerell
Cockerell, T. D. A., 1924, Proc. U. S. Nat. Mus., Vol. 63, Article 7. (Taken from locality considered to be of upper or middle Miocene age. It is of interest to note that a species of *Cichlasoma* is still abundantly found in Haiti.)

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CICHLID FISHES IN THE WEST INDIES WITH ESPECIAL REFERENCE TO HAITI, INCLUDING THE DESCRIPTION OF A NEW SPECIES OF *CICHLASOMA*.

JOHN TEE-VAN
General Associate, Department of Tropical Research

AN ANNOTATED LIST OF THE CYPRINODONT FISHES OF HISPANIOLA, WITH DESCRIPTIONS OF TWO NEW SPECIES.

GEORGE S. MYERS
United States National Museum

ADDITIONS TO THE FISH FAUNA OF HAITI AND SANTO DOMINGO.

WILLIAM BEEBE
Director, Department of Tropical Research
and
JOHN TEE-VAN
General Associate

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CICHLID FISHES IN THE WEST INDIES WITH ESPECIAL REFERENCE TO HAITI, INCLUDING THE DESCRIPTION OF A NEW SPECIES OF *CICHLASOMA*.[1]

JOHN TEE-VAN
General Associate, Department of Tropical Research

(Figs. 269-272 incl.)

OUTLINE

INTRODUCTION

The present paper is a continuation of studies made on the fishes of Haiti which were started in 1927 under the direction of Dr. William Beebe, as a result of the Haitian Expedition of the Department of Tropical Research of the New York Zoological Society. The marine fish of the island were reported upon by Beebe and Tee-Van in 1928, the mainly freshwater families Cichlidae and Poeciliidae being omitted in their ac-

[1] Contribution No. 475, Department of Tropical Research, New York Zoological Society.

count. The specimens of the former family are here reported upon, and the fishes of the latter will be treated by Dr. George S. Myers of the United States National Museum.

Cichlid fishes have been the source of considerable controversy, both as to their distribution, recent and fossil, and as to the validity of many species. The present paper, it is hoped, will add to the understanding of the Antillean forms.

CICHLID FISHES IN THE WEST INDIAN ISLANDS EXCLUSIVE OF HAITI

Fishes of the family Cichlidae have at one time or another been reported from the following West Indian Islands: Trinidad, Barbados, Jamaica and Cuba, in addition to the records that are the subject of this paper.

TRINIDAD: As far as the West Indian Islands are concerned, the Trinidad records may be immediately dismissed. The zoological affinities of Trinidad with South America are so close that there is no reason for considering the island as part of the West Indian archipelago, and this is further borne out by the fact that the Trinidad cichlids are also known from the neighboring mainland.

BARBADOS: The record of *Cichlasoma adspersum* (Günther, 1862) from Barbados is exceedingly questionable. Hubbs (1920, p. 4) has shown that the single specimen upon which the species was based falls easily within the range of variation of the Cuban species, *Cichlasoma tetracanthus*. In confirmation of this it may be stated that Pellegrin (1904), who had specimens of *Cichlasoma* from Cuba, gave them the name *adspersum*, thus suggesting the similarity if not identity of the fish of the Cuban and Barbadian records. Later, Myers (1928, pp. 34-35) stated that he chose to believe for the present that the Barbadian record was an error. As the species has been unrecorded from Barbados or any of the surrounding islands since the original description, and as the single specimen can be shown to be identical with the Cuban species, I see no reason for not concluding that the Barbadian record was an error, and that *adspersum* should be relegated to the synonymy of *tetracanthus*. Hubbs (1920) has already come to this conclusion.

JAMAICA: Pellegrin (1904, p. 187) recorded *Cichlasoma octofasciatum* (Regan), a Central American cichlid, from Jamaica. This record is most likely an error, although it is quite possible that cichlids may be found on the island, as the geographical location of the island is within the range of the genus. However, the probability of a Jamaican species of *Cichlasoma* being identical with one from Central America, considering the high degree of speciation to be found in the latter region, is very small. Under any circumstances, Pellegrin's record need not trouble us as far as the Cuban and Haitian forms discussed in this paper are concerned, as the specimen he recorded belonged to the group in *Cichlasoma* possessing eight to ten anal spines, while the others mentioned have but four.

CUBA: Cichlids have long been known from the island of Cuba, *tetracanthus* having been described by Cuvier and Valenciennes in 1831. During recent years the systematic treatment of the Cuban cichlids has been rather a tempestuous one. It may briefly be reviewed as follows:

Eigenmann in 1904 studied a series of 236 specimens from the island, and came to the conclusion that "An examination of all of these proves either the presence of several instead of a single species or a remarkable variation with localities." He hesitatingly divided his specimens into five subspecies of *tetracanthus,* and one new species, *nigricans,* stating, however, that, "I venture to describe here certain of the aberrant forms as new, without, however, feeling that they are distinct varieties or species, or that some of the other forms referred to *H. tetracanthus* are not also new."

Pellegrin in his revision of the Cichlidae (1904) determined all of his Cuban specimens as *adspersum,* listing no specimens under the name of *fuscomaculatus,* the synonym that he chose to use in place of *tetracanthus.*

Regan in his 1905 revision of the genus *Cichlasoma,* synonymized, without comment, under *C. tetracanthus,* all of the forms erected by Eigenmann. His action was based on twenty-six of Eigenmann's specimens.

Eigenmann in his "Catalogue of the Fresh-Water Fishes of Tropical and South Temperate America," (1909), disagreed with this decision, as he restored all of his original subspecies and species to full specific rank.

Hubbs in 1920 examined part of the material upon which Eigenmann had worked, and some additional specimens. After reiterating Eigenmann's account of the extreme variability of the Cuban forms and otherwise discussing the situation, he states: "In other words, the variations have at most an imperfect geographical significance. The variations in form possibly are sexual, for some large individuals are slender, while others are robust; the variations in color are perhaps correlated with sex, and imperfectly with age. Most of the variations, however, seem to be of an individual, rather than racial, sexual, or age, character."

Hubbs also reviewed the status of each of the species and subspecies named by Eigenmann and concluded that, "Unless further evidence of their distinctness is forthcoming, therefore, more than one form of cichlid can scarcely be recognized in Cuba."

To summarize the West Indian situation, it is apparent that, omitting Haiti, cichlid fishes are definitely known in the West Indian islands only from Cuba, that the Cuban fish is an exceedingly variable one, and that while the present Jamaican record is questioned, it is quite possible that fishes of this group will be found on that island.

In connection with the variability of the Cuban fish, it is of interest to record the present distribution of the species of *Cichlasoma* on the mainland of Central and South America. The distributions given in Eigenmann's Catalogue (1904) plus the ranges given for new species since the publication of that volume result in the following tables:

RANGE *South America*	Number of Species Recorded
Paraguay to Trinidad	1
Paraguay to Orinoco	1
La Plata Basin	1
La Plata Basin and S. E. Brazil	4
E. Central Brazil	1
Amazons	4
Amazons, Guiana	4
Rio Negro and Orinoco	1

Range	Number of Species Recorded
South America (continued)	
Ecuador	2
Colombia	4
Total Number of South American Species	18
Central America	
Panama and Colombia	1
Panama	5
Panama and Guatemala	1
Costa Rica	8
Nicaragua	14
Salvador	1
Honduras	1
British Honduras	1
Honduras and Guatemala	1
Guatemala	13
Guatemala to Mexico	3
Mexico to Nicaragua	1
Mexico	21
Total Number of Central American Species	71

These tables are suggestive when the variability of the Cuban form is taken into consideration. They show that in the continental mass of South America, species are relatively few in number and on the whole possess wide distributions. In Central America the condition is quite different. Here the variability of the fishes of the genus has expressed itself in the production of some 71 known forms, four times as many as in the much larger but more uniform land mass of South America. The recorded ranges of the Central American fish are also much smaller, many being restricted to one river or lake system. Although the geographical conditions in the two regions are quite different, it is felt that the large number of species from Central America may be the result of lack of comparative material, both geographical and as far as size and sex are concerned, and, judging by the Cuban fish, that many of the pres-

ent recognized species may represent but phases or local races of other species.

CICHLID FISH IN THE ISLAND OF HAITI (HISPANIOLA)

The presence of fishes of this family in the island of Haiti was unknown until 1924, when Cockerell described a fossil species, *Cichlasoma woodringi,* from upper or middle Miocene strata.

In 1928 Myers noted the first living fish, as the result of a specimen taken in the Gurabo River in the northern part of the Dominican Republic. He stated that his single specimen "is close to or identical with *C. tetracanthus* of Cuba, differing only slightly from Regan's description of that fish. The pelvic fins reach the anal fin, the caudal peduncle is nearly as long as deep, and the dorsal spines increase in length to the ninth, thence slightly decrease to the last." This description differs from the material from the Haitian Expedition, and will be noted later.

During the Haitian Expedition of the Department of Tropical Research many cichlids were observed and sixty-nine specimens ranging from 23 mm. to 215 mm. were preserved.

An examination of this material reveals a considerable amount of variation, both in form and in color, the latter ranging from pale gray to brownish black, with and without black bands, bars and spots. These variations are somewhat difficult to correlate with other factors. However, field notes seem to bear out that there is a sexual difference in some of the color variations, as a pale and a dark colored specimen were often taken at the same time. Unfortunately, our smaller sized material is not sufficiently well preserved to determine this question. The variations in form, while not as extensive as those shown by the Cuban fishes, are still quite considerable.

IDENTIFICATION OF THE CONTEMPORARY HAITIAN SPECIES AND COMPARISON WITH THE CUBAN FORM

The Haitian fishes examined are from four localities and three drainage basins, as follows:

1—Gurabo River near Las Quemados, Santo Domingo. This is in the drainage basin of the Rio Yaqui del Norte.
2—Hinche, on the Guayamouc River, Haiti. This is part of the Artibonite River system.
3—Étang Saumâtre, a saline lake in the Cul-de-Sac Plain of Haiti.
4—Grande Rivière de Cul-de-Sac, in the plain of the same name in Haiti.

The two last mentioned localities are in the same general basin, and although the lake has no outlet and is separated from the river by a distance of approximately 10 kilometres, the fishes of the two localities appear to be the same.

Examination of the material reveals that the Haitian fish is close to the Cuban species, as might be expected, and that the situation is similar to the one in that island as far as apparent variability is concerned. It is also evident from this relatively scanty material that specimens from the other drainage basins of Haiti are needed for comparison, as variation correlated with locality is indicated by the materials.

These conclusions are based on the following facts:

1. The Gurabo River specimen, from a basin separated from those of the other fishes, is evidently a separate form. In appearance and measurements it is different from our Cul-de-Sac Plain specimens, but its relationship is difficult to establish on the basis of a single fish. This specimen is the one that Dr. Myers reported upon in 1928, and he will report further on it in other publications. Whether the differences demonstrated by this fish from the other Haitian fishes are to be ascribed to variation or whether each of the drainage basins possesses a separate form will depend upon the procuring of additional specimens.

2. The Hinche specimens from the Artibonite basin cannot be directly compared either with the Gurabo River or the Cul-de-Sac Plain fish, because of the disparity in size. The three fish are 141 mm., 161 mm. and 215 mm. long, while the largest Cul-de-Sac fish is 117 mm. Apparently they are close to the latter fish and in the chart they have been included as part of the growth stages. Smaller material from the Artibonite basin is needed for comparison.

3. As has been mentioned, the fish of the two localities in the Cul-de-Sac Plain are the same as far as can be determined. There is considerable variability in the group, but as a whole they are more uniform than the Cuban forms.

To demonstrate the similarity of the Cuban and Haitian forms, the following table, listing Regan's and Eigenmann's descriptions of Cuban fish plus the characters of the Haitian fish, has been made:

CHARACTER	*Cuban Fish*		*Haitian Fish*
	Regan	Eigenmann	Cul-de-Sac Plain and Hinche
Depth in length	2 to 2.6	2 to 2.7	2.2 to 2.65
Head in length	2.5 to 3	2.6 to 2.7	2.3 to 2.85
Eye in head	3 to 4.3	3.5 to 5	3 to 5.4
Snout	Shorter than postorbital head	Same	Slightly shorter than postorbital head
Maxillary	Extending to below anterior margin of eye	Same	Not quite reaching anterior margin of eye
Premaxillary Process	Extends to above anterior third of eye	———	Same
Jaws	Equal, or the lower slightly projecting	Same	Same
Gill-Rakers	8 to 10	———	Same
Scales	28 to 31	27 to 29	30 to 32
Dorsal Fin	XV-XVI, 10 to 12	XIV-XVI, 10 to 12	XIII-XV, 11 to 12
Anal Fin	IV, 8 to 10	IV, 8 to 10	IV, 8 to 9

The chart (Fig. 269), illustrating a few of the characters mentioned above, shows some of the changes related to age. It emphasizes the unreliability of comparison of unequal sized specimens in this group of fishes.

While the similarity of the Haitian fish to the Cuban is quite close, there are also differences to be observed. Because of the variation of the forms, comparisons are not as easy to make as they might be, but some of the differences are given in following paragraphs.

A character that is not well demonstrated in the table given

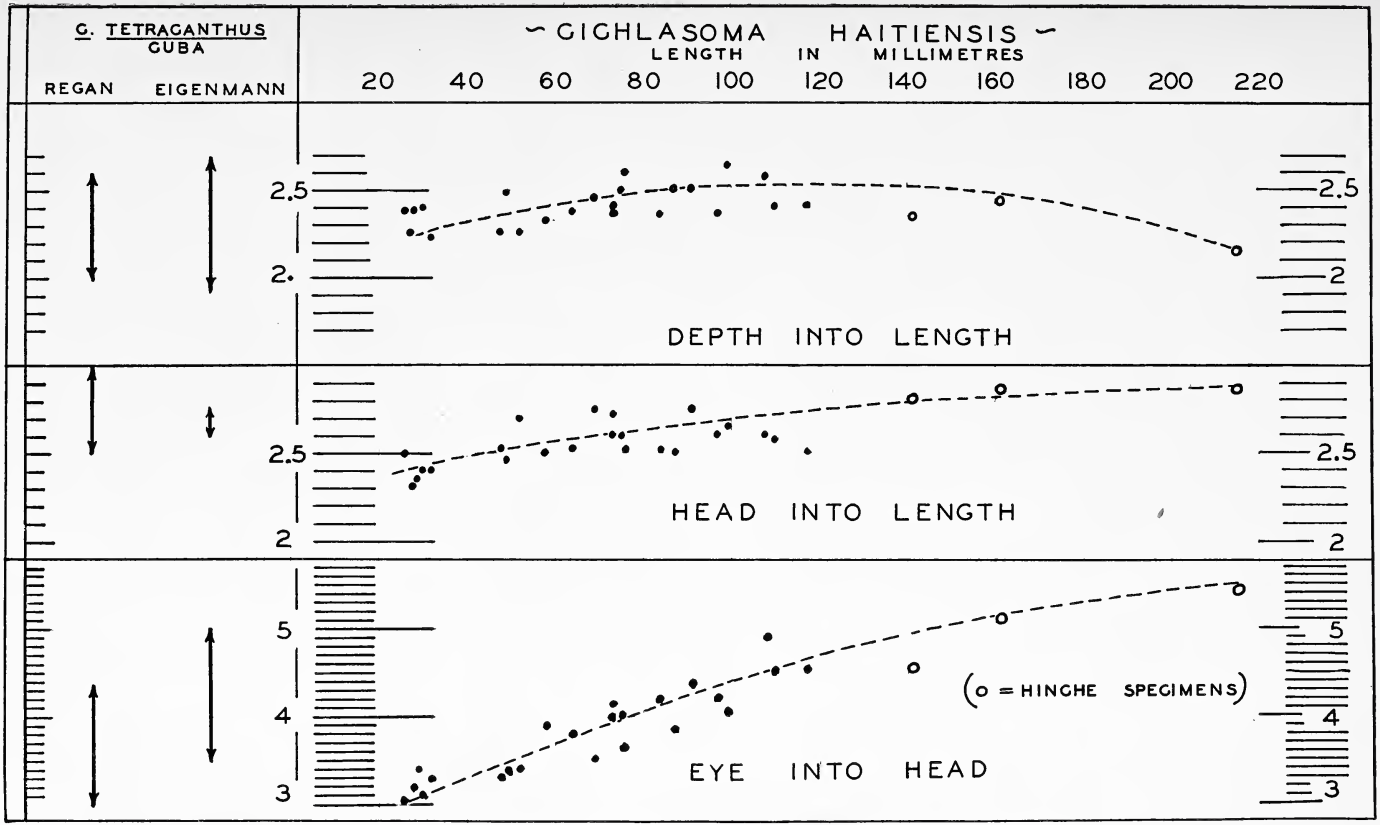

Fig. 269. Proportions of *Cichlasoma haitiensis* correlated with growth, and comparison of proportions of *Cichlasoma tetracanthus* of Cuba as recorded by Regan and Eigenmann.

above is the difference in the number of spines in the dorsal fins of the Cuban and Haitian fishes. When we compare the data given by Eigenmann for his 236 Cuban fishes with that of the Haitian series, we find that the Haitian fish average one dorsal spine less than those of Cuba. The following table, based on 305 specimens, shows how this average works out:

Species	Total Number of Specimens	Number of Dorsal Spines			
		13	14	15	16
Cuban	236	—	1	233	2
Haitian	69	2	61	6	—

Considering that the difference is based upon a relatively large series of specimens, and that there is no likelihood of contact between the Cuban and Haitian forms, there is no hesitation in establishing a name for the Haitian Cul-de-Sac Plain fish, *Cichlasoma haitiensis*, based on this character and others to be mentioned. It will be of interest to see whether this average difference can be demonstrated for all Haitian fish or whether it is true only of the present Cul-de-Sac Plain and Hinche material.

In addition to the difference in the dorsal fin count, the Haitian fish have a slightly longer snout and a somewhat greater scale count than those from Cuba. These characters are included in the description of the species on page 294.

COMPARISON OF THE CONTEMPORARY HAITIAN SPECIES WITH THE HAITIAN FOSSIL FORM

Cockerell, in 1924, as has been mentioned, described a fish from Miocene beds from the vicinity of Los Cahobas, Haiti. This species, as indicated in the following table, is exceedingly close to the living Haitian fish. The similarity of the fossil species to the modern is paralleled in the plants that were taken at the same time and place as the fossil fish and recent plants.

This is emphasized by Berry (1923). In speaking of the locality at which *Cichlasoma woodringi* was taken and referring to the plants taken at the same location, he states (p. 3): "The locality W 185 F, which is considered of middle or upper Miocene age, contains the same *Gymnogramme* found at two other localities which are also referred to the Miocene. In the absence of clearly defined stratigraphic evidence I would be inclined to consider all three localities of the same age. Although the present collections are not conclusive, I would be inclined to regard the few Miocene plants collected as pointing to late, rather than to early Miocene age." Later, on the same page, is this statement: "The flora described is too small to be of any special significance. It is, perhaps, superfluous to point to its modern facies and tropical character."

In order to compare the fossil with the modern species, a 74 mm. modern fish from Étang Saumâtre has been chosen, a length comparable to that of the fossil, and its characters listed side by side with those of Cockerell's original description.

Comparison of the Contemporary Haitian Species with the Fossil Haitian Form

Character	*woodringi* Original description	*haitiensis*
Dorsal fin count.....	XIV, 10 or 11	XIV, 11
Anal fin count.....	IV, 10	IV, 10
Base of pelvic fin.....	Distinctly before level of beginning of dorsal fin.	Slightly behind level of beginning of the dorsal fin
Body shape.....	Practically as in *tetracanthus*	Same
Lower Jaw.....	Somewhat protruding	Same
Scales	Quadrate, a little over 2 mm. broad, with 7 to 14 basal radii, and in the apical field, fine, ctenoid elements arranged in decussating series. (Position of scale not stated)	Quadrate, 3.5 mm. long by 3.84 mm. deep, 7 to 12 basal radii, fine ctenoid elements in apical field arranged in interdigitating rows (Scale from middle of side)

Comparison of the Contemporary Haitian Species with the Fossil Haitian Form

Measurements in Millimeters:

	woodringi	*haitiensis*
Eye	7.5	7.5
Orbit to end of lower jaw	About 16	10
Orbit to end of upper jaw	" 14	9.3
Length of spinous dorsal	" 21	25.2
Length of soft dorsal	" 9	10.2
Length post. dorsal spines	" 9	8.7
Length soft dorsal rays	Over 10, damaged	13.5
Vertebrae in region of soft dorsal	3 in about 4.4	Length of one vertebra 2.3
Longest anal spines	About 10.5	9.4
Soft anal rays	Over 21	16
Tip of lower jaw to base of anal fin	46	52
Base of pelvic to base of anal fin	About 20	22
Depth of body at level of pelvic fin	26.6	28.2
Depth of body at about end of soft dorsal fin	12.3	12

Examination of the table reveals the following differences between the fossil and living forms. The fossil species is described as having:

1. Pelvic fin base distinctly before the origin of the dorsal fin, instead of equal to or slightly behind.
2. Smaller sized scales.
3. Different sized vertebrae.
4. Shorter anal rays.
5. Longer distance between the orbit and the tips of the upper and lower jaws.

In order to check up on these differences, Dr. George S. Myers, Curator of Fishes at the United States National Museum, was asked to reexamine the fossil fish. His notes, which he has given me permission to quote and for which I tender my thanks, are as follows:

"I have obtained the type of *Cichlasoma woodringi* from Dr. Gilmore and examined it under a binocular. It is on a slab of very friable material. I find that there are very clearly 15 dorsal spines, instead of 14 as given by Cockerell, and 10 soft rays. There are four anal spines, though part of the last is split off and looks like a fifth. The soft anal rays cannot be counted.

"In examining the scales and other external features I have picked out a *Cichlasoma* from Source Trou Caiman, Haiti, collected by Dr. R. M. Bond, of exactly the same size as the fossil,

and used it as reference. On the type slab, the scales are well preserved only on the breast at the region which would be covered by the appressed pectoral. Referring to the recent fish I find the scales at that point *exactly* like those of the fossil in size, and so far as I can see, in ornamentation as well.

"As the principal diagnostic character of *C. woodringi,* Cockerell uses the anterior position of the pelvics. I have carefully examined these fins and their bases in the type. They are scarcely 3 mm. anterior to the position in the recent Trou Caiman fish. Furthermore, the fossil has been much crushed and the bones disarranged in the thoracic region and I have little doubt that the right pelvic has been pushed forward out of its normal position.

"In all other ways in which it is possible to compare the fossil with the recent fish, such as head length, shape of body, etc., I can see no specific differences whatever between the type of *C. woodringi* and the recent specimen from Trou Caiman."

These notes of Dr. Myers remove the different sized scales, the disparity in the position of the pectoral fins, and the difference between the measurements of the distance between the jaws and the eye—the latter two evidently being due to the compression and consequent forward extension of the anterior part of the fish during fossilization—from the alleged distinction between the fish. Two characters remain, the shorter anal rays and the difference in vertebrae size.

As far as the rays are concerned the difference is not an especially good one, as there might easily be sufficient variation to account for this.

The difference in size of vertebrae, however, seems to constitute a real distinction between the two forms. The difference in measurements has already been noted. Dr. Myers in his reexamination of the holotype of *C. woodringi* states: "I have worked out the number of vertebrae as follows: There appear to be two (plus hypleural = 3) lost at the tail. By gently working off the matrix which shows as a light blotch across the fish in Cockerell's plate, I can count all the rest of the caudal vertebrae, and by counting the neural spines, get the number of abdominal centra. My count is 33 (including the hypleural as one of these) or 14 plus 19. I do not think that there can be an error of more than two in my count."

For comparison with this data the vertebrae counts of six Étang Saumâtre specimens have been tabulated. All six agree in possessing the same number of vertebrae that Regan recorded for modern Cuban *C. tetracanthus*—13 abdominal, plus 15 caudal, plus 1 hypleural (urostyle).

It is evident, therefore, that, even accepting Dr. Myers' minimum count of 31, the fossil cichlid can be distinguished from the contemporary form by slightly smaller and more numerous vertebrae. The distinction can be shown thus:

		Abdominal	Caudal	Urostyle (Hypleural)	Total
C. woodringi	1 spec.	14	16 or 18	1	31 to 33
C. haitiensis	6 spec.	13	15	1	29

DESCRIPTION OF A NEW SPECIES OF HAITIAN CICHLID FISH

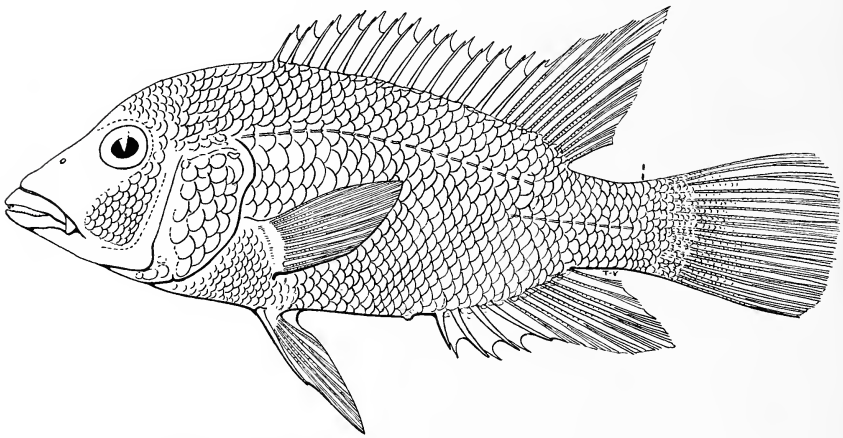

Fig. 270. *Cichlasoma haitiensis* Tee-Van. Type specimen, 108 mm. standard length.

Cichlasoma haitiensis new species

TYPE: No. 7302, Haitian Expedition, New York Zoological Society, Étang Saumâtre, near Maneville, Cul-de-Sac Plain, Haiti, March 15, 1927; standard length 108 mm. Type in the

collections of the Department of Tropical Research of the New York Zoological Society.

Sixty-five specimens from the type locality and Grande Rivière de Cul-de-Sac, plus three specimens from Hinche, are also in the collection.

FIELD CHARACTERS: Small to medium sized, compressed fishes living in fresh water, occasionally in brackish, with a long dorsal fin composed of rays and spines, the spinous portion longer than the soft; a single nostril on each side of the head; small canine teeth present anteriorly. Grayish to brownish black, variable; body plain or with small black spots. Occasionally dark vertical bands are present and a common color pattern is a spot at the base of the tail, one on the middle of the sides and one at the upper margin of the opercle.

DESCRIPTION:[2] Depth of body 2.2 to 2.65 (2.56) in the length; length of head 2.34 to 2.75 (2.7); snout slightly shorter than or equal to postorbital part of head (2.7); diameter of eye 3 to 5 in head (4.7); interorbital space slightly less than eye diameter in a 29 mm. fish and a 57 mm. specimen, slightly greater than eye diameter in a 117 mm. fish (3.9 in head in type), once and two-thirds the eye diameter in a 215 mm. Hinche fish. Maxillary slightly exposed (2.95 in head) extending to just below the anterior margin of the eye or not quite reaching the eye; jaws equal or the lower slightly projecting; preopercle with a shallow notch on its posterior limb; teeth of the upper jaw with anterior pair of teeth enlarged, in larger specimens two or three pairs are enlarged; lower jaw with two or three pairs enlarged, forming weak canines; fold of the lower lip continuous; 8 to 10 gill rakers on the lower part of the first arch; 5 branchiostegal rays. Scales 30 to 33 plus a few small scales on the caudal, 4 between the lateral line and the anterior part of the soft dorsal, 7 between the lateral line and the origin of the spinous dorsal, a small sheath of scales, especially noticeable on the soft dorsal; lateral line pores averaging 18 to 20 plus 9 to 11. Dorsal fin XIII to XV, 11 to 12, the first spine short, the spines then gradually increasing to the last, but occasionally the penultimate 4 or 5 are equal in length and the last spine

[2] For ease of comparison the order of description is the same as that used for *tetracanthus* by Regan. The proportions are those of a series of 25 specimens examined and measured. The proportions of the type specimen are given in parentheses.

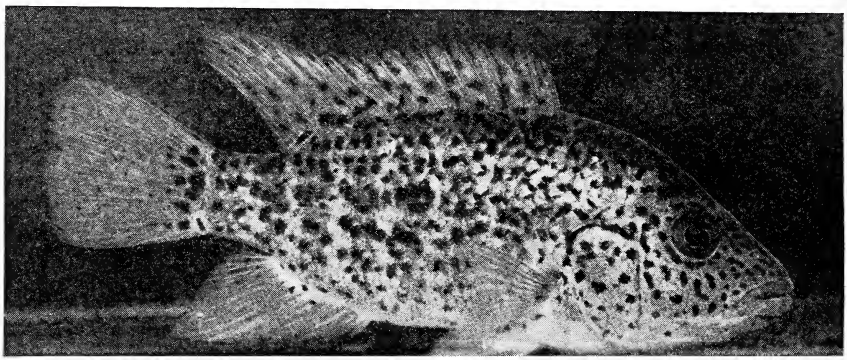

Fig. 271. *Cichlasoma haitiensis.* Specimen from Étang Saumâtre, Haiti, 100 mm. standard length.

longest; soft dorsal fin tip extending, when laid back, from the base of the caudal fin in small, to almost to the tip of the caudal fin in large, specimens. Anal IV, 8 to 10. Pectoral fin tip not reaching to the vertical of the origin of the anal fin; pelvic fin reaching the anus or slightly beyond, in some specimens shorter. Caudal subtruncate or rounded. Profile rounded from dorsal fin to eye, then more or less straight from eye to snout.

Color highly variable. Pale gray through olivaceous brown to almost black, with varying degrees of the following patterns: Some or all of the patterns may be completely absent. Body with small black spots. A series of vertical bands on the body, most prominent in small fishes. A black spot on the middle of the

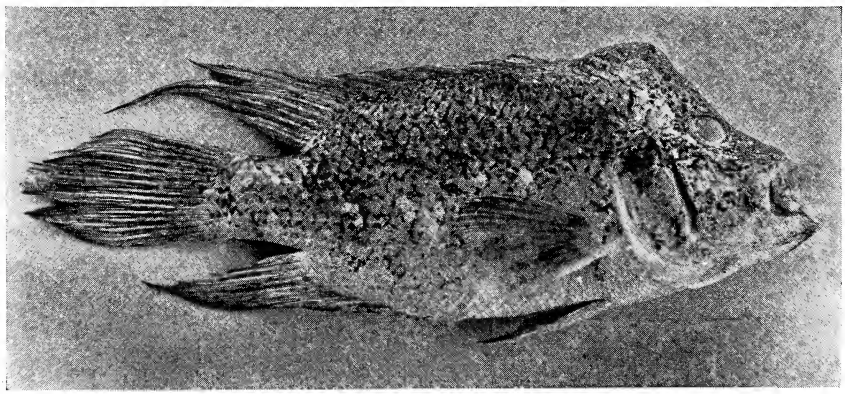

Fig 272. *Cichlasoma.* Specimen from Hinche, Gurabo River, Haiti, with gibbous forehead, standard length 215 mm. This is the largest specimen mentioned in this paper.

sides, another at the base of the caudal, and a much paler one at the origin of the lateral line; these three spots, especially in small fish, sometimes connected by a narrow black line. Fins pale to dusky; in dark specimens the fins are almost as black as the body.

The three large specimens from Hinche have not been included in the above description. They are very close to the present species and may be the same. The disparity in size makes comparison impossible.

Larger specimens have gibbous foreheads, as is usual among cichlids and some other families.

NATURAL HISTORY NOTES

COMMON NAME: In Haiti these fish are known as "Odo."

OCCURRENCE IN HAITI: This species has been taken by the Haitian Expedition at the following localities: Fresh water stream at Maneville, Étang Saumâtre, and various places in Étang Saumâtre to the eastward of Maneville; Grand Rivière near the Agricultural Station in the Cul-de-Sac Plain. It is probably distributed through the streams of the basin.

Étang Saumâtre[3] is brackish, the salinity being about one-fifth that of sea water. It has no drainage at present, and it is fed by small streams.

ABUNDANCE: In many localities, such as those at Étang Saumâtre, this is a common species. In this lake they were sufficiently abundant to be a source of food for the natives, and small baskets of these fish were observed being carried to town.

METHOD OF CAPTURE: Taken by us mostly in small seines. The natives capture them by using sheets of cloth in place of seines. These they manoeuver under the fish and then rapidly bring water, fish and all to the surface. One small Negro boy was especially adept at capturing Odos. His method was to stalk a fish and chase it into a small cavity in the bottom. He then dived under, closing up the cavity with his hands, and removed the fish.

[3] For details of this lake *see* Woodring, Brown and Burbank, 1924.

SOCIABILITY: The majority of these fish were found solitarily or in pairs, rarely in small groups of six to eight. They were often seen in considerable numbers among schools of poecilids. This was especially true of localities in Étang Saumâtre along rocky shorelines where fresh water streams ran into the lake. In the Grand Rivière they were found in company with fresh water mullets, *Agonostomus monticola* (Bancroft).

FOOD: The stomach contents of numerous individuals from Étang Saumâtre included algae and other water plants and quantities of small white turret shells. Dead shells of this mollusc were exceedingly abundant along the shores of this lake.

SIZE AT MATURITY: Fishes of 75 mm. standard length are capable of breeding. An 87 mm. fish taken on March 15 contained about 300 eggs ready for spawning, each egg being a broad oval, 1.5 mm. by 2 mm. in diameter. A male of 112 mm. taken on the same day had considerably enlarged gonads.

SUMMARY

Cichlid fishes have been reported, excluding Trinidad as belonging, zoologically, to the continental mass of South America, from the West Indian islands of Barbados, Jamaica, Cuba and Haiti.

The Barbados record is considered as an error in locality for a Cuban fish.

The Jamaican record is also a questionable one, although it is quite possible that cichlid fishes will be found on that island. The fish upon which the Jamaican record was based belonged to the group of species possessing 8 to 10 anal spines, while those of Cuba and Haiti, with which this paper is concerned, have but four.

The history of the Cuban fish shows that this form is exceedingly variable, the variation having resulted in the description of five new subspecies and one species, all of these later being synonymized under *tetracanthus*. It is probable that further field study will show that some of the Cuban forms can be correlated with factors such as sex.

In connection with the variability of the Cuban fish, the species of *Cichlasoma* from Central and South America have

been tabulated, with the result that it is shown that in the smaller but more varied land mass of Central America there are four times as many species as in the larger but more uniform mass of South America. Although it is evident that there is a great deal more variation in the northern portion of the range of the genus, it is also suggested that, judging by the Haitian and Cuban species, many of these forms may later be shown to be variations or phases of other species.

Cichlid fishes are known in Haiti from a fossil species described by Cockerell, from a contemporary specimen reported by Myers and from the present Haitian Expedition material.

Examination of the contemporary Haitian fish reveals that it is close to *tetracanthus* of Cuba. From the scanty material at hand it seems that there is either a separate form from each of the drainage basins from which specimens are at hand, or that there is wide variation, as has been found in Cuba.

The Haitian Cul-de-Sac Plain specimens, when compared with the Cuban form, show an average lesser number of spines in the dorsal fin, a longer snout and a slightly greater number of scales. Whether the difference in number of spines of the dorsal fin will hold true of the Haitian fishes as a whole, or whether it represents merely the characters of the Cul-de-Sac Plain fish, is not known. The Cul-de-Sac Plain fish is considered as a new species, *Cichlasoma haitiensis*.

Comparison of the living Haitian fish with the Miocene fossil *Cichlasoma woodringi* Cockerell, has been made. From a reexamination of the fossil by Dr. George S. Myers, Curator of Fishes of the United States National Museum, and comparison with a contemporary specimen, it is evident that the fossil fish cannot be distinguished externally from the living form. However, the fossil form has smaller and more numerous vertebrae, and for the present this species must be maintained.

A new species, *Cichlasoma haitiensis*, is described from Cul-de-Sac Plain fishes.

Natural History notes are given relating to Common Name, Occurrence in Haiti, Abundance, Method of Capture, Sociability, Food and Size at Maturity.

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AN ANNOTATED LIST OF THE CYPRINODONT FISHES OF HISPANIOLA, WITH DESCRIPTIONS OF TWO NEW SPECIES[1]

GEORGE S. MYERS
United States National Museum

(Figs. 273-279 incl.)

The cyprinodont fishes obtained in Haiti by Dr. William Beebe and Mr. John Tee-Van in 1927 were turned over to the writer for study in connection with his work on the fishes of Hispaniola. Since the final paper revising and illustrating the fresh-water fish fauna of the island will be still further delayed, it seems best at this time to list the known species of the cyprinodonts and bring together the rather scattered recent literature on the group. In listing the species I have briefly recorded the specimens obtained by Dr. Beebe's expedition. The full data on this material will be set forth later in my monograph.

Besides the cyprinodonts, the fresh-water fish fauna of Hispaniola includes only one (or perhaps two) cichlids, an *Agonostomus*, and a few gobies. Since the marine fishes and the cichlids have already been covered in other papers in this volume of ZOOLOGICA, the present contribution practically completes the list of the known fishes of the island.

I wish to thank Dr. Beebe and Mr. Tee-Van for the use of their important material and for their interest and help. The figures illustrating the paper were made by Mr. Pablo L. Bravo. The drawings of *Mollienisia dominicensis* and *Limia dominicensis* were made at the expense of the United States National Museum.

Family CYPRINODONTIDAE
Subfamily *Fundulinae*
Genus *Rivulus* Poey

Rivulus heyei Nichols

Rivulus heyei Nichols, 1914, p. 143 (Saona Isl.); Myers, 1925, p. 370 (on holotype); Myers, 1927, p. 123 (name only).

This species is as yet known only from the holotype, 20 mm. long, and not in particularly good condition. Mr. Nichols tells me that the specimen was found swimming in the camp water-bucket by Mr. de Booy while he was camping on Saona Island, off the southeastern coast of Hispaniola. If it were not for the fact that this detail of the collecting is remembered, I should be inclined to doubt the locality, since *Rivulus* has never been taken on Hispaniola itself. However, the various species of the genus are very secretive, usually inhabiting masses of vegetation in very small bodies of

[1] Published by permission of the Secretary of the Smithsonian Institution.
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water. Search should be made for *Rivulus* in such places all over the main island.

R. heyei is not well distinguished from the Cuban *R. cylindraceus* and more material must be secured before its systematic status is clear.

Subfamily *Cyprinodontinae*
Genus *Cyprinodon* Lacépède

I have experienced some difficulty in attempting to determine the position of a species, described below as *Cyprinodon bondi,* in accordance with Hubbs' key to the genera of American Cyprinodontinae (Hubbs, 1926, p. 16). It soon became apparent that some of the characters used by Hubbs to separate his new genus *Floridichthys* from *Cyprinodon* were not constant, but that others not hitherto noticed set *Floridichthys* apart as a very distinct genus. My difficulty was caused by the fact that adults of *bondi,* although the fish is undoubtedly a member of the genus *Cyprinodon,* agree with most of the key characters given by Hubbs for *Floridichthys.* I give revised definitions of the two genera below.

Cyprinodon

1. Nearly all of the preorbital area (excepting the upper part, on a level with the nostrils) scaly, the free edges of the scales directed upward; squamation always rising in front above level of lower part of eye.
2. Anterior edge of squamation of top of snout formed of several scales which are usually somewhat irregular, leaving a variable (usually rather narrow) naked area between them and the premaxillary groove.
3. Scaly flap separating pelvic fins usually short and somewhat irregular; it is composed of one or two distal scales and two to five basal scales, all of which are to some degree asymmetrical.
4. Inner border of iris smoothly oval.
5. Dorsal fin of adult males smaller and higher, the last two rays much shorter than the longest anterior ones.
6. Caudal peduncle either somewhat slender throughout or else deep anteriorly and constricted at caudal base.
7. Scales rather thin and squamation in general less regular; dorsal origin more posterior; almost always an ocellus or dark spot on the basal part of the last dorsal rays in the female.

Floridichthys

1. Preorbital area naked above a line running down from the lower part of the orbit to the lower part of the maxillary; anterior cheek squamation not rising above level of lower part of eye.
2. Anterior edge of squamation of top of snout formed of one broad, regular plate, emarginate in front, covering nearly whole width of snout, and leaving a rather wide naked area between it and the premaxillary groove.
3. Scaly flap separating pelvic fins long, strictly regular, and symmetrical, composed of two large, wide, regular scales in tandem order, the distal one elongated.
4. A small, pointed projection of the iris extending down over the upper part of the pupil of the eye.
5. Profile of erected dorsal fin of adult males lower and more broadly rounded, the last two rays almost as long as the highest anterior ones.
6. Caudal peduncle uniformly very deep.

7. Squamation heavy and very regular; dorsal origin more anterior; no ocellus or dark spot on the basal part of the last dorsal rays in the female.

From the above it will be seen that I have totally abandoned the enlargement of the humeral scale, the restriction of the branchial apertures, and the ciliation of the scales as differences between these two genera. In *C. bondi* the humeral scale of the adult is not normally enlarged, although a few specimens show it and it is always more or less evident in the young. The branchial openings of *bondi* are as large as those of *carpio*, the genotype of *Floridichthys*, and there is little difference between *bondi* and certain other species of *Cyprinodon* (*elegans*, *macularius*) in this character. Adult male *bondi* do not show the ciliation of the scales of other forms of *Cyprinodon*, except slightly on the cheek, where the ctenii are usually strongest.

Jordanella agrees with *Cyprinodon* rather than with *Floridichthys* in the frontal and preorbital squamation, but differs from both in the greatly reduced (and sometimes absent) scaly flap between the pelvics. Further, *Jordanella* does not show the peculiar tongue of iris, and I believe that, on the whole, it is much more closely related to *Cyprinodon* than to *Floridichthys*. The Old World genus *Aphanius* is very close to *Cyprinodon* but differs, besides the elongate form, in the more weakly united premaxillaries. The surfaces at the point of junction are small, and the median, posteriorly directed, premaxillary processes are decidedly narrower than in the American genus. *Tellia*, from the Atlas region of northwest Africa, is said to differ from "*Cyprinodon*" (equals *Aphanius*) only in the absence of pelvic fins, a character of doubtful value since *Cyprinodon macularius* often (and *C. diabolis* almost always) lacks these fins. I have seen no material of *Tellia*, but the published figures lead me to suspect that it is not as close to *Aphanius* as has been supposed. Its body and head form, though shorter, reminds one of *Empetrichthys*, and its pharyngeals and other characters need reexamination.

Cyprinodon bondi, new species

DIAGNOSIS: A very large *Cyprinodon*, the adults reaching at least 82 mm. total length, this being in excess of any known member of the genus. It is remarkably different from all others known to me in the large size, high scale count (28 to 30 to end of hypural), the lack of enlargement of the humeral scale in the adult, the long straight predorsal profile, and the slightly emarginate (or at least very sharply truncate) caudal fin.

HOLOTYPE: U.S.N.M. 100960. Adult female, 66 mm. standard length, 82 mm. total. Étang Saumâtre, Haiti, Feb. 20, 1933. R. M. Bond.

PARATYPES: U.S.N.M. 100961. Ten smaller specimens, the largest 35 mm. standard length. Same locality, date and collector as holotype. Numerous other paratypes collected in Étang Saumâtre by Dr. Beebe and Mr. Tee-Van.

Counts and measurements (in mm.) of three finely preserved specimens (holotype and two largest paratypes) in Dr. Bond's series are now given. Standard length 66, 35, 31. Total length 82, 46, 41. Depth 31, 14.5, 13. Head 21, 11, 10. Snout 7, 3.5, 3.5. Eye 6, 4, 3.5. Interorbital 7.5, 3.3, 2.5. Width of operculum 5.5, 3.5, 3.3. Least depth caudal peduncle 12, 6.3, 5.5. Length penultimate dorsal ray 7.5, 5, 4.5. Length third dorsal ray 14, 8, 7.5. Predorsal length 37, 19, 17.5. Preorbital width 6, 3, 2.5. Preventral length (to tip lower jaw) 38, 19, 17. Length pectoral fin 18, 10, 9. Dorsal rays (count) 11, 11, 11. Anal 11, 11, 11. (The dorsal and anal are each usually 11; in one specimen they are 12-12, and in another 11-10). Pectoral 17-16, 16-16, 17-17. Pelvic 7, 7, 7. Caudal 7-12-7, 7-12-6, 7-12-7. Scales lateral

28 + 3, 30 + 3, 28 + 4. Scales transverse (dorsal origin to pelvic origin) 14, 14, 14. Scales predorsal 11, 11, 12.

In the high scale count this species would seem to agree with the Cuban *Cyprinodon felicianus* (Poey, 1868, p. 412; Jordan and Evermann, 1896, p. 676). *C. felicianus* was described from a single specimen which may not now be in existence. Poey's description is incomplete, many points now considered important having been omitted. Breder (1932) has recently included *felicianus* in that part of his synopsis of West Indian Cyprinodons characterized by the lack of an enlarged humeral scale. Since no specimens have been reported since Poey's time, and the humeral scale was not mentioned in his description, I am at a loss to explain Breder's placement unless he had access to the type or more recent unreported material.

There are two lots of Cuban Cyprinodons received from Poey and labeled as *C. felicianus* in the United States National Museum (37434 and 37535). None of these specimens agrees with Poey's description in the high scale count, unless one includes the scales on the base of the caudal. However, the single example (male) in lot 37535 is exactly the same (standard) length as that given by Poey for his male holotype. This specimen has 30 scales if one counts a few in front of the upper end of the opercle and on the caudal base behind the hypural, not usually included by modern workers. This specimen may be the holotype, but if it is, *felicianus* is very close to, or identical with, *C. variegatus riverendi.* Lot 37434 represents the same form. The humeral scale is enlarged and the scales are 25 or 26.

Dr. Luis Howell Rivero has been so kind as to make a search for the type of *felicianus* in the Museum of Comparative Zoology. He finds no specimen agreeing exactly with Poey's measurement, but there are others, sent by Poey as *felicianus,* similar in their characteristics to those in the National Museum.

Since the specimens of *felicianus* in the National and Harvard collections were sent to these two institutions by Poey as representative of his species, I am inclined to accept them as such, in spite of the fact that the type is not certainly recognizable among them. This being the case, I am forced to consider *bondi* as new, since it in no way closely resembles Poey's specimens. The other West Indian Cyprinodons all have even fewer scales than *felicianus.*

C. bondi is named for Dr. R. M. Bond, who collected the types during an ecological investigation of the Hispaniolan lakes. The species will be figured and more completely described in my final paper on the cyprinodonts of Hispaniola.

Family POECILIIDAE

Subfamily *Gambusiinae*

Genus *Gambusia* Poey

Gambusia dominicensis Regan

Gambusia dominicensis Regan, 1913, p. 989, pl. 99, fig. 7 (Haiti); Hubbs, 1926, p. 25 (in key; copied).

This species is common in southern Haiti. Dr. Beebe and Mr. Tee-Van obtained it in the Cul-de-Sac Plain five miles north of Port-au-Prince and at Étang Saumâtre.

?Gambusia oligosticta Regan

? Gambusia oligosticta Regan, 1913, p. 988, text-fig. 169B, pl. 99, fig. 1, 2 (Jamaica); Hubbs, 1926, p. 25 (in key; copied).

I have examined one lot of Gambusias (U.S.N.M. 78247) collected by Mr. J. B. Henderson at Thomazeau, in the Cul-de-Sac Plain of Haiti, which I cannot at present separate from the Jamaican *oligosticta*. They have the same heavy body and long head and the gonopodial characters are practically identical.

Gambusia beebei, new species

DIAGNOSIS: A very large species, belonging to the subgenus *Gambusia*, allied to the Antillean group containing *punctata, wrayi, gracilior,* and others. In the gonopodium the spines of ray 3 are very long, considerably overtopping the hook of ray 4, the longest spine more than equal to two-thirds of the combined basal length of all. The extremely long, heavy head (nearly a third standard length), the long snout (over a third head), and the long, heavy jaws are seen in no other species, although approached by *wrayi*, from which *beebei* differs otherwise in the longer spines and their basal segments of ray 3 and in the much more posterior dorsal and anal. No spots or speckling and no suborbital bar present.

MATERIAL: Sixty-four females, 35 to 93 mm. total length, and 3 males, 36 to 58 mm. total length, all obtained at Lake Miragoâne, in the southwestern peninsula of Haiti, by William Beebe and John Tee-Van. The species is known only from this one collection and station.

HOLOTYPE: No. 7168, Dept. Tropical Research, New York Zoological Society. Adult male, 47 mm. standard length, 58 mm. total. Étang de Miragoâne, Haiti, S. W. end of lake, from Aux Cayes Road. Apr. 12, 1927. William Beebe and John Tee-Van.

DESCRIPTION OF HOLOTYPE: Dorsal 9. Scales lateral 31, plus 3 on caudal. Scales predorsal 16.

Head .27.[2] Interorbital .08. Eye .09. Snout .095. Maxillary end to tip of lower jaw .115. Depth .22. Peduncle .15. Snout tip to dorsal origin .63. Snout tip to anal origin .49. Height of longest dorsal ray .145. Length of pectoral .18.

Form elongate, pike-like; head very long and pointed, both from above and from side. Lower jaw very prognathous. A flattened continuous curve from snout to dorsal. Body scarcely or not at all angulated. Lower profile behind anal fin slightly convex. Caudal fin with outer rays slightly produced and central margin convex.

Gonopodium .52 of standard length. Segments of enlarged third ray rather short and wide, the 13 distal segments with long spines. Longest spine, with its basal limb, more than two-thirds total basal length of the spine-bearing segments. The central spines all have an elongated lower limb similar to those of *G. punctata*. The lobe formed by the spines considerably overtops the tips of the two divisions of ray 4. Elbow of anterior division of ray 4 well developed, composed of 2 segments only partially divided, with two others entering slightly at the proximal base. Segments of anterior branch of ray 4 distal to elbow not coalesced with a ridge-like extension from the elbow. Posterior division of ray 4 with terminal hook and 4 distinct serrae, these not especially long or hooked. Ray 5 below the terminal hook not greatly bowed.

Below yellowish, above brownish. Occiput and midpredorsal line blackish. Chin and sides of lower jaw dusted with black. A fine dark hair-line along middle of whole length of sides, strongest above pectorals,

[2] The proportions are given in hundredths of the standard length and are expressed as though taken on an ideal longitudinal axis of the body. This method is not used in the measurements of *Cyprinodon bondi*, which were taken from point to point, as indicated, with dividers.

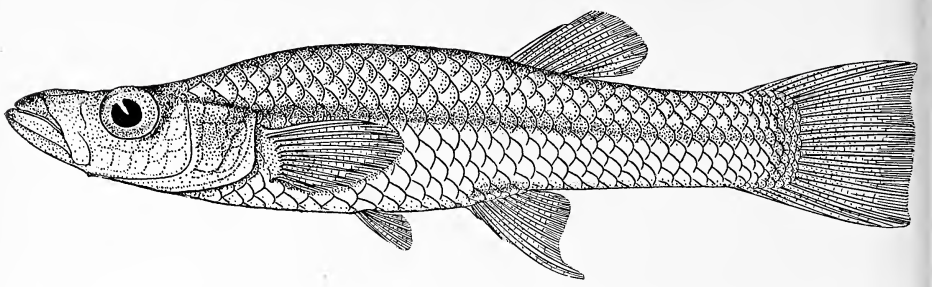

Fig. 273. *Gambusia beebei* Myers. Old female, paratype, 93 mm. total length.

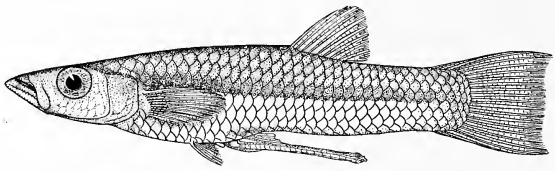

Fig. 274. *Gambusia beebei* Myers. Adult male, holotype, 58 mm. total length.

weak on tail. Sides above this streak dusky,[3] with edges of scales heavily dark-edged. No black dots or speckles on sides. No suborbital bar. Fins without speckles, but with faint dusting of dark chromatophores along rays.

DESCRIPTION OF FEMALE: No. 7299, Dept. Tropical Research, New York Zoological Society, total length 93 mm. Dorsal 9. Anal 11. Scales lateral 32 + 3. Scales predorsal 16.

Head .30. Interorbital .11. Eye .07. Snout .105. Maxillary end to tip lower jaw, .13. Depth .23. Peduncle depth .12. Snout tip to dorsal origin .66. Snout tip to anal origin .61. Dorsal broken. Length longest anal ray .16. Length pectoral .18.

Form elongate, pike-like; head very long and heavy, jaws somewhat rounded from above. Length of upper lip nearly half eye. Distance from tip of snout to cleft of mouth equal to eye. Width of mouth from cleft to cleft equal to interorbital. Dorsal profile concave to nape, thence shortly convex, the curve straightening to dorsal. Central portion of top of snout raised into a characteristic "nasal boss," not evident in young or half-grown females. Body not angulated. Anal margin more or less straight after the third and fourth rays, which are prolonged.[4] Caudal edge slightly convex, the outer rays a little produced. Appressed pectoral fin reaches middle of appressed pelvic fins.

Coloration as in male.[5]

VARIATION: The scales vary but little, lateral 30 or 31, predorsal 15 or 16. The dorsal is consistently 9, varying to 8 in a few. The anal in the female is 10 or 11. The first two rays and the last are small. The smaller females lack to a large extent the concave profile at the nape

[3] Too heavily indicated in Fig. 274. In all cases in which the figures disagree with the text, the latter is to be taken as correct.

[4] Only the third shown prolonged in the drawing.

[5] The figure of the female likewise shows too heavy an indication of a lateral band.

although this is usually somewhat evident. None but the very largest shows the upraised "nasal boss." The largest male (holotype) shows a longer, sharper snout, both from above and from the side, than do the two smaller ones. He further differs from these two in the structure of the gonopodium, the spine-bearing segments of ray 3 being more numerous and the spines and their basal limbs being longer. Further, the suture which in the holotype nearly divides the main segment of the "elbow" of ray 4 into two, has not appeared in these smaller fishes. These facts indicate that after maturity the gonopodium may change with age.

Following are proportions of seven females of graded size, of standard lengths of 64.5, 61, 53, 46, 37, 35, and 28.5 mm., respectively. Head .285, .32, .315, .28, .29, .26, .29. Interorbital .10, .11, .11, .10, .11, .11, .10. Eye .075, .09, .085, .085, .09, .085, .09. Snout .105, .115, .11, .09, .10, .095, .095. Snout tip to dorsal origin .68, .67, .66, .68, .66, .65, .67.

DISCUSSION OF RELATIONSHIPS: The great size, the elongate form, the large head, the long jaws, the peculiar dorsal profile and nasal boss of the older females, as well as the bodily proportions and the gonopodial structure of the male, set off this species as one of the most distinct in the genus. It has been directly compared with specimens of all of the West Indian Gambusias save *melapleura* and *caymanensis*, (neither of which seem at all close) including type material of *wrayi*, *gracilior*, *oligosticta* and *manni*. It differs widely from all of them in a number of characters.

In Hubbs' key to the species of *Gambusia* (Hubbs, 1926, p. 21), *beebei* falls within the subgenus *Gambusia* on gonopodial characters. It does not, however, agree with the bodily proportions expressed in division d2, the mouth having a deep lateral cleft, the jaws being rather pointed from above, especially in the male, the width of the head less than the distance from snout tip to posterior border of eye, and the width of the upper jaw being less than the great length of the upper jaw, measured to end of maxillary. Within the subgenus *Gambusia*, *beebei* agrees with division h1 of Hubbs' key in having the spines of ray 3 considerably overtopping the terminal hook of ray 4, but differs in that the longest spine is somewhat less in length than the bases of the combined spinous segments.

The three species included in division h1 by Hubbs are *senilis*, *nobilis* and *affinis*, all inhabitants of southern Texas and northeastern Mexico. I have compared examples of all three with *beebei*, and there is indeed a remarkable similarity in the gonopodia[6]. The most obvious difference is to be seen in the considerably longer basal limbs of the spines of ray 3 of *beebei*. Furthermore, the form of the "elbow" of ray 4 differs, and the "serrae" are much less elongate and hooked in the new form. When one comes to the bodily proportions and general appearance, *beebei* at once shows that it is not closely related to these tiny mainland species. The wide cleft of the mouth, the long snout and jaws, the enormous head, the nasal boss and concave nape of the old females, the color, and, not least, the large size, do not allow us to place *beebei* near these forms.

Proceeding to other possible relatives, we find the new form differing from Hubbs' group h2 in the length of the spines of ray 3, which overtop the hook of ray 4. This is the group of the subgenus *Gambusia* confined, with the sole exception of *nicaraguensis*, to the Antilles. With *nicaraguensis*, *beebei* agrees to some extent in the form of the anal of the female, but

[6] Our specimens of *G. nobilis* were collected at Phantom Lake, Toyahvale, Texas, by G. M. Kranzthor and the writer, May 21, 1929, and form the first large series of this fish ever collected. Hubbs (1929, p. 2) has redescribed *nobilis* from a few specimens collected by others near Toyahvale. It will be noted in Regan's figure of the gonopodium of *senilis* (Regan, 1913, text-fig. 168E) that the spines of ray 3 are of a peculiar straight form, very different from the rather curved shape seen in other species. It is thus of interest that in our large series of *nobilis*, surely all one species, this straight *senilis* type of spines is seen in some specimens, while in others a more elongate curved type is present. There are numerous intermediates connecting the two types.

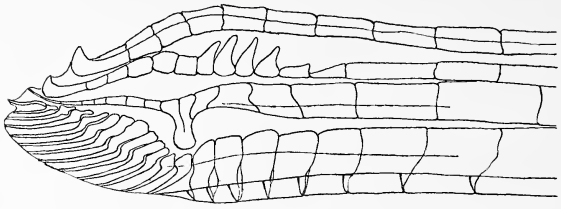

Fig. 275. *Gambusia beebei* Myers. Distal end of gonopodium of holotype. Camera lucida drawing by G. S. Myers.

differs in all the points mentioned above with reference to *senilis, nobilis* and *affinis* as well as the added ones of the lesser depth and lesser compression of the body.

Of the island forms no material of either the Jamaican *melapleura* or *caymanensis,* from Grand Cayman, has been available for comparison. The males of neither are known, and the described females (Regan, 1913, p. 988 and 990) are of small size (largest 47 mm. for *melapleura* and 26 mm. for *caymanensis*). Very likely both are smaller species than the new one; *beebei* is certainly immature at 26 mm. and probably at 47 mm. also. Specimens of *beebei* of about 40 mm. show the following apparent differences from *melapleura.* Dorsal 8 and 9 (versus 11 or 12). Interorbital 1½ (versus 1¾) in head. Dorsal origin midway between caudal base and a point somewhat behind pectoral origin. Least depth of peduncle equals half head. No traces of spots on fins or body. Compared with the description of *caymanensis,* small females of *beebei* are seen to differ most significantly in dorsal position, this fin being still further forward in *caymanensis* than in *melapleura,* and in interorbital width (1½ in head versus 2 to 2¼). The color is likewise very different; *beebei* has no suborbital bar, no series of spots on the dorsal and no markings on the caudal.

There remain seven Antillean species for comparison, *manni*[7] of the Bahamas, *punctata* and *puncticulata* of Cuba, *wrayi, oligosticta* and *gracilior* from Jamaica, and *dominicensis* from Hispaniola itself. Dr. Carl L. Hubbs has been kind enough to compare one of the smaller males and a series of females of *beebei* with the types of *manni.* He writes as follows: "The Haiti *Gambusia* . . . is certainly not *manni.* It is a very much larger fish, with a much longer snout (more instead of less than one-third head), slenderer, without trace of suborbital bar and with the barest trace of fin spots and of axial streak."

The figures of the gonopodia of *dominicensis, oligosticta, wrayi* and *gracilior* given by Regan (1913, Text-Figs. 168 and 169) show that none of these species have the spines of ray 3 nearly as long as those of *beebei,* and it should be particularly noted that in none do these spines have a long, well-developed basal limb, so conspicuous in *beebei. Punctata,* on the other hand, has the spines of ray 3 long, with a well-developed basal limb, but the gonopodium differs in other ways. In the first place the bowing below the hook of ray 5 is much greater in *punctata* than in *beebei,* and secondly the spines of ray 3, although themselves proportionally almost as long as in the new species, reach scarcely past the hook of ray 4. These spines, in *beebei,* are more numerous (12 versus about 9) and project much further beyond the hook of ray 4. The greater bowing of ray 5 and the more bunched spines of ray 3 give the tip of the gonopodium of *punctata* a characteristic thickened, rounded appearance, very different from that of the new species. In form, *punctata* differs widely from *beebei* in the much deeper body, shorter

[7] See Hubbs, 1927.

jaws, snout and head, and the presence of rows of spots on the body and fins, as well as in fin counts and fin positions.

The Cuban *puncticulata* is a small fish, rather variable in its characters, showing little similarity to the new fish. The Jamaican *oligosticta*, of which I have seen type material received by exchange from the British Museum, is very close to *puncticulata* and may not be distinguishable. *Oligosticta* is represented by a so far unreported similar form in Haiti, which is likewise doubtfully distinct from *puncticulata*. From all three forms *beebei* differs in the associated characters of very large head, long jaws and snout, as well as in the dorsal position, the general body form and the absence of spots. The long spines and their basal limbs in ray 3 of the gonopodium and the blunt serrae of ray 4 are further differences of note.

Gambusia gracilior, of which I have examined typical material received by exchange from the British Museum, is a small species which, in the very short spines of ray 3 of the gonopodium, shows no close relationship with *beebei*. The small head, the short jaws and snout, the spotted fins and the small size are distinctive. *Dominicensis* is close to *gracilior* and differs in the same way. We have large series of this species, the common *Gambusia* of Haiti.

With *Gambusia wrayi*, from Jamaica, *beebei* shows more similarity than with any other form. It thus has been of value to have at hand two (adult male and female) of Regan's types of *wrayi*, on loan from the British Museum. For this courtesy I must express the greatest thanks to Mr. J. R. Norman, Assistant Keeper of the Department of Zoology. In the rather large, heavy head, the elongate form, the comparatively large size and the absence of spots, *wrayi* approaches or agrees with *beebei*, but on comparison of these types of *wrayi* with specimens of *beebei* of similar size, numerous differences come to light. In the first place, these smaller females of *beebei* have not attained nearly their full growth, although some are probably adult. Of course we have no way of telling whether or not *wrayi* may grow larger than the types, but the two specimens at hand (male 29.5 mm. standard length, female 43 mm.) have the full-bodied appearance of mature Gambusias while *beebei* of the same size looks slender and immature. Further, these *beebei* have a longer head (about 3 2/5 versus 3 2/3 in the standard length), longer snout (which, due to the longer head, is contained in the head length about thrice, as it is in *wrayi*), much longer jaws, a much more slender head, body and caudal peduncle, and a more posterior dorsal. The heavy, undershot jaw of *beebei*, with its blackish dusting of chromatophores, distinguishes the specimens at a glance from *wrayi*.

Another difference has been noted, in a character not hitherto used for the distinction of species of this genus. The frontal and ethmoid region of the top of the head is, in *Gambusia*, separated from the supraorbital region by a distinct groove on each side which dies out over the center of the orbit and usually runs outward as it approaches the fold separating the premaxillary from the top of the head. This ethmo-frontal area between the two grooves is the region which, in old females of *beebei*, is upraised into what I have called the "nasal boss." In examining *wrayi* it is seen that the ethmo-frontal grooves (as we may call these structures) are rather wide apart, slightly converging posteriorly, near their ends, and diverging but little anteriorly. In *beebei*, on the other hand, the grooves are only about half as far apart, diverging slightly but evenly for a distance, and then flaring suddenly outward as they approach the premaxillary groove. Females of *beebei*, likewise, have a distinctly narrower interorbital and a sharper lower jaw, viewed from above, than does *wrayi*.

In gonopodial characters *wrayi* may be considered to show but little other than a general similarity to *beebei*. The bowing of ray 5 below the terminal hook appears greater in Regan's figure (Regan, 1913, Text-Fig.

168b) but in the type in hand this is much less evident. It is in the spines of ray 3 that the greatest differences are observed. In *wrayi* they are short and scarcely overtop the terminal hook of ray 4, and the basal limb is short and not prolonged. In *beebei*, even in the smaller males, the spines are much longer, considerably overtopping ray 4, and the long basal limbs are well developed.

Thus, in spite of resemblances to *wrayi*, it would seem that *beebei* is an isolated member of the genus *Gambusia* with no very close relatives among the known forms. Possibly its relationships are to be sought in some yet-to-be-discovered species in Jamaica, in Cuba, or even in Hispaniola.

Since the above was written, Breder (1934) has described *Gambusia hubbsi* from Andros Island, Bahamas. This small fish is similar to *manni*, *oligosticta* and *puncticulata*, and is not at all closely related to our new form.

HABITS AND HABITAT: This species is known only from the type collection and nothing is recorded of its habits other than that the specimens were obtained with a 20-foot seine on a sandy beach. Lake Miragoâne is a fresh-water lake.

REMARKS: With *punctata* of Cuba, this is the largest *Gambusia* known. Eigenmann (1903, p. 223) has recorded a *punctata* 92 mm. in length, but whether this includes caudal or not I cannot say. The largest female *beebei* is 93 mm. total, a very large *Gambusia* indeed.

I take pleasure in dedicating this interesting species to Dr. William Beebe in recognition of his extensive ichthyological work in Haiti.

Subfamily *Poeciliinae*

Genus *Mollienisia* Le Sueur

Mollienisia dominicensis (Evermann & Clark)

Platypoecilus dominicensis Evermann and Clark, 1906, p. 852, fig. 2 (San Francisco Mts., Santo Domingo, 40 miles from Santo Domingo City).

Limia dominicensis (in part) Regan, 1913, p. 1015 (excluding description and all of synonymy save reference to Evermann and Clark).

Limia caudofasciata (not of Regan) Nichols and Myers, 1923, p. 2 (Lo Bracita, Prov. Pacificador, S. D.).

Mollienisia dominicensis Myers, 1931, p. 2 (Lo Bracita, Prov. Pacificador, S. D.; Artibonite System, Haiti).

DIAGNOSIS: A small *Mollienisia* with a small dorsal fin, the origin of which is midway between the head (females) or the eye (males) and the caudal base. The normal number of dorsal rays is 8½ and of anal rays 9½. The lateral series of scales number 28 to 30. In the male, the first pelvic ray is short, with a conspicuous, fleshy, clavate tip which is closely attached to a broad bony protuberance of the second ray at the middle of the latter. Gonopodium with the membranous hook of ray 3 and the terminal retrorse segment of the posterior branch of ray 5 well-developed. Ray 3 with more or less well-developed spinous processes on the posterior side, as in *M. latipinna*. The chief gonopodial difference between this species and *M. sphenops*, *M. latipinna*, and their close relatives lies in the spinous processes of the anterior face of ray 3. In the other forms these are simple spines. In *M. dominicensis*, on the contrary, these processes are nearly all widely T-shaped or even faintly bifurcate at their tips, only a very few (sometimes only one) of the distal processes being developed as simple spines. Color dark, the scales of the upper parts heavily dark edged. Both sexes with a black spot (stronger in females) at the base of the posterior dorsal rays, the fin dark-edged in males. Males with six to ten narrow, blackish, vertical bars, much narrower than the interspaces, from dorsum to venter, beginning above the anal base. Female with faint traces of vertical bars.

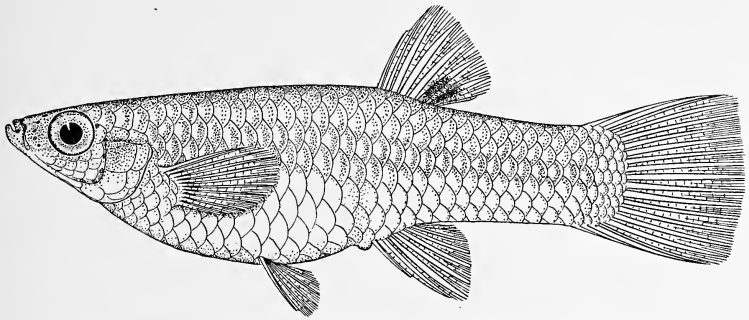

Fig. 276. *Mollienisia dominicensis* (Evermann and Clark). Adult female, L'Atalaye Plantation, Haiti. Twice natural size.

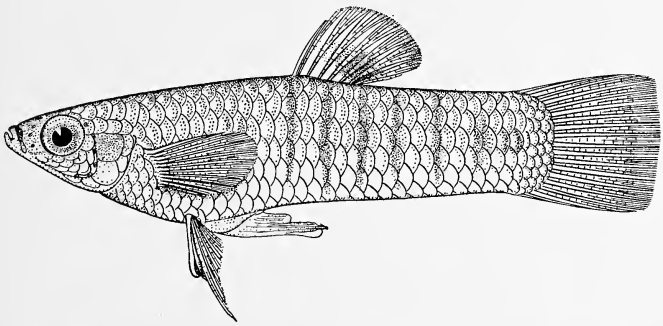

Fig. 277. *Mollienisia dominicensis* (Evermann and Clark). Adult male, L'Atalaye Plantation, Haiti. Twice natural size.

The rather striking differences between this species and others in the genus *Mollienisia*, particularly in the gonopodium, lead me to propose the new subgenus ***Psychropoecilia***, genotype *Platypoecilus dominicensis*, the name being in allusion to the clear mountain torrents which are the habitat of the species.

This is the species described by Evermann and Clark (1906) as *Platypoecilus dominicensis*. However, the confusion which has arisen since Regan erroneously synonymized the species with *Limia dominicensis* (Cuvier and Valenciennes) leads me to believe that it would be much better to rename the *Mollienisia*. Further, according to one interpretation, Jordan and Clark's name, having once been sunk as a homonym (and synonym) of *Limia dominicensis* (Cuvier and Valenciennes), cannot be resuscitated. I submitted the facts to Dr. C. W. Stiles, Secretary of the International Commission of Zoological Nomenclature, for his private opinion, and he assures me that, under a strict application of the Rules, the species must be renamed. In spite of the fact that I believe the renaming of Evermann and Clark's species would clarify the situation, I cannot subscribe to the view that the mere synonymizing of a species with another bearing an identical specific name is sufficient cause for renaming the species of later date. General acceptance of such procedure would leave the way open for anyone to (erro-

neously) synonymize many species, even of different genera, with the motive of renaming them himself at a later date.

Besides the material recorded by Nichols and Myers (1923) and Myers (1931), I have examined a fine series of 250 specimens of *M. dominicensis* (U. S. N. M. 88884, 100286, and 100287) collected in a small mountain stream, in the Artibonite system, at l'Atalaye Plantation, about 3 miles west of San Michel, Haiti, during March, 1928, by A. J. Poole, as well as the holotype of the species in the National Museum.

Genus *Limia* Poey

Limia perugiae (Evermann & Clark)

Platypoecilus perugiae Evermann and Clark, 1906, p. 851 (San Francisco Mts., S. D.).

Limia perugiae Myers, 1925, p. 371 (name only).

This species, which is still known only from a single female specimen, is probably a *Limia*. It appears to be very close to *L. melanonotata* but it is more slender and the caudal peduncle is much longer. I have examined the type and find that the distance from the end of the base of the anal fin to the first short supplementary lower caudal rays is much greater than the body depth at the origin of the dorsal, while in young *melanonotata* of the same size this measurement is much less than the body depth at the dorsal origin. Further, *perugiae* was taken in the mountains of southeastern Santo Domingo, while *melanonotata* is essentially a fish of the lowlands of Haiti.

Limia melanonotata Nichols and Myers

Limia melanonotata Nichols and Myers, 1923, p. 1 (Las Lajas, on L. Saumâtre, S.D.).

This species, as yet known only from the type series of females and one female from Maneville, Haiti, appears to be the largest, most striking, and most abundant Poeciliid of the Cul-de-Sac Plain. It is a deep-bodied fish very close to *L. nigrofasciata* Regan, but is distinguished by a number of characters. The younger females are marked with a few series of black spots down the middle of the sides which fade out slightly in the full grown adults of 60 mm. standard length. The male, which never develops the peculiar humpbacked profile of adult *nigrofasciata*, has a high, black dorsal fin and a yellow caudal with a wide, black, terminal border. There are several narrow, vertical, dark bars on the posterior part of the body.

The finest and largest specimens I have seen were the series taken in Source Trou Caiman by Dr. A. W. Herre and Dr. R. M. Bond..

Dr. Beebe and Mr. Tee-Van secured this species in great abundance in Étang Saumâtre, and from a locality 5 miles north of Port-au-Prince.

Limia nigrofasciata Regan

Limia nigrofasciata Regan, 1913, p. 1015, pl. 101, fig. 1, 2 (Miragoâne, Haiti); Nichols and Myers, 1923, p. 1 (Las Lajas, S.D.; Maneville, Haiti).

Limia arnoldi Regan, 1913, p. 1016, pl. 101, fig. 5 (Miragoâne, Haiti).

Through the courtesy of Mr. J. R. Norman of the British Museum I have been able to examine two of Regan's types of *Limia arnoldi*, and I am fully in agreement with Rachow (1914, p. 194, footnote 8) that the species was based on subadult examples of *nigrofasciata*. Regan's material of *arnoldi* and *nigrofasciata* consisted of aquarium specimens sent to him by

Rachow and by J. P. Arnold, the two distinguished aquarists of Hamburg. These men knew this species well in aquaria and Rachow's opinion was certainly to be relied on.

Nigrofasciata is a very variable species, as shown by the large series I have examined, and the younger adult males are very different from the old humpbacked individuals such as the one Regan figured.

The species is abundant in the Cul-de-Sac Plain and about Étang Saumâtre. Beebe and Tee-Van obtained a fine series at Lake Miragoâne, the type locality.

Limia dominicensis (Cuvier and Valenciennes)

Poecilia dominicensis Cuvier and Valenciennes, 1846, p. 131, pl. 526, fig. 1 (Santo Domingo).

Limia dominicensis (in part) Regan, 1913, p. 1015 (on type material; excluding types of *Poecilia melanogaster* and *Platypoecilus dominicensis* Evermann and Clark in synonymy).

This species was the first Poeciliid known from Hispaniola, although judging from the material I have seen, it is one of the rarest. Regan had two of Cuvier and Valenciennes' types, and he referred Günther's five female types of *Poecilia melanogaster* to the species, as well as including Evermann and Clark's *Platypoecilus dominicensis*. The latter is, as indicated above, a *Mollienisia*. Through the courtesy of Mr. J. R. Norman, I

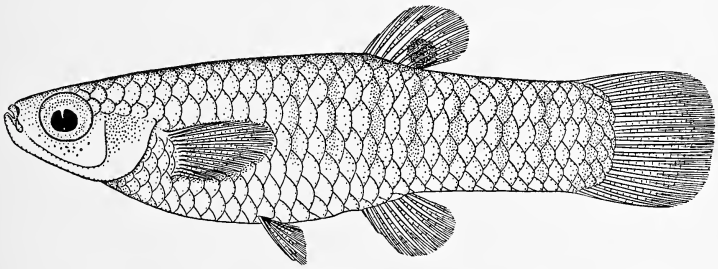

Fig. 278. *Limia dominicensis* (Cuvier and Valenciennes). Female type (cotype) of *Poecilia dominicensis* Cuvier and Valenciennes. 2½ times natural size. The cheek and opercular scales have fallen off the specimen.

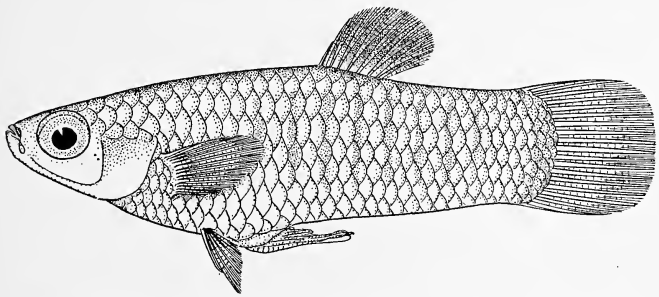

Fig. 279. *Limia dominicensis* (Cuvier and Valenciennes). Male type (cotype) of *Poecilia dominicensis* Cuvier and Valenciennes. 2½ times natural size. The cheek and opercular scales have fallen off the specimen.

have been able to examine one of the types of *melanogaster* and to compare it with a male and female from the type lot of *Poecilia dominicensis* Cuvier and Valenciennes, received by exchange from the Paris Museum through the good offices of Dr. J. Pellegrin. (These two types of *dominicensis* are now U.S.N.M. 94584.) I have no hesitation in pronouncing *melanogaster* to be a different species. The type locality of *melanogaster* is not certainly known, but Günther (1866, p. 346) thought the types might be from Jamaica. The type examined by me seems to be the same as a Jamaican *Limia* very close to *L. caudofasciata* Regan. *Limia melanogaster* is then, a Jamaican fish[8] differing from *caudofasciata* chiefly in the stouter body, the coloration, and the very large, black "pregnant spot" developed by the females. Males of *melanogaster* frequently have a smaller black spot in the same position!

The only examples of *Limia dominicensis* yet known appear to be the types, from an unknown locality in Santo Domingo. The two I have seen are small fish, with the color much faded. There are seven or eight faint vertical bars, similar to those of *nigrofasciata* and the female has a black spot at the base of the posterior dorsal rays. The body is fairly elongate and the dorsal of the male is not enlarged.

Limia ornata Regan

Limia ornata Regan, 1913, p. 1016, pl. 101, fig. 7 (Haiti).

This boldly spotted species was described from five females. It has been well known in Germany as an aquarium fish and has been described and figured many times in German aquarium books and journals. Dr. Beebe and Mr. Tee-Van secured a fine series at Lake Miragoâne.

Limia heterandria Regan

Limia heterandria Regan, 1913, p. 1017, pl. 101, fig. 3, 4 (La Guayra, Venezuela, in error); Myers, 1925, p. 371 (on type of *H. zonata* Nichols),

Heterandria zonata Nichols, 1915, p. 603, fig. 3 (Sanchez, Samaná Peninsula, S. D.).

I have already indicated that *zonata* is a synonym of *heterandria* and that the type locality of the latter species, which was based on aquarium specimens from Germany, must be incorrect.

Limia nicholsi Myers

Heterandria versicolor (not of Günther) Nichols, 1915, p. 603, fig. 1, 2 (San Juan River at Samaná, S. D.).

Limia nicholsi Myers, 1931, p. 1 (San Juan River at Samaná, S. D.; on Nichols' material).

This species is known only from the types.

Limia versicolor (Günther)

? Poecilia dominicensis (not of Cuvier and Valenciennes; in part) Günther, 1866, p. 346 (Santo Domingo; excluding Barbados specimen).

[8] This fish has been described and figured as a new species, *Limia tricolor*, by Stoye (1933). It is also mentioned and figured by Stoye (1935, p. 65, pl. 14) and by Innes (1935, p. 298, fig.). Stoye mentioned no types in his original description, but examples have been deposited by him in the Museum of Zoology, University of Michigan.

Girardinus versicolor Günther, 1866, p. 352 (Santo Domingo).

? Poecilia (*Acropoecilia*) *tridens* Hilgendorf, 1889, p. 52 (Port-au-Prince, Haiti).

Limia versicolor Regan, 1913, p. 1017, text-fig. 173E (Santo Domingo).

I am not at all sure that Hilgendorf's *Poecilia tridens* refers to this species. I have seen only three specimens certainly referable to *versicolor*. They were collected by Dr. Beebe and Mr. Tee-Van at Source Mariani, Haiti.

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ADDITIONS TO THE FISH FAUNA OF HAITI AND SANTO DOMINGO[1]

WILLIAM BEEBE, SC. D.
Director, Department of Tropical Research
and
JOHN TEE-VAN
General Associate, Department of Tropical Research

In 1927 the Haitian Expedition of the Department of Tropical Research of the New York Zoological Society, under the direction of Dr. William Beebe, spent five months in the field studying the fishes of Port-au-Prince Bay and nearby territory. The present paper completes the reports on the fishes of that expedition.

For a summary of the species of fish known from the island the reports published in ZOOLOGICA, Vol. X, Nos. 1, 2 and 3, must be consulted and to these should be added the list of species noted in this paper. This list is composed of species reported from Haiti-Santo Domingo, the references to which had either been omitted from the previous papers or had appeared after they were issued. There is also one correction of identification, and one species added from an unpublished record.

The three published fish reports of the expedition, mentioned above, are as follows:

"The Fishes of Port-au-Prince Bay, Haiti, With a Summary of the Known Species of Marine Fish of the Island of Haiti and Santo Domingo," William Beebe and John Tee-Van, ZOOLOGICA, Scientific Contributions of the New York Zoological Society, Vol. X, No. 1, 1928, pp. 1-279.

"Cichlid Fishes in the West Indies with Especial Reference to Haiti, Including the Description of a New Species of *Cichlasoma*," John Tee-Van, ZOOLOGICA, Vol. X, No. 2, 1935, pp. 281-300.

[1] Contribution No. 477, Department of Tropical Research, New York Zoological Society.

"An Annotated List of the Cyprinodont Fishes of Hispaniola, with Descriptions of Two New Species," George S. Myers, ZOOLOGICA, Vol. X, No. 3, 1935, pp. 301-316.

ADDITIONAL SPECIES RECORDED FROM THE ISLAND OF HAITI AND SANTO DOMINGO

Family SYNGNATHIDAE

Hippocampus reidi Ginsburg
Ginsburg, I., Journ. Washington Acad. Sci., Vol. 23, No. 12, 1933, p. 561.

Family MUGILIDAE

Mugil cephalus Linnaeus
Fowler, H. W., Proc. Acad. Nat. Sci. Phila., Vol. 71, 1919, p. 153.

Family CENTROPOMIDAE

Centropomus cuvieri Bocourt
Fowler, H. W., Proc. Acad. Nat. Sci. Phila., Vol. 58, 1906, p. 428. (This species has been synonymized with *C. pedimacula*, which in turn has been placed under *C. pectinatus*).

Family HAEMULIDAE

Haemulon album Cuvier and Valenciennes
Fowler, H. W., Proc. Acad. Nat. Sci. Phila., Vol. 81, 1929, p. 638.

Anisotremus surinamensis (Bloch)
Fowler, H. W., Proc. Acad. Nat. Sci. Phila., Vol. 81, 1929, p. 640.

Family GERRIDAE

Eucinostomus harengulus Goode and Bean
Fowler, H. W., Proc. Acad. Nat. Sci. Phila., Vol. 81, 1929, p. 646. (This species has been synomized at various times under *E. pseudogula* and also under *E. californiensis*).

Family SCIAENIDAE

Bairdiella chrysura (Lacépède)
Fowler, H. W., Proc. Acad. Nat. Sci. Phila., Vol. 80, 1928, p. 462.

Umbrina broussonnettii Cuvier and Valenciennes.
Fowler, H. W., Proc. Acad. Nat. Sci. Phila., Vol. 81, 1929, p. 653. (Recorded as *Sciaena broussonnettii*).

? Stellifer rastrifer Jordan and Eigenmann.
Fowler, H. W., Proc. Acad. Nat. Sci. Phila., Vol. 81, 1929, p. 651. (Locality of specimen not certain).

Family CORIDAE

Iridio bivittata (Bloch)
In ZOOLOGICA, Vol. X, No. 1, p. 203, this species was included, following Meek and Hildebrand's conclusions, under *Halichoeres radiatus*. Meek and Hildebrand, as has already been noted (ZOOLOGICA, Vol. XIII, No.

7, 1933, p. 150) were quite wrong in merging these two forms, and it is therefore necessary to reestablish this as a valid Haitian species.

Family SCARIDAE

Scarus emblematicus Jordan and Rutter
Fowler, H. W., Proc. Acad. Nat. Sci. Phila., Vol. 80, 1928, p. 462 (Recorded as *Callyodon emblematicus*).

Family GOBIIDAE

Bollmania litura Ginsburg
Ginsburg, I., Smithsonian Misc. Coll., Vol. 91, No. 20, 1935, p. 1.

Family ANTENNARIIDAE

Antennarius nuttingi Garman
Two specimens of this species from Jeremie, Haiti, are in the collections of the Museum of Comparative Zoology at Cambridge.

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HAEMATOLOGY OF THE CAMELIDAE

By Eric Ponder, J. Franklin Yeager
and
Harry A. Charipper
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Zoologica Vol XI, No. 1.

HAEMATOLOGY OF THE CAMELIDAE

By Eric Ponder, J. Franklin Yeager and Harry A. Charipper

*Department of Biology, New York University and the New York Zoological Society**

Aside from the common misinformation that the red cell of the camel is oval and nucleated, there is surprisingly little known concerning the haematology of the Camelidae. Gulliver (1875) gives the diameter of their dried red cells. Bottcher (1877) describes the erythrocytes as being nucleated. Ponder (1924) lists red cell counts and measurements for various species, and also points out that there is no evidence for Bottcher's statement that the camel red cells are nucleated. Concerning the white cells there is no reliable information available.

The purpose of this study is to give concisely and yet with sufficient detail the haematology of the Camelidae (which includes the camels and "cameloids"). In all cases the blood was taken into oxalate from a neck vein of healthy animals kept under the ordinary conditions of captivity. The examination of the cells was commenced within one hour from the time of withdrawing the blood.

Unless otherwise stated, the following descriptions and differential counts are based on blood films prepared by the smear method stained with Wright's blood-stain. The red cell counts were made in the usual way, using Hayem's solution. Triplicate counts were made and the average result per cubic millimetre is given. The white cell counts were obtained in a similar way, using a solution of acetic acid for dilution. The haemoglobin was estimated as carboxy-haemoglobin by Palmer's colorimetric method, with the blood of one of us (H. A. C.) as a standard (100 per cent). These readings were made in triplicate and the average determined. The polynuclear counts were made in the manner described by Cooke (1914), and on 100 cells. The stain employed was iron haematoxylin, but counts can also be made on films stained with Wright's or Giemsa's stain. The method used for determining the resistance

* The first of a series of researches undertaken by a coöperative arrangement between the Department of Biology of New York University and the New York Zoological Society.

of the red cells to haemolysins has been adequately described by Ponder (1927) and Yeager (1928), while the technique for studying the dimensions of the red cells has also been given in full by Ponder and Millar (1924).

I. Llama glama

a—The red cells, when seen in the fresh state in plasma, have the appearance of flattened ellipsoids, with a perfectly regular outline and homogeneous structure. The erythrocytes do not form typical rouleaux, but remain in contact with one another so as to form 'chains,' one end of one cell overlapping the end of the cell next to it, and so on.

In stained films the red cells appear smaller than in the fresh state, but retain their shape remarkably well. Measurements of the length and breadth of these cells in the fresh and dried preparations show a definite change in size on drying.

Fresh red cells in plasma—Length 7.8 μ. Breadth 4.3 μ.

Red cells in dried films—Length 7.2 μ. Breadth 3.9 μ.

When the erythrocytes are fixed in methyl alcohol, the haemoglobin is especially deposited in the central parts of the cell, and as a result the central area takes on a deeper stain than the peripheral region. This appearance may possibly be responsible for the erroneous statement which has sometimes been made that the cells are nucleated.

b—The average haemoglobin percentage is 89 per cent.

c—Red cell count (cells per cubic millimetre)—11,300,000.

d—White cell count (cells per cubic millimetre)—10,300.

e—The morphology of the white cells of a young specimen shows no outstanding difference as compared to that of the adult. It may be noted, however, that the blood of young animal stains more rapidly and gives a better differentiation than that of the adult.

1—The polymorphonuclear neutrophilic leucocytes (P. M. N.) are approximately circular and range in size from 10 to 12 μ. The nucleus is quite irregular in form, showing the familiar lobations of polymorphs in general. The cytoplasm is slightly acidophilic in reaction and studded with many fine granules which are neutrophilic and which stain a lilac color in some cells and pink in others.

2—The polymorphonuclear eosinophiles (P. M. E.) are circular or slightly oval in shape and fairly constant in size, 10 μ. Their nucleus is similar to that of the neutrophile just described, but stains less intensely. The cytoplasm, which stains a very light blue and is hardly distinguishable, is practically filled with coarse bright red granules.

3—The polymorphonuclear basophilic leucocytes (P. M. B.) are fairly circular in outline, and are the smallest of the polymorphonuclear leucocytes, 8 μ. The nucleus which occupies the greater part of the cell is difficult to differentiate since it is basophilic in staining quality and takes a blue-purple color slightly less intense than that of the coarse granules which fill the cytoplasm.

4—The lymphocytes (L.) are more circular than any of the other blood elements and range in size from 8 to 10 μ. The nucleus is circular or slightly ovoid in outline, stains a deep blue, and fairly fills the cell, leaving a variable margin of faint sky-blue tinted cytoplasm. Occasionally a few scattered azure granules of variable size may be seen.

5—The large mononuclear leukocytes (L. M.) are variable in outline from perfect circles to irregular ovals. They average approximately 12 μ in size. The eccentrically-placed nucleus stains deep blue, yet several shades lighter than that of the lymphocytes, and presents a slight indentation on the side toward the larger area of cytoplasm. The cytoplasm which stains a light blue similar to that of the lymphocytes invariably contains a goodly number of coarse, azure granules.

6—The transitional leukocytes (T.) are large ovoid cells ranging from 10 to 12 μ in size. The nucleus appears eccentrically placed and deeeply notched, and stains similar to that of the polymorphocuclear leukocyte. The cytoplasm stains a light blue and contains a large number of neutrophilic granules which tend to be concentrated and more deeply stained in the notch of the nucleus. It is difficult to distinguish these cells from the Class I polynuclear neutrophilic leucocytes.

f—The differential count as determined by classifying the cells according to the description just given is:

P. M. N.	63	L.	11
P. M. E.	10	L. M.	4
P. M. B.	10	T.	2

g—The polynuclear count for this animal is very much the same as in man and rabbit.

	I	II	III	IV	V
L. glama	14	29	40	13	4

h—Resistance of red cells to haemolysins.

1—The resistance to saponin was found to be 0.75 times as great as in man.

2—The resistance to sodium taurocholate is 1.20 times as great as in man.

3—The red cells were found to be resistant to 0.28 per cent saline which is a decidedly greater resistance than is shown by human erythrocytes which haemolyze at 0.32 per cent saline.

II. Llama pocas

a—The general morphology of the red cells of *Llama pocas* is essentially the same as that of *Llama glama*. The measurements are slightly different, and are given merely as a matter of record.

Fresh red cells in plasma—Length 8.0 μ. Breadth 4.3 μ.

Red cells in dried film—Length 7.6 μ. Breadth 4.1 μ.

b—Haemoglobin, 106 per cent.

c—Red cell count, 19,400,000.

d—White cell count, 12,100.

e—The general morphology of the blood elements are so much alike that for the sake of brevity the description given for *Llama glama* is adequate for

Llama pocas. The following brief note on each type of cell will therefore be limited to those differences deemed of note.

1—The polymorphonuclear neutrophilic leukocytes (P. M. N.) vary in size from 8 to 10 μ. The neutrophilic granules are regularly placed and somewhat coarser than ordinarily. Both the granules and cytoplasm stain poorly and in a large number of cells are decidedly chromophobic.

2—The polymorphonuclear eosinophilic leukocytes (P. M. E.) are approximately 8 to 9 μ in diameter, irregularly oval in outline and heavily studded with large bright red granules.

3—The polymorphonuclear basophilic leukocytes (P. M. B.) are surprisingly frequent in occurrence. They are approximately circular in outline and 4 to 5 μ in diameter. It is impossible to differentiate the nucleus which is practically lost in the heavy deeply staining basophilic granules which fill the cytoplasm.

4—The lymphocytes (L.) are definitely circular in outline and 6 to 8 μ in diameter. The nucleus is centrally located, leaving a narrow border of clear blue cytoplasm. No azure granules were observed.

5—The large nomonuclear leukocytes (L. M.) average 10 μ in diameter. The eccentrically placed, notched nucleus stains the same as that of the lymphocytes.

6—The transitional leukocytes (T.) range from 10 to 12 μ in size. The neutrophilic granules of the cytoplasm, as well as the cytoplasm itself, stains well, and therefore can be used as a differential for distinguishing between this type of cell and a Class I polynuclear neutrophilic leukocyte.

f—Differential Count:—

P. M. N.	51	L.	4
P. M. E.	5	L. M.	2
P. M. B.	37	T.	1

g—Polynuclear Count:—

	I	II	III	IV	V
Llama pocas	22	31	37	8	2

h—Resistance to haemolysins:—

1—The resistance to saponin was found to be 1.00 times as great as in man.

2—The resistance to sodium taurocholate is 1.90 times as great as in man.

3—The red cells were found to be resistant to 0.28 per cent saline which is a decidedly greater resistance than is shown by human erythrocytes which just haemolyze at 0.32 per cent saline.

III. Camelus dromedarius

a—With the exception of the slight difference in size the red cells of this animal are very similar to those of *L. glama* and need no further description.

Red cells sizes:—

Fresh red cells in plasma—Length 8.0 μ. Breadth 4.6 μ.

Red cells in dried film—Length 7.1 μ. Breadth 4.1 μ.

b—Haemoglobin, 96 per cent.

c—Red cell count, 10,800,000 per c. mm.

d—White cell count, 12,000 per c. mm.

e—With the exception of the differences in size the cells of this animal are so similar to those of *Llama glama* that the morphological description given in part one can be applied to the various cellular elements of this blood.

1—The polymorphonuclear neutrophilic leukocytes (P. M. N.) are fairly constant in size, 13 μ.

2—The polymorphonuclear eosinophilic leukocytes (P. M. E.) are comparatively numerous. The coarse granules which fill the cytoplasm stain a deep pink rather than the characteristic bright red, and the cell shows an irregular ragged outline. Their size is roughly 11 μ.

3—The polymorphonuclear basophilic leukocytes (P. M. B.) are 10 μ in diameter. The coarse granules which fill the cytoplasm seem to stain more intensely at the periphery of the cytoplasm where they appear almost blue black in contrast to the definite deep purple of the other granules closer to the nucleus.

4—The lymphocytes, (L.) which are approximately 8 μ in diameter, have a very thin cytoplasmic rim which stains the usual sky-blue. In some cases the deep blue nucleus appears to fill the cell completely and no cytoplasmic rim can be differentiated.

5—The large mononuclear leukocytes (L. M.) average about 13 μ in size and show light blue staining granules in the cytoplasm rather than the azure granules as usually described.

6—The transitional leukocytes (T.) are easily recognized because of their size, 15 μ. The eccentrically placed indented nucleus, however, is not proportionately as large and as a result there is a good deal of cytoplasm to be seen. The fine neutrophilic granules are sparsely scattered throughout the cell.

f—Differential Count:—

P. M. N.	55	L.	8
P. M. E.	27	L. M.	6
P. M. B.	3	T.	1

g—Polynuclear Count:—

	I	II	III	IV	V
C. dromedarius	24	35	32	7	2

h—Resistance to haemolysins:—

1—The resistance to saponin was found to be 1.03 times as great as in man.

2—The resistance to sodium taurocholate is 1.72 times as great as in man.

3—The red cells were found to be resistant to 0.28 per cent saline which is a decidedly greater resistance than is shown by human erythrocytes which just haemolyze at 0.32 per cent. saline.

IV. Camelus batriens

a—The red cells of this species are sufficiently similar to those of *L. glama* as to warrant no descriptions other than a notation of their sizes.

Fresh red cells in plasma—Length 8.1 μ. Breadth 4.5 μ.
Red cells in dried film—Length 7.5 μ. Breadth 3.6 μ.

b—Haemoglobin, 87 per cent.

c—Red cell count, 10,450,000.

d—White cell count, 10,800.

e—There is no marked difference in the staining quality or morphology of the blood elements of the young animal as compared to that of the adult. The leukocytes of this species of camel are larger and better differentiated than those of the other species studied in this group.

1—The polymorphonuclear neutrophilic leukocytes (P. M. N.) are irregular in outline tending more toward the circular than the oval in shape. Their approximate mean diameter is fairly constant, measuring approximately 16 μ. The nucleus which is typically polymorphous stains a light reddish purple. The cytoplasm which is clear and very slightly tinted a light blue contains various sized evenly stained neutrophilic granules.

2—The polymorphonuclear eosinophilic leukocytes (P. M. E.) are typical. They measure approximately 12 to 14 μ in diameter.

3—The polymorphonuclear basophilic leukocytes (P. M. B.) are circular in outline with an irregular incompletely lobed nucleus which stains a reddish purple, making it easily distinguishable from the light blue cytoplasm thickly packed with coarse deep blue or purple stained granules. These cells measure about 8 to 10 μ.

4—The lymphocytes (L.) vary in size from 12 to 16 μ and contain a large deep blue staining nucleus which is slightly eccentric in position. The irregular rim of cytoplasm stains the typical sky-blue.

5—The large mononuclear leukocytes (L. M.) are irregularly circular in outline. The nucleus which is large and deeply indented stains a reddish purple. The sky-blue cytoplasm contains many azure granules clumped, as usual, in the indentation of the nucleus. These cells are rather constant in size, measuring about 22 μ.

6—The transitional leukocytes (T.) contain a deep blue staining nucleus in a pink colored cytoplasm which is filled with typical neutrophilic granules. These cells are very large, averaging approximately 30 μ in diameter.

f—Differential Count:—

Adult	P. M. N.	67	L.	11
	P. M. E.	15	L. M.	3
	P. M. B.	2	T.	2

g—Polynuclear Count:—

	I	II	III	IV	V
C. batriens	23	36	34	6	1

h—Resistance to haemolysins:—

1—The resistance to saponin was found to be 0.96 times as great as in man.
2—The resistance to sodium taurocholate is 1.42 times as great as in man.
3—The red cells were found to be resistant to 0.26 per cent NaCl, which

is a decidedly greater resistance than is shown by human erythrocytes which haemolyze at 0.32 per cent saline.

It cannot be expected, of course, that the examination of the necessarily few specimens of each species will provide us with perfectly trustworthy information, for allowance has to be made for individual variations; we believe, however, that the data presented is both more representative and more trustworthy than any at present existing.

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HAEMATOLOGY OF THE PRIMATES

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and
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HAEMATOLOGY OF THE PRIMATES

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While occasional references may be found regarding the red cell counts and the differential counts of certain primates, these are usually secondary matters arising in connection with some research problem. Aside from the work of Gulliver (1875), which concerns itself with the red cell sizes alone, there is no single investigation dealing primarily with the haematology of the primates. The present study has been undertaken with a view to fulfilling the need for this particular investigation.

The blood of the monkeys is best obtained from a marginal ear vein. The ear is first shaved and rubbed with ether or benzene; a prominent vein near the margin of the ear is then opened with a single cut with a razor blade. Much of the difficulty which may be experienced in controlling adult specimens of the larger primates may be avoided by using young animals, but the difficulty is not as a rule great if the animal is held by a keeper with whom it is familiar.

With the exception of the blood of the spider monkeys, the dilutions for the red blood cell count, white blood cell count, haemoglobin determination, and occasionally for the suspensions for haemolysis, were made from fresh unoxalated blood. The smears for the differential counts and polynuclear counts were obtained at the same time. The blood of the spider monkeys was collected into oxalate in the usual proportions. Owing to the difficulty which we have experienced in obtaining more than quite small quantities of blood from many of the monkeys, a modification has been introduced in the method of preparing the films of cells for measurement. A small volume of blood is drawn into a capillary pipette, which is then sealed at both ends. When the preparation of red cells is made for photography, the seals are removed and the contents of the tube, consisting of serum and clot, expelled on to the surface of a slide. The clot is removed with a pair of fine forceps, and the remaining serum covered with a coverslip. The

* The second of a series of researches undertaken by a coöperative arrangement between the Department of Biology of New York University and the New York Zoological Society.

serum always contains a considerable number of cells, which can be photographed and measured in the usual manner. Under these conditions the cells are measured in serum instead of in oxalated plasma, but this does not affect their mean diameter.

Except where otherwise stated, the technique employed is identical with that described in the first paper of this series (Haematology of the Camelidae). It should also be mentioned that the general morphology of the leucocytes of the primates examined in this investigation is so much like that of the leucocytes of man that differences alone are described.

I. Gorilla gorilla

a—The red cells are typical biconcave discs similar to the red cells of man. Their mean diameter, however, is slightly smaller. Cells in plasma have a mean diameter of 7.7 μ, while cells in dried films have a diameter of 7.3 μ.

b—The average haemoglobin percentage is 83 per cent.

c—Red cell count per cubic millimetre, 6,250,000.

d—White cell count per cubic millimetre, 6,800.

e—The morphology of the cells presents several points of interest.

1—The polymorphonuclear neutrophiles (P. M. N.) are circular in outline and range in size from 9 to 12 μ. There appears to be a predominance of bilobed cells. The cytoplasm, granules, and nucleus are typical.

2—The polymorphonuclear eosinophiles (P. M. E.) measure approximately 11 μ. The deep red granules are evenly distributed throughout the light blue cytoplasm. The nucleus stains less intensely than that of the neutrophiles.

3—The polymorphonuclear basophiles (P. M. B.) are circular and measure about 10 μ. The nucleus is obscured by the coarse basophilic granules. The cell has the appearance of a compact mass of chromatin with minute chromophobic areas.

4—The lymphocytes (L) are the smallest of the white cells, and measure only 8 μ. The nucleus is irregular and practically fills the cell.

5—The large mononuclears (L. M.) are variable in outline from perfect circles to irregular ovals. They measure about 16 μ. The eccentrically placed nucleus stains a deep blue. There are a very few coarse azure granules scattered throughout the cytoplasm.

6—The transitional leucocytes (T) closely resemble the class I polymorphs in size and shape. The granules in the cytoplasm are coarser and are concentrated about the nucleus.

f—The differential count is as follows:

P. M. N.	63	L.	23
P. M. E.	5	L. M.	4
P. M. B.	3	T.	2

g—The polynuclear count is similar to that of man, and is as follows: 17 : 28 : 39 : 14 : 2.

II. Pan calvus (Chimpanzee)

a—The red cell size alone is worthy of record. The cells in plasma measure 7.8 μ, while dry cells measure 7.4 μ.

b—Haemoglobin, 89 per cent.

c—Red cell count, 7,300,000.

d—White cell count, 10,400.

e—The leucocytes of this animal show no variations worthy of note, except that the lymphocytes have an extremely thin layer of light blue cytoplasm about a large irregular nucleus. Small dark granules can be seen scattered at random in the scanty cytoplasm. The measurements of the white cells are:

P. M. N.	8–10 μ.	L.	7 μ.
P. M. E.	9 μ.	L. M.	11 μ.
P. M. B.	5–10 μ.	T.	(none found)

f—The differential count is as follows:

P. M. N.	58	L.	16
P. M. E.	5	L. M.	1
P. M. B.	20	T.	—

g—The polynuclear count is 3 : 12 : 45 : 32 : 8.

h—The resistance of the red cells to haemolysins is as follows:

1—The resistance to saponin is 1.7 times that of the cells of man.

2—The resistance to taurocholate is 2.7 times that of human cells.

3—The red cells are resistant to 0.28 per cent NaCl, a resistance considerably greater than that of human erythrocytes.

III. Pongo pygmæus (Orang-utan)

a—The red cells in plasma measure 7.8 μ, while dried cells measure only 7.4 μ.

b—Haemoglobin, 80 per cent.

c—Red cell count, 6,880,000.

d—White cell count 9,400.

e—The morphology of the leucocytes presents a few interesting features.

1—The polymorphs have an uneven outline which can be considered as roughly circular. They measure 10 μ in diameter. The nucleus is multilobed and uneven; the cytoplasm shows a variable staining reaction owing to the fact that it is studded with a mixture of eosinophile and basophile granules.

2—The eosinophiles are almost circular in outline, and measure 7 μ in diameter. The nucleus stains a light purple and is set in a poorly staining cytoplasm with coarse eosinophile granules.

3—The basophiles resemble small lymphocytes with coarse basophilic granules. The nucleus is fairly regular, but its outline is difficult to trace owing to the number of the cytoplasmic granules. The cytoplasm seen between the granules is light blue. The size varies from 5 to 8 μ.

4—The lymphocytes are about 5 μ in diameter. The time required for staining the smears of this blood is quite different from that ordinarily used. The initial staining proceeds rapidly (15 to 25 seconds), while the differentiation requires a full two minutes.

f—The differential count is:

P. M. N.	55	L.	24
P. M. E.	4	L. M.	2
P. M. B.	15	T.	—

g—The polynuclear count is 3 : 12 : 40 : 28 : 17.

IV. Papio cynocephalus (Yellow Baboon)

a—Red cells in plasma measure 7.7 μ, while dried cells measure 7.3 μ.
b—Haemoglobin, 87 per cent.
c—Red cell count, 6,970,000.
d—White cell count, 10,400.
e—With the exception of the size of the eosinophiles, which measure 17 μ, the white cells of this monkey show few differences from those of man. The transitional leucocytes are rather small, measuring only about 11 μ as opposed to the 20 μ measurement for the same cells in man. The sizes of the other white cells are given below:

P. M. N.	12 μ	L.	8 μ
P. M. B.	10 μ	L. M.	19 μ

f—The differential count is: —

P. M. N.	65	L	29
P. M. E.	2	L. M.	2
P. M. B.	1	T.	1

g—The polynuclear count is 10 : 25 : 40 : 20 : 5.
h—The resistance to saponin is 0.57 times that of human cells, and the resistance to taurocholate 0.42 times as great. The cells resist 0.18 per cent NaCl; this is a very great resistance indeed.

V. Lasiopyga griseoviridis (Green Monkey)

a—Cells in plasma measure 7.8 μ, while dried cells measure 7.4 μ.
b—Haemoglobin, 87 per cent.
c—Red cell count, 6,400,000.
d—White cell count, 12,600.
e—The staining properties and morphology of the cells require no description. The cells sizes are:—

P. M. N.	10 μ	L.	8 μ
P. M. E.	7 μ	L. M.	12 μ
P. M. B.	10 μ	T.	—

f—The differential count is:—

P. M. N.	58	L	31
P. M. E.	7	L. M.	3
P. M. B.	1	T.	none

g—The polynuclear count is 8 : 20 : 38 : 22 : 12.
h—The resistance to saponin is 0.9 times that of the cells of man; to taurocholate the resistance is 0.40. The cells are less resistant to NaCl than are the cells of man, haemolysing at 0.43 per cent.

VII. Magus maurus (Celebes Macaque)

a—Red cells in serum, 7.9 μ; in the dried state, 7.2 μ.

b—Haemoglobin, 88 per cent.

c—Red cell count, 5,000,000.

d—White cell count, 7,600.

e—The transitional leucocytes contain a mixture of basophilic and eosinophilic granules in addition to the typical lilac colored granules. Otherwise there is no noteworthy difference from the cells of man. The cell sizes are:—

P. M. N.	10 μ	L.	23 μ
P. M. E.	9 μ	L. M.	14 μ
P. M. B.	8 μ	T.	19 μ

f—The differential count is:—

P. M. N.	69	L.	23
P. M. E.	2	L. M.	1
P. M. B.	4	T.	1

g—The polynuclear count is 32 : 32 : 31 : 5 : 0.

h—The resistance to saponin is 1.55 times as great as in man, while the resistance to taurocholate is 0.55 times as great. The cells resist 0.22 per cent NaCl.

VI. Pithecus rhesus (Rhesus Monkey)

a—Red cells in plasma measure 8.0 μ, while dried cells measure 7.3 μ.

b—Haemoglobin 77 per cent.

c—Red cell count, 5,000,000.

d—White cell count, 10,400.

e—The blood elements of this form are decidedly chromophilic, for they stain easily and differentiate rapidly. The lymphocytes especially show a marked differential staining. Their cytoplasm stains a beautiful blue, while the azure granules stand out in bold relief. The cell sizes are:—

P. M. N.	5 μ	L.	5 μ
P. M. E.	6 μ	L. M.	12 μ
P. M. B.	7 μ	T.	—

These cells are all rather small in size, the largest being no bigger than a polymorph of human blood.

f—The differential count is:—

P. M. N.	73	L	18
P. M. E.	3	L. M.	2
P. M. B.	1	T.	none

g—The polynuclear count is 12 : 32 : 40 : 14 : 2.

h—The resistance to saponin is 0.73 times that of human cells, while to taurocholate it is approximately the same. The cells resist 0.27 per cent NaCl, and are therefore more resistant than the cells of man.

VIII. Pithecus irus (Common Macaque)

a—Red cells in serum, 8.0 μ: in dried films, 7.1 μ.

b—Haemoglobin, 90 per cent.

c—Red cell count, 6,432,000.

d—White cell count, 7,200.

e—The polymorphs are typical, and measure 10 μ in diameter. The eosinophiles occur in quite large numbers, and measure 8 μ in diameter; their granules are large and uniform, and stain an intense red. The nucleus is less lobated than usual. The basophiles are also numerous, and measure 7–12 μ. The lymphocytes measure 10 μ, the monónuclears 15 μ, and the transitionals 11 μ.

f—The differential count is:—

P. M. N.	37	L.	18
P. M. E.	19	L. M.	1
P. M. B.	24	T.	1

g—The polynuclear count is 18 : 37 : 39 : 6 : 0.

h—The resistance of the red cells is given by the following figures: saponin, 1.0, taurocholate, 0.49, hypotonic saline, 0.16 per cent NaCl. This latter is the greatest resistance yet recorded.

IX. Cebus fatuellus (Sapajou)

a—Red cells in plasma, 7.8 μ; in dried films, 6.8 μ.

b—Haemoglobin, 90 per cent.

c—Red cell count, 5,100,000.

d—White cell count, 10,400.

e—The polymorphs are difficult to stain properly, and the nucleus is obscured by the eosinophilic and basophilic granules which fill the cytoplasm. There are some neutrophile granules present. The size of these cells is 13 μ. The lymphocytes are peculiar in that they contain an irregular nucleus with slightly scalloped margins. The cell sizes are:—

P. M. N.	13 μ	L.	8 μ
P. M. E.	10 μ	L. M.	11 μ
P. M. B.	7 μ	T.	11 μ

f—The differential count is:—

P. M. N.	68	L.	21
P. M. E.	5	L. M.	2
P. M. B.	3	T.	1

g—The polynuclear count is 10 : 22 : 42 : 18 : 8.

h—The resistance to haemolysins is shown by the following figures: saponin, 1.42, taurocholate, 1.12, hypotonic saline, 0.38 per cent NaCl.

X. Ateleus ater (Black Spider Monkey)

a—Red cells in plasma, 9.1 μ; in dried films, 7.7 μ.

b—Haemoglobin, 76 per cent.

c—Red cell count, 5,760,000.

d—White cell count, 10,000.

e—The eosinophiles are peculiar in that areas of the cytoplasm do not contain granules of any kind. The large bright red granules are concentrated on one side of the nucleus, leaving the remaining part of the clear light blue

cytoplasm devoid of granules. No large mononuclears or transitional cells appear to be present. The sizes of the cells are:—

P. M. N.	13–17 μ	L.	10 μ
P. M. E.	12 μ	L. M.	—
P. M. B.	8 μ	T.	—

f—Differential count:—

P. M. N.	69	L.	18
P. M. E.	12	L. M.	none
P. M. B.	1	T.	none

g—Polynuclear count:—3 : 6 : 5 : 10 : 10 : 10 : 14 : 42. This is a most remarkable count, for not only are there eight classes, but as many as 42 cells show eight nuclear lobes.

h—Resistance to haemolysins:—saponin, 1.24, taurocholate, 1.63, hypotonic saline, 0.28 per cent NaCl.

XI. Ateleus geoffroyi (Gray Spider Monkey)

a—Red cells in plasma, 8.8 μ; in dried films, 7.9 μ.

b—Haemoglobin, 80 per cent.

c—Red cell count, 3,840,000.

d—White cell count, 7,000.

e—The polymorphs are approximately 10 μ in diameter, and contain extremely lightly staining cytoplasm filled with fine neutrophile granules. The basophiles appear to be composed almost entirely of nuclear material, only a few basophilic granules being resolvable at the edge of the cell. The lymphocytes also have very little cytoplasm, and contain a few azure granules. The large mononuclears have a clear sky blue cytoplasm which contains no granules at all. The cell sizes are:—

P. M. N.	10 μ	L.	8 μ
P. M. E.	11 μ	L. M.	13 μ
P. M. B.	6–8 μ	T.	—

f—Differential count:—

P. M. N.	73	L.	15
P. M. E.	8	L. M.	1
P. M. B.	3	T.	none

g—Polynuclear count:—8 : 18 : 21 : 29 : 19 : 4 : 1. Like the count of Ateles ater, the count is very right handed.

h—Resistance to haemolysins:—saponin, 1.28, taurocholate, 1.46, hypotonic saline 0.28 per cent NaCl.

XII. Saimiri sciureus (Squirrel Monkey)

a—Red cells in serum, 6.4 μ; in dried films, 6.1 μ.

b—Haemoglobin, 84 per cent.

c—Red cell count, 7,416,000.

d—White cell count, 11,000.

e—The lymphocytes can properly be divided into small and large, for they show a wide variation in size (5–14 μ). The other cells are typical. The sizes are:—

P. M. N.	10 μ	L.	5–14 μ
P. M. E.	8 μ	L. M.	12 μ
P. M. B.	8 μ	T.	—

f—Differential count:—

P. M. N.	65	L.	26
P. M. E.	6	L. M.	1
P. M. B.	2	T.	none

g—Polynuclear count:—8 : 15 : 30 : 22: 15 : 10.

h—Resistance to haemolysins:—saponin, 0.90, taurocholate, 0.95, hypotonic saline, 0.27 per cent NaCl.

XIII. Aotus trivirgatus (Owl Monkey)

a—Red cells in serum, 7.1 μ; in dried films, 6.7 μ.

b—Haemoglobin, 71 per cent.

c—Red cell count, 4,664,000.

d—White cell count, 8,200.

e—The films are exceedingly difficult to stain, owing to the serum taking on a grayish-blue color which obscures the cell outline. Direct fixation with methyl alcohol before staining seems to help, but no satisfactory technique has been developed for dealing with the blood films of this animal. Except that there are no large mononuclears or transitional cells, all the leucocytes observed were found to be typical. The cells sizes are:—

P. M. N.	7 μ	P. M. B.	8 μ
P. M. E.	10 μ	L.	9–10 μ

f—Differential count:—

P. M. N.	79	P. M. B.	1
P. M. E.	8	L.	12

g—Polynuclear count:—6 : 20 : 34 : 16 : 4.

XIV. Callithrix jacchus (Marmoset)

a—Red cells in serum, 7.7 μ; in dried films, 7.0 μ.

b—Haemoglobin, 67 per cent.

c—Red cell count, 6,624,000.

d—White cell count, 7,800.

e—The mononuclears are atypical in that the cytoplasm stains a light blue and is filled with fine purple granules which are evenly distributed. The nucleus is approximately central. The cell sizes are:—

P. M. N.	10–11 μ	L.	5–9 μ
P. M. E.	11 μ	L. M.	16 μ
P. M. B.	8 μ	T.	—

f—Differential count:—

P. M. N.	72	L.	19
P. M. E.	2	L. M.	3
P. M. B.	4	T.	none

g—Polynuclear count:—35 : 32 : 28 : 5 : 0. This count is a little left handed.

h—Resistance to haemolysins:—saponin, 0.57, taurocholate, 0.71, hypotonic saline, 0.40 per cent NaCl.

XV. Lemur catta (Ring-tailed Lemur)

a—Red cells in plasma, 6.8 μ; in dried films, 6.3 μ.
b—Haemoglobin, 87 per cent.
c—Red cell count, 7,936,000.
d—White cell count, 16,400.
e—The polymorphs are typical except that they contain some rather coarse neutrophile granules. The eosinophiles contain peculiar red granules, characterized by their hyaline appearance. The lymphocytes contain an exceedingly small amount of cytoplasm. The sizes are:—

P. M. N.	10 μ	L.	6–8 μ
P. M. E.	10 μ	L. M.	12 μ
P. M. B.	9 μ	T.	13 μ

f—Differential count:—

P. M. N.	66	L.	23
P. M. E.	7	L. M.	1
P. M. B.	2	T.	1

g—Polynuclear count:—5 : 25 : 38 : 25 : 7.
h—Resistance to haemolysins:—saponin, 0.64, taurocholate, 1.0, hypotonic saline 0.42. This latter figure is greater than that for the cells of man.

XVI. Lemur mongos (Brown Lemur)

a—Red cells in plasma, 6.7 μ; in dried films, 6.3 μ.
b—Haemoglobin, 75 per cent.
c—Red cell count, 10,304,000.
d—White cell count, 15,400.
e—No transitional or mononuclear cells could be found. The eosinophiles contain only a few red staining granules. The basophiles also contain few granules. The sizes are:—

P. M. N.	10 μ	P. M. B.	6–8 μ
P. M. E.	11 μ	L.	9–12 μ

f—Differential counts:—

P. M. N.	69	L.	27
P. M. E.	1	L. M.	none
P. M. B.	3	T.	none

g—Polynuclear count:—5: 18 : 40 : 25 : 10 : 2.

Atypical leucocytes

While examining the stained smears of the blood of the sapajou, gorilla, and squirrel monkey, a large polymorphonuclear leucocyte was encountered, which measured from 18–23 μ in diameter. The nucleus is typically polymorphic, stains a deep purple, and has at least four lobes. The cytoplasm is clear, stains light pink, and contains no granules. It occurs approximately once in every 200 cells.

SUMMARY

Except for small differences of size the red cells of the Primates resemble those of man. The largest cells are those of the spider monkeys while the smallest are those of the lemurs. The red cell counts vary from 5,000,000 to 7,000,000 and the haemoglobin content from 75 to 90 per cent. The erythrocytes offer considerable variations in their resistance to haemolysis by simple haemolysins, but are in general considerably more resistant to hypotonic saline haemolysis than are human cells. The morphology of the white cells is very similar to that found in man, minor differences only being found, and the differential counts present no unusual features. The total white cell count varies from 7,000 to 16,000. For most genera of monkeys the polynuclear count is more right-handed than the count for man and in the case of Ateles ater as many as 40 per cent of the polymorphs may be cells containing 7 nuclear lobes.

A fuller account of the haematology of the Primates will be found in the Quarterly Journal of Experimental Physiology, vol. xix.

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DIRECT BONE FORMATION IN THE ANTLER TINES OF TWO OF THE AMERICAN CERVIDAE, VIRGINIA DEER (*ODOCOILEUS VIRGINIANUS*) AND WAPITI (*CERVUS CANADENSIS*)

WITH AN INTRODUCTION ON THE GROSS STRUCTURE OF ANTLERS

By Charles V. Noback, PhD., and Walter Modell, B.S.

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DIRECT BONE FORMATION IN THE ANTLER TINES OF TWO OF THE AMERICAN CERVIDAE, VIRGINIA DEER (*Odocoileus virginianus*) AND WAPITI (*Cervus canadensis*)

WITH AN INTRODUCTION ON THE GROSS STRUCTURE OF ANTLERS

By Charles V. Noback, Ph.D., and Walter Modell, B.S.*

New York Zoological Park

Illustrations from photographs made in the Zoological Park

Introduction

(Figs. 1 to 56 incl.)

This paper is the report of a study of the gross and microscopic structure of growing antler tines in Virginia deer (*Odocoileus virginianus*) and the wapiti or American elk (*Cervus canadensis*). The major portion of the histological work was confined to a study of the tip of a growing wapiti antler. A similar histological study of the tip of a growing antler in the Virginia deer indicated that essentially the same process of growth is present in the growing antler tines of both of these American Cervidae. It is not our purpose to consider the general external structure such as the size and pattern of antlers, as this subject has been treated in works on natural history [Hornaday (18)].

A striking and impressive feature of antler-bearing Cervidae is that these large osseous structures are shed and renewed annually. One is impressed by the size and strength of these very rapidly growing osseous structures, which present perhaps the most rapid growth of membranous bone found in mammals.

Numerous descriptions are given of the number of tines or branches that antlers possess, and such terms as brow, bez, trez, royal, sur-royal and crown tines are frequently used in general descriptions of antlers. Aristotle (1) (384 to 322 B. C.) considered them as secondary sexual characters and noted that they were shed annually. "If stags are castrated before they are old enough to have horns [antlers], these never appear; but if castrated after they have horns [antlers], their size never varies, nor are they subject to their annual change." Redi in 1657 quoted by Owen (2) expresses the same

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opinion as Aristotle but gives no experimental data to support his views. In 1766 Buffon et Daubeton (3) in their "Histoire naturelle général" make the same statement regarding antlers and castration.

Prior to the nineteenth century, writers seem to have confined their records to descriptions of the general antler pattern, shedding, and the effects of castration. Since this paper will not deal with castration effects we will proceed to note some of the views that have been held on the structure and composition of antlers.

As late as 1758 Buffon (4) expressed the opinion that antlers were composed of wood, growing in a manner similar to the growth of the branches of a tree. Barr's (5) translation of Buffon's Works in 1807 contains the following reference on a red deer antler. "Its substance is perhaps more of the nature of wood than bone; it is, as it were, a vegetable grafted upon the animal." The velvet was designated as écorcé (bark). "Bois" is frequently used by the French to designate an antler.

The earliest references on the actual composition of antlers which we were able to find were those of Chevrueil (6) (1818) and Georges Cuvier (7) (1817). These writers were apparently the first to recognize and record the fact that the cervine antler is composed of bone. The former states that the antler of ruminants consists of bone and that on boiling, the organic matter is converted into gelatine, and that no fat is present. Cuvier (7) in an article under Cerf states, "antlers are composed of bone."

Johannes Müller (8) (1825) believed that the bony core of the ruminant horn and the antler are similar in structure, and considers the tubercle of the budding antler to consist of cartilage which ossifies in a manner similar to bones of the foetal skeleton. Gegenbaur (9) (1867) describes the ossification of the antler as an exceptional kind of cartilage metaplasia and agrees with Lieberkühn (10) (1864), who also believed that the antler was preformed in cartilage.

Landois (11) (1865) observed and recorded that the antler was not preformed in cartilage but in reality was a form of membranous bone. It remained for Robin et Herrmann (12) (1882) to confirm this finding and to present clear histological evidence as to the actual character and composition of the osseous structure of antlers. They gave a detailed description of the process of ossification and growth of the Roebuck (*Cervus capreolus*) antler from an undifferentiated connective tissue through a preosseous stage to membranous bone,

together with a description of the phases of osteoblastic development. They use the term preosseous substance (substance preosseous, or substance fondamental de l'os de Müller) to describe the clear amorphous material containing osteogenic fibrillae which surrounds the osteoblasts.

Gadow (13) (1902) in a paper on "The Evolution of Horns and Antlers" emphatically denies direct bone formation in the antler and describes the presence (page 210) of "a dense layer of hyaline cartilage which together with the rapidly proliferating connective tissue. . . . forms the growing point of the future pricket." He presents no original work in support of this statement. In reply to Dürst (14) (1902), who states that the bone of the antler is not formed by the intervention of cartilage, Gadow (13) states (page 222), "He [Dürst] and others will have to accustom themselves to the existence of cartilage in places where textbooks carefully abstain from mentioning it."

Fambach (15) (1909) in a critical review and by original work confirms the observations of Landois, Robin et Herrmann and Dürst on the structure of antlers.

Macewen (16) (1920) page xi, states, "The inquiry into the phenomena connected with the growth and shedding of the deciduous antler of the deer is undertaken to determine the data of a very interesting phase of nature which had not already been investigated, was imperfectly understood and which on its own merits, was of intrinsic value." Without referring to any previous work on the histogenesis of the bone in the antler he concludes from original work that (page 49). "The antlers showed a vigorous formation of bone through cartilage of the main stem and the basal portions of the tines, while the terminal parts of the same tines developed through direct bone formation."

Before going into a detailed account on the structure of antlers we feel it advisable to review the gross characteristics which differentiate the antler from the hollow horn of ruminants. The cervine antler is a deciduous bony protuberance arising from the pedicle of the frontal bone, covered with a true skin, the velvet, during its period of growth. This velvet is shed after ossification has been completed. Horns may be considered as the permanent keratogenous sheaths of ectodermal origin which enclose an osseous core arising from the frontal bone of the hollow-horned ruminants. Horns are present in both sexes, and except in the prong-horned antelope,

are never shed. The prong-horned antelope sheds its horns each year.

The males of all Cervidae with the exception of the Chinese water deer (*Hydropotes inermis*) are antler-bearing, while in the caribou (*Rangifer caribou*) and reindeer (*Rangifer tarandus*) both sexes bear deciduous antlers.

As the antlers of American deer are in process of growth from April to October, it will be realized that it is very difficult to obtain material for study without injury to the animal. The specimens used in this investigation were obtained from accidentally broken antlers.

Gross External Antler Structure

At birth the antler-bearing young present no external indication of an ensuing antler. Several months after birth small paired bulges of the frontal bone, covered with the skin of the head, begin to appear anteriorly and laterally on the frontal bone. These bulges grow with marked rapidity to form the pedicle. The first antler grows from the tip of this pedicle when the deer is about eighteen months old. Ossification of the antler begins at the base and keeps pace with the growing tip, so that a section at any level is harder than that above it and less ossified than that below. Growth continues until the pattern of the species and individual is completed, ossification continuing until the tip has become ossified, after which the velvet is shed. The antler does not increase in diameter as it grows in length [Caton (17)] except at the corona around the base, which is the only region showing an increase in diameter. The external appearance of the annually recurring cycle of successive changes of the wapiti antler is illustrated in the accompanying series of photographs by Sanborn (20) (Figs. 1-16) and also described by Hornaday (18).

The Velvet

The velvet which envelops the growing antler is an extension from the skin of the head (Fig. 23). After the antler has been shed it regenerates and grows from the adjacent cutaneous border to cover the tip of the pedicle. It is noteworthy that the velvet does not in any way resemble scar tissue but contains all the elements of cervine skin.

The velvet may be separated into three layers—an innermost

fibrous layer, the corium, and a peripheral epidermal layer (Figs. 17, 18 and 19). The fibrous layer, consisting of coarse collagen fibers arranged longitudinally, is quite vascular and gradually merges with the deeper undifferentiated connective tissue layer (Fig. 20). A few capillaries may be seen to pass from the fibrous layer of the velvet and to enter the layer of undifferentiated connective tissue in the region of the growing tip.

The corium (Figs. 17, 18 and 19) lies peripheral to the fibrous layer, containing hair follicles and sebaceous glands together with many fibrillae arranged in various directions, but most of the fibrillae are at right angles to the epidermal layer (Fig. 18). The hair follicles with the ducts of their sebaceous glands pierce the epidermis (Figs. 17 and 19). Paccinian corpuscles, Meissner's corpuscles, nerves and free nerve endings have not been demonstrated with hematoxylin and Orange G or Del Rio Hortega's silver carbonate method. The epidermal layer forms the outer coat of the velvet (Figs. 17, 18 and 19) and corresponds to the ectoderm (keratogenous layer) of skin.

Gross Internal Antler Structure

Figures 22 to 28 illustrate the gross internal structure of Virginia deer antlers in successive stages of seasonal growth. Fig. 29 illustrates the gross external appearance and Fig. 30 the gross internal appearance of the tip of the growing wapiti antler. (Old antler shed April 18, 1929; specimen obtained through accident July 2, 1929.)

The following description of the gross internal structure of the deer antler is primarily based upon a study [Noback (19)] of three antlers from the Virginia deer (*Odocoileus virginianus*) and the head of a Columbia black-tailed deer (*Virginianus columbianus*). These specimens were obtained at the New York Zoological Park during the summer of 1928. The first, an antler in early velvet, representing about two months' growth, was obtained on June 1, 1928. The second antler, representing a growth of about four months, came from a buck which died on July 25, 1928. The third, representing about six months' growth, was secured on October 4, 1928. The head of the Columbia black-tailed deer came from an old buck which died on January 28, 1929, four weeks after shedding its antlers.

In the latitude of New York, during late winter or early spring of each year, the mature antler is shed, after which a new one grows from the tip of the pedicle. The exposed surface of the osseous pedi-

cle (Figs. 22 and 23) is bare at the time of shedding. The marginal border of skin is the source of a cutaneous structure, the velvet, which soon envelops the free surface. While the velvet is developing, a mass of undifferentiated connective tissue, embryonic in character, is beginning to form. The growth of modified skin, the velvet, which later becomes covered with fine short hair, protects the connective tissue cap.

It may be noted that the pedicle is a cylindrical outgrowth from and a part of the frontal bone of the skull. The relation of the frontal bone to the pedicle is shown in Fig. 28. The blood supply of the pedicle is derived from the internal vascular system of the frontal bone.

A gross examination of the tine of a growing antler reveals that it is elastic in consistency while its cut surface presents a glistening bluish-white appearance which grossly resembles cartilage. Microscopic examination, however, reveals that the tip of the growing antler consists of a mass of newly formed undifferentiated connective tissue.

Growth of the antler seems to take place somewhat as follows: The cap of undifferentiated connective tissue "grows out" while the tissue at the base ossifies. Bone formation is more intense within the wall of the antler so that on examination we find that the wall of the cylindrical antler shaft is very compact in comparison with the interior. The interior of the antler is filled with a mass of soft bone tissue, a veritable network of fine blood channels which serve to supply the growing tip with an adequate amount of blood from the Haversian systems of the pedicle and frontal bone. The growing tip is primarily dependent for its nourishment upon blood received from the frontal bone through the pedicle and partly from the blood vessels of the velvet.

The gross internal structure of the tines of a young growing antler is illustrated in the accompanying photograph (Fig. 24) of a longitudinal section through a two months' growth of antler in velvet. The photographed specimen was secured on June 1, 1928 as the result of an accident. All the stages of growth in a growing antler tine may be seen in this photograph. A good view of the velvet and its hair may be seen in Fig. 25, a cross section from the beam of the antler where blood vessels in the velvet are plainly visible. The gross structure of the growing shaft is seen to consist of spongy bone richly

supplied with blood, while the wall consists of compact bone where calcification is more complete. The growing bone imperceptibly merges with the undifferentiated connective tissue.

A later stage illustrating the internal structure of a four months old antler is shown in Fig. 26. It will be seen that the clear tip has been practically replaced by new bone. It may be seen that the velvet covering the tip of the antler has begun to degenerate, as indicated by its darkening and drying out.

Figure 28 shows the internal structure of the mature antler, pedicle and frontal bone obtained by a longitudinal section. This antler is bare, free of velvet, and is composed solely of bone. The wall of the mature antler is seen to consist of hard compact bone while the interior still contains spongy, vascularized bone. The base of the antler is firm and compact, with a ring of bone overflowing the base to form the corona or burr. The line of demarcation between antler and pedicle is clear and distinct. It is along this line that separation from the pedicle takes place when the antler is shed and it is from this area on the pedicle that a new antler will grow. Complete ossification of a mature antler tip can be seen in Fig. 27.

Sections for microscopic study were obtained from the growing tip of a 75-day old wapiti antler. A close view of the exterior of the wapiti antler tine is illustrated in Fig. 29, showing the hair of the velvet very distinctly. The external appearance of an antler of essentially the same age can be seen on the wapiti in Fig. 12. A longitudinal section showing the gross internal structure of this antler tine can be seen in Fig. 30.

From within, the following three layers in the antler tine may be identified—a core of preosseous tissue in the process of ossification (Fig. 30), a layer of undifferentiated connective tissue, and the velvet. The layer of undifferentiated connective tissue is very thick at the tip where it forms a cap. It continues down the sides of the antler, gradually becoming narrower until it finally becomes imperceptible.

Microscopic Structure of Growing Antler Tine

The growing tines of a 75-day old wapiti antler and a two months' old antler from a Virginia deer were used to study the process of ossification in the tip of a growing antler. Del Rio Hortega's silver carbonate method was used as a general staining procedure to

demonstrate cellular as well as fibrillar structure. A modification of this method was used to demonstrate the fibrillar network.

Del Rio Hortega Silver Carbonate Method

1. Fix the tissue in a ten per cent. (10%) neutral formalin solution (excess of magnesium carbonate in formalin).
2. Cut sections, with a freezing microtome, 15 to 20 microns thick.
3. Wash the sections thoroughly in distilled water. A few drops of ammonium hydroxide should be added to the first wash water.
4. Sections are stained in the silver carbonate solution, which solution is prepared as follows:

Five (5) c. c. of a ten per cent. (10%) aqueous solution of silver nitrate (Ag NO3) [Merck] are added to twenty (20) c. c. of a five per cent. (5%) solution of sodium carbonate (Na2 CO3) [Merck]. Without separating the precipitate add ammonia drop by drop until the precipitate is dissolved. Shake the beaker while adding the ammonia and be careful not to add too much. Finally add fifty (50) c.c. of distilled water and keep the solution in a dark brown bottle where it should keep well for several weeks.

The method of staining follows:

Wash the sections in a small Stender, then place them in ten (10) to fifteen (15) c. c. of the silver carbonate solution. Heat gently until a temperature of fifty (50) degrees Centigrade is attained or until the sections become yellowish brown. Discard the silver solution.

5. Before the silver solution cools, transfer the sections to distilled water and wash for from one-half (½) to one (1) minute.
6. Reduce the silver in a solution of fifteen (15) per cent. neutral formalin.
7. Wash thoroughly in distilled water. Examine under the microscope. If too pale place in silver carbonate solution again and repeat the whole procedure.
8. Tone with a two-tenths (0.2) per cent. aqueous gold chloride solution until grayish purple (five to ten minutes).
9. Wash in distilled water.
10. Fix with a five per cent. (5%) aqueous solution of sodium hyposulphite (sodium thiosulphite) for one to two minutes.
11. Wash very thoroughly in distilled water.
12. Run through alcohols 80%, 90% and absolute.
13. Clear in following solution:

Carbolic Acid crystals	5 grams
Creosote	50 c.c.
Xylol	45 c.c.

14. Mount in Dammar or Balsam.

The Modification which brings out the fibrillar structure consists of:

1. Fixation in neutral formalin (excess of magnesium carbonate in formalin) for at least a week.
2. Place in following solution for three days:

94 c.c. of a ten per cent. (10%) neutral formalin solution.
6 c.c. of concentrated Nitric acid.

3. Add two drops of concentrated ammonia to wash water.
4. The procedure given above is then followed.

Microscopic examination reveals an imperceptible merging of the fibrous layer of the velvet with the contiguous layer of undifferentiated connective tissue (Fig. 20). A definite line of demarcation between the undifferentiated connective tissue and the region of active ossification is present only where ossification is pronounced (Figs. 17, 31 and 32). A periosteum, as found in long bones, consisting of an outer fibrous restraining membrane with an inner osteogenic layer, is not present in the growing antler.

The undifferentiated connective tissue is composed of many layers of fusiform cells. These cells, with large dark, ovoid nuclei (Figs. 33 and 34), resemble those found in mysenchyma. For the most part, they are arranged parallel to the curvature of the cap. A delicate fibrillar network can be seen throughout this layer (Fig. 51), apparently continuous with the somewhat heavier fibers of the velvet. In lower sections along the sides of the ossifying core where ossification is distinct (Fig. 17), it is possible to measure the thickness of the undifferentiated connective tissue layer. In a cross section 3.0 cm. from the tip of the antler the undifferentiated connective tissue layer is 1.1 mm. thick; at 4.0 cm. it is 1.0 mm.; at 5.0 cm. it is 0.9 mm.; at 5.5 it is 0.75 mm. in thickness. These measurements indicate the gradual narrowing of this layer.

The presence of fusiform cells, with large, dark, ovoid nuclei, in the cap has been noted above (Figs. 33 and 34). Following a longitudinal section proximally, the aspect of these cells greatly changes (Fig. 43). They become larger, rounder and more granular, gradually losing their processes. Their nuclei which also become larger and rounder eventually assume an eccentric position in the cell. Longitudinal series of thin elongated cells with long darkly staining nuclei and lightly staining cytoplasm occasionally break through the layers of undifferentiated connective tissue cells just below the tip of the cap (Figs. 34 to 42). This series of cells seems to represent the evolution of the undifferentiated cell into an endothelial cell. The remaining cells are grouped around the evolving endothelial cells, so that in cross section 0.5 cm. to 1.5 cm. from the tip of the antler the appearance is presented of small masses of thin cells with lightly staining cytoplasm surrounded by the larger slightly basophilic cells. These actively proliferating basophilic cells derived from the undiffer-

entiated connective tissue of the cap possess fibroblastic characteristics.

In the lower sections these fibroblastic cells, enmeshed in a network of compacted fibrils, are more mature (Figs. 52, 53 and 54). Still lower (below 3.0 cm.) they show a clearing of cytoplasmic granules and signs of beginning atrophy (Figs. 43 and 55).

No spaces have been observed, in the masses of cells destined to form the endothelial lining of the blood channels, within two centimetres of the tip of the antler (Fig. 40). Below this level the developing endothelial cells gradualy form the lining of the blood channels (Figs. 35, 36 and 42) which are continuous with the wider channels below, bringing blood from the vessels of the diplöe of the frontal bone.

Two centimetres below the tip, cells from the periphery proliferate toward the newly forming centres of ossification (Figs. 44 to 50). The type of cell from which they originate is apparently of the same morphological character as those found in the cap. Their evolution seems to be more rapid, i. e., the series of cells representing the phases of the osteoblastic development is shorter than the series in the development of the fibroblastic cells originating from the cap.

Differing slightly in shape, the cell derived from the periphery has the definitive form of the osteoblasts (Figs. 46, 50 and 56). It is smaller, more basophilic, and more polygonal than the cell from the cap. The fibroblastic cells from the cap seem to lay down the fibrillar framework which later becomes ossified, while osteoblasts from the periphery apparently pass to the newly formed centres of ossification. Mitotic figures are present in the cells of the undifferentiated connective tissue and rare in the region of the matured osteoblasts.

As mentioned above, the tip of the cap shows a delicate fibrillar network (Fig. 51). As the developing fibroblasts increase in size they separate, while the fibrillar network spreads out to enclose them within its meshes, the fibrils coalesce to form a coarser network (Figs. 52, 53 and 54). Centres destined to become blood channels are devoid of the fibrillar network but contain a few delicate longitudinal fibrils (Figs. 51 and 52).

As the fibrillar network becomes coarser, the enmeshed cells at first show slight and later marked atrophy, together with a gradual disappearance of cytoplasmic granules (Figs. 43 and 55). Slight but definite centres of ossification first appear two centimetres below the

tip of the antler, immediately deep to the peripheral undifferentiated connective tissue. In this region of ossification the fibrils, becoming heavier, coalesce, the enclosed cells apparently atrophying from pressure. An occasional enclosed osteoblast does not atrophy and becomes an osteocyte of the mature antler bone. The trabecular framework is apparently formed by coalescence of fibrils (Fig. 54), beginning just under the peripheral undifferentiated connective tissue gradually extending distally and centrally.

Osteoblasts seem to migrate from the periphery to the spaces between the endothelium of the blood channels and the surrounding preosseous ring (Figs. 50 and 56). The migration of the osteoblasts from the periphery to the centre is made possible by a continuity of these spaces. The osteoblastic migration through these spaces seems to be the mechanism by which central ossification takes place. The process of ossification continues peripherally so that the wall of the antler finally consists of compact bone while the central portion remains spongy.

The vascular system of the growing antler consists of simple blood channels which are not surrounded by concentric lamellae which characterize the Haversian systems of skeletal bone. This sharply differentiates the bone of the antler from that of the pedicle.

The content of the blood channels in the antler apparently consists solely of blood. We have not been able to demonstrate the presence of fat or hematopoeitic elements found in the marrow of the diplöe of the membranous bones of the cranial vault.

Fibroblasts from the undifferentiated connective tissue cap lay down the ossifiable fibrillar framework while the osteoblasts from the periphery seem to complete the process of ossification.

The presence of fibrils in the matrix surrounding the fibroblasts and absence of cartilage during the entire process of growth leads us to conclude that the antler is a form of membranous bone.

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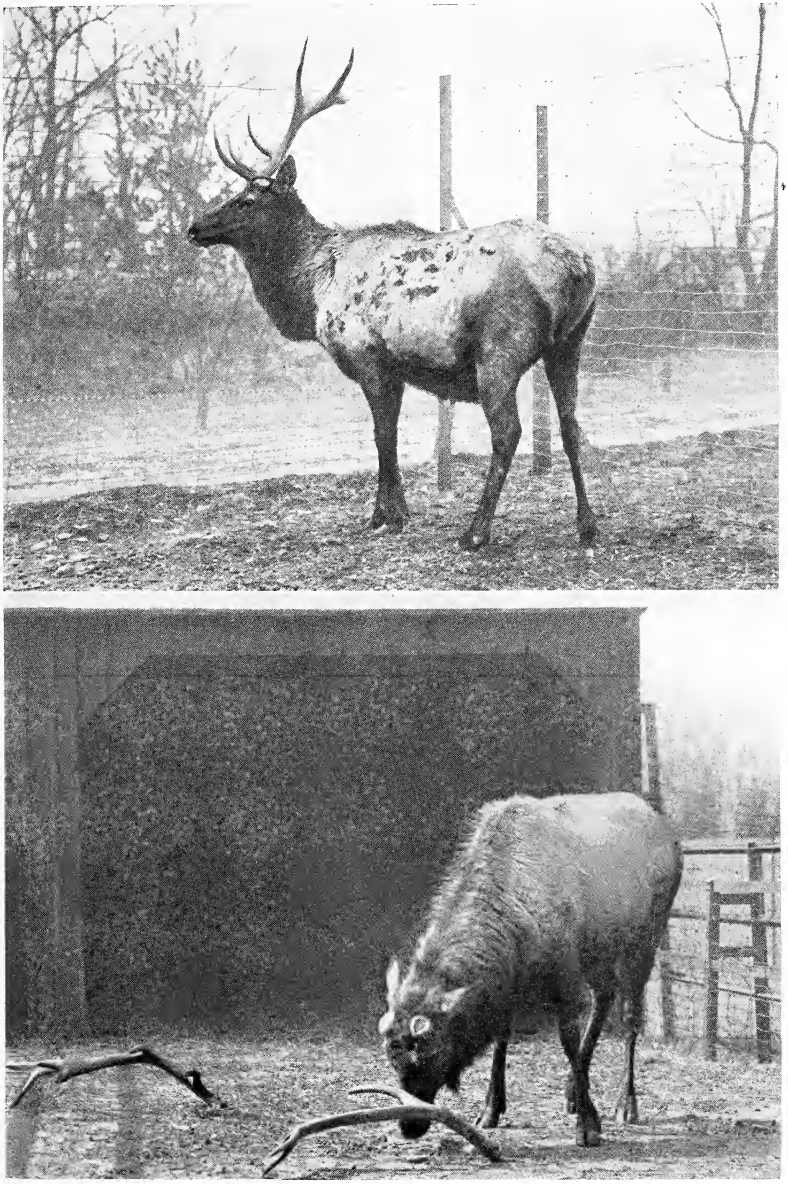


Fig. 1. *Upper.* The matured antlers of the wapiti are usually shed in March, occasionally in February. The exposed surface of the pedicle is shown after one antler had been dropped. Fig. 2. *Lower.* The appearance of the exposed pedicle tips after both antlers had been shed. Figs. 2, 9, 15 and 16 are used here for demonstration. The other figures are from the same animal.

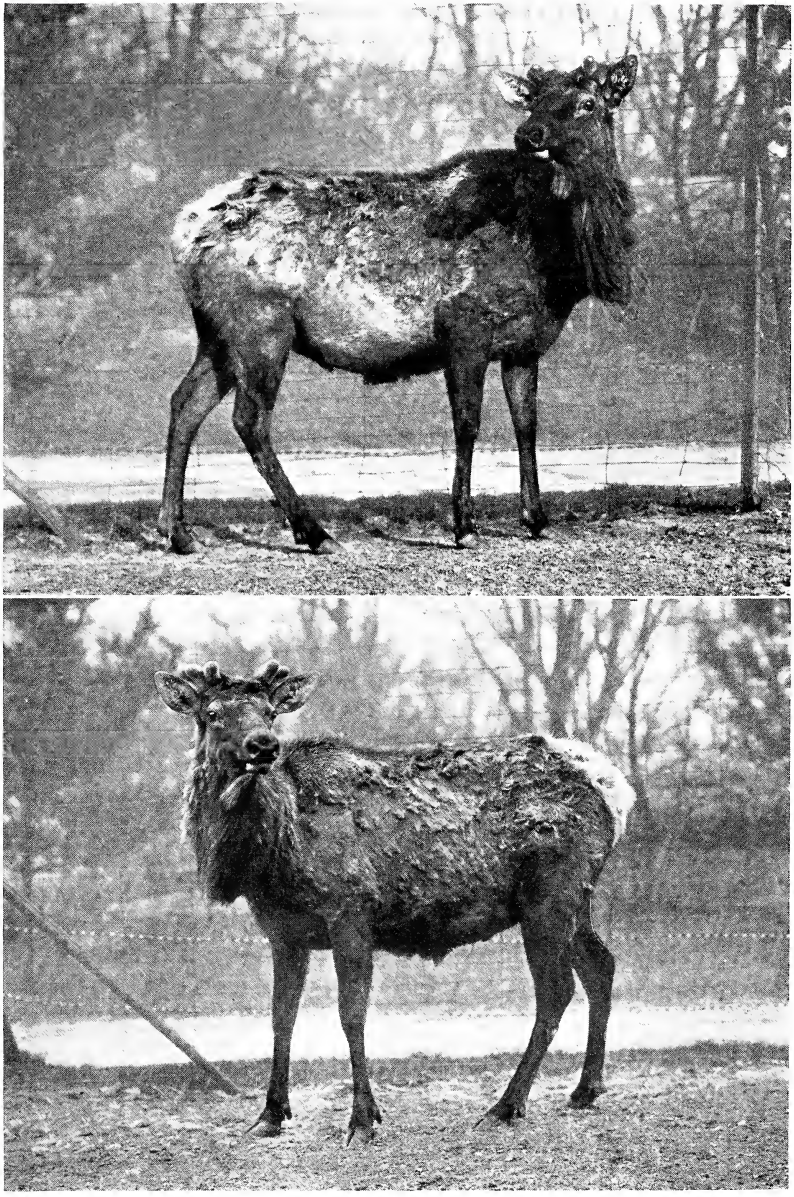


Fig. 3. *Upper.* Antlers budding from the pedicle, April 26.
Fig. 4. *Lower* The new antlers are beginning to show the branch-like form.

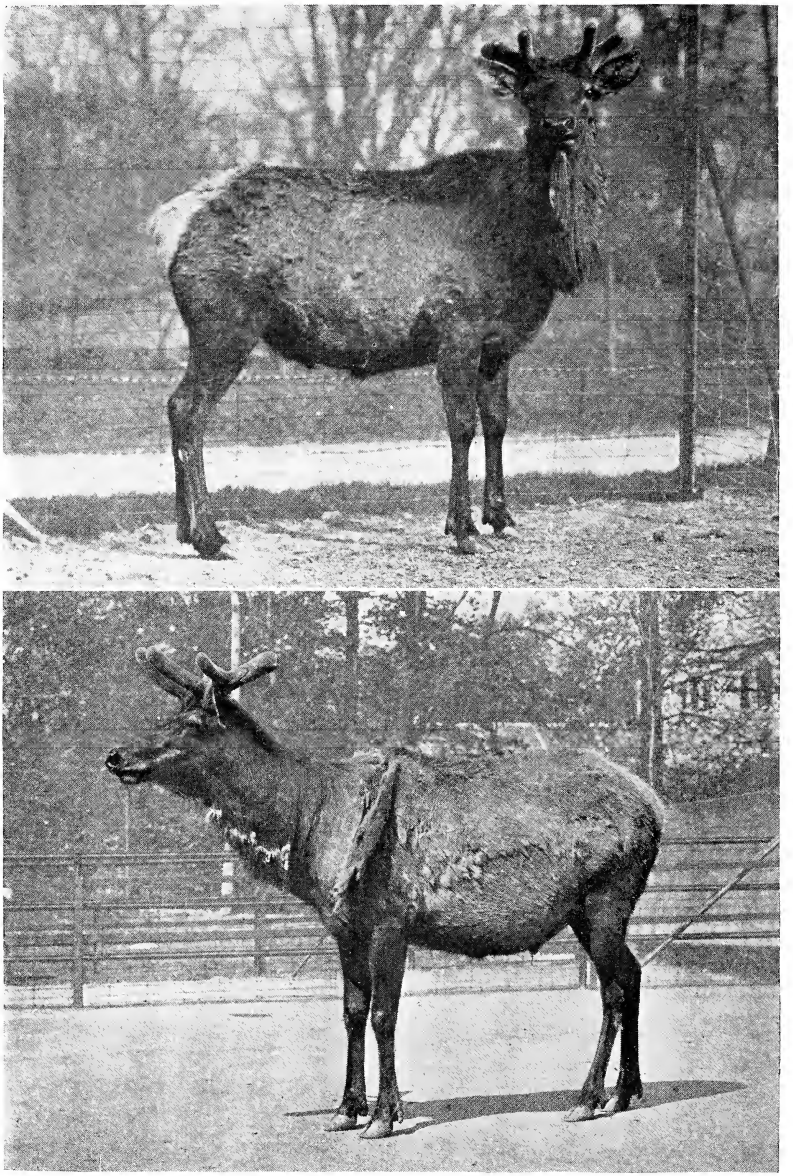


Fig. 5. *Upper.* The rapidity of growth is shown by the appearance of the antlers about the 5th of May. Fig. 6. *Lower.* The branching of the antlers indicates their future pattern; May 9.

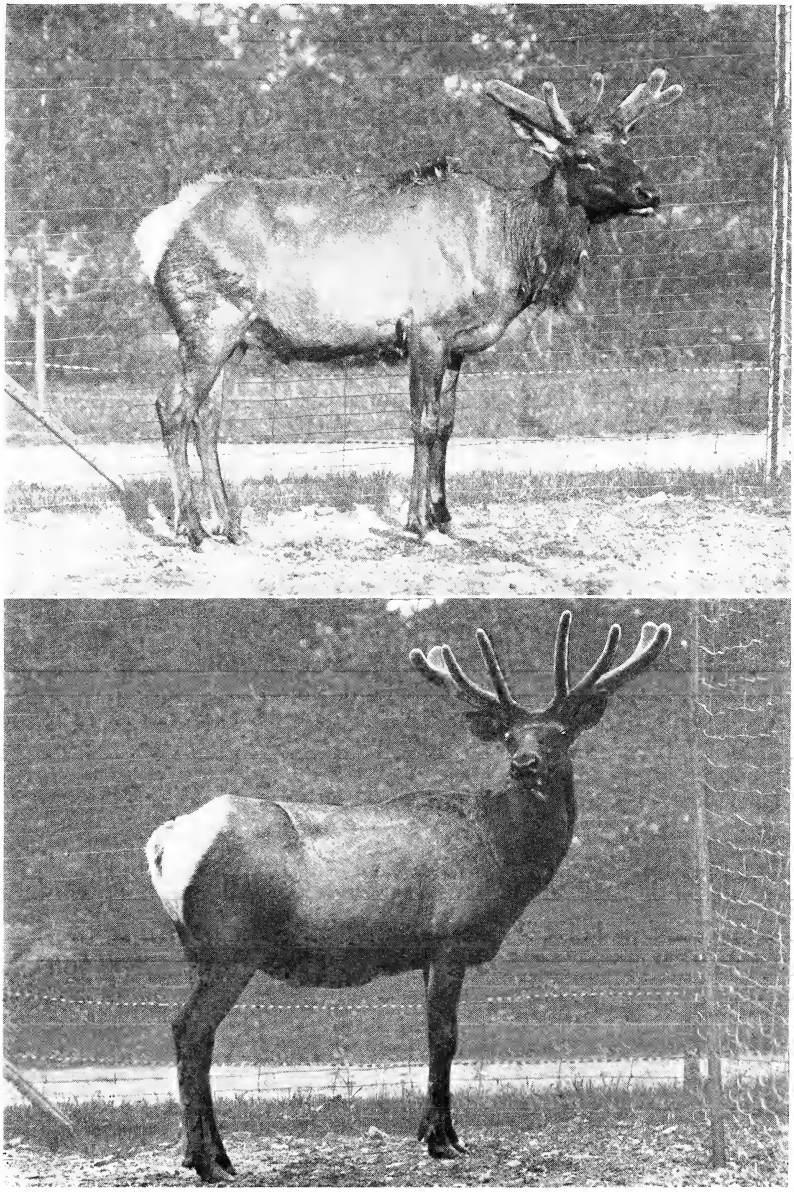


Fig. 7. *Upper.* The growing antler structure shows increased division on May 16, and the rough coat of old hair is shedding out. Fig. 8. *Lower.* As the antlers approach their normal size, they become a prominent and striking feature of the male wapiti.

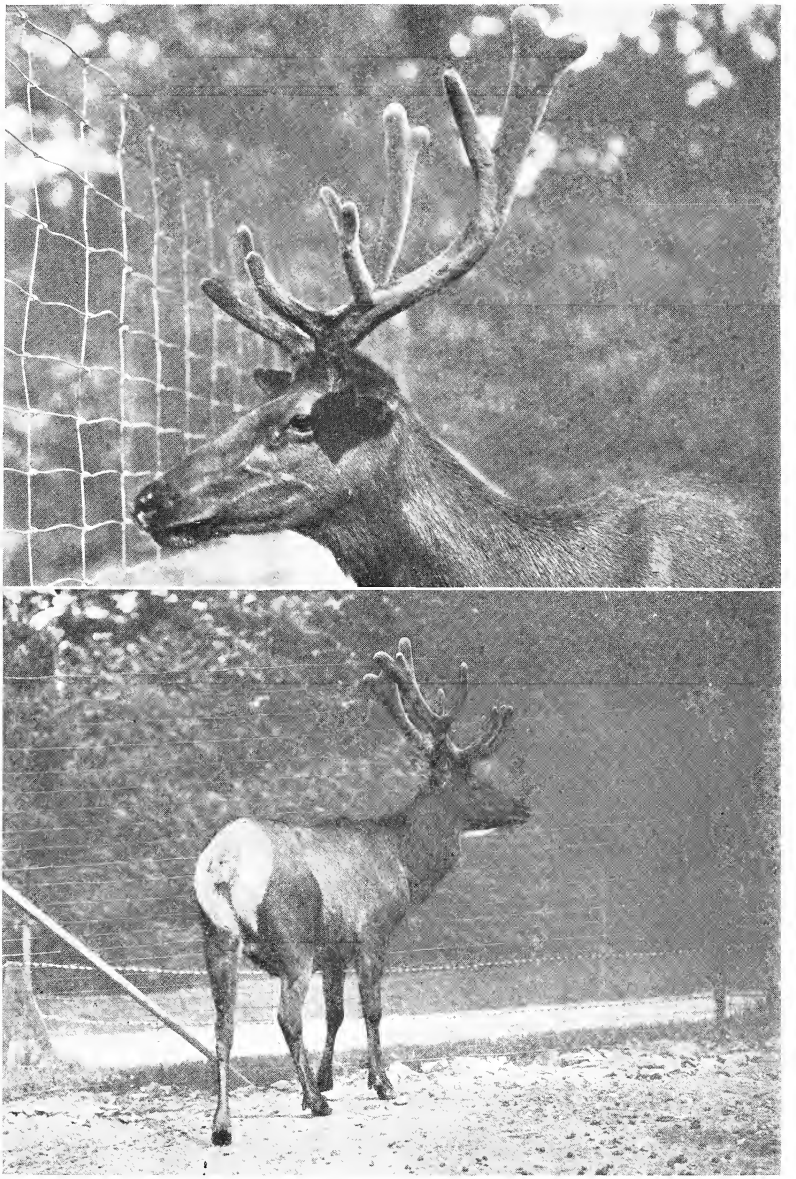


Fig. 9. *Upper.* During the period of development, while the antlers are in the velvet stage, the wapiti exercises the greatest care in avoiding hard objects. Fig. 10. *Lower.* The velvet masks the trim osseous structure of the antler.

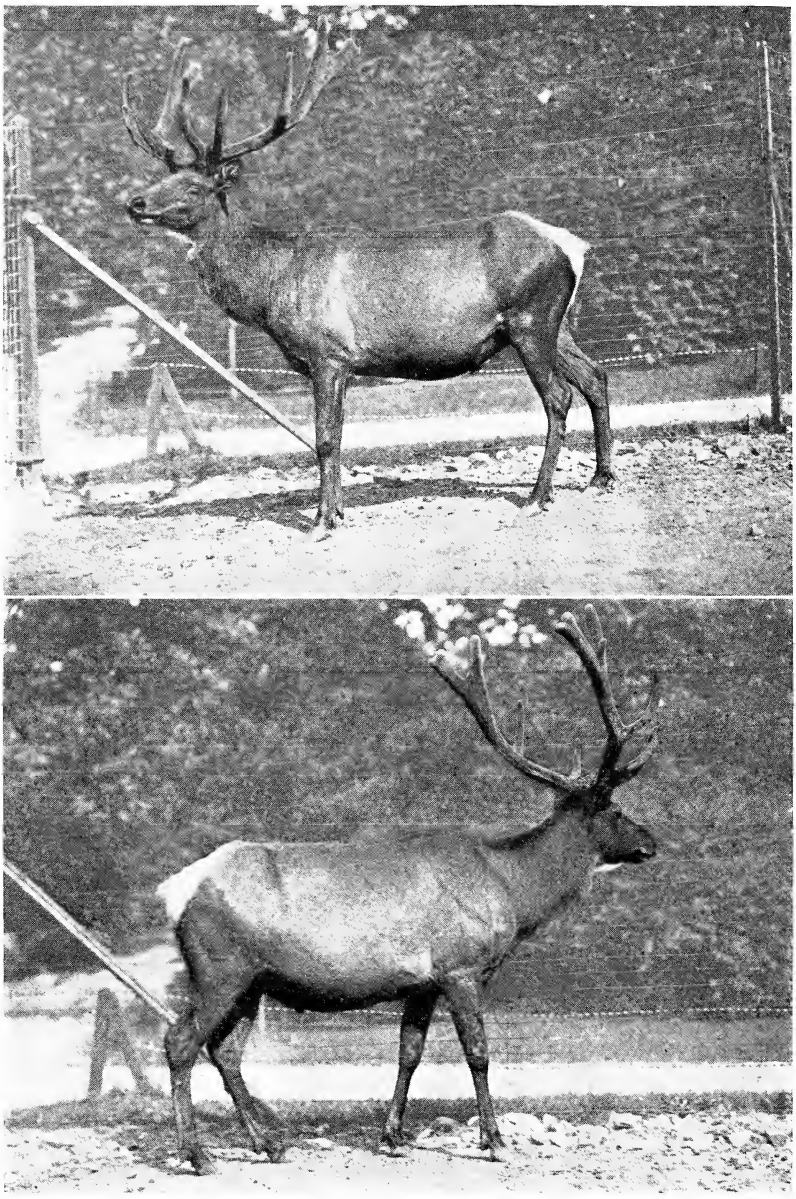


Fig. 11 *Upper.* On July 6, the antlers are approaching the final stages of development. There is a noticeable shrinking of the velvet especially at the tips. Fig. 12. *Lower.* In midsummer, July 12, the antlers have attained their greatest length.

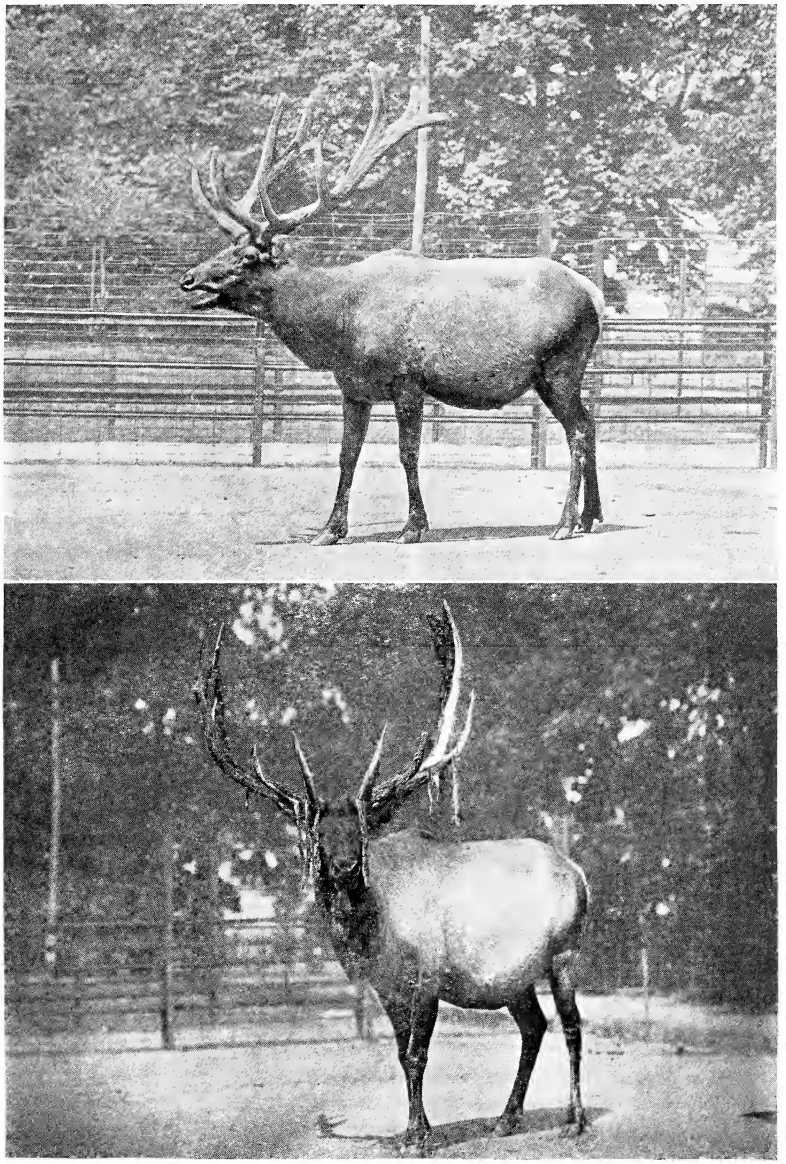


Fig. 13. *Upper.* The antler pattern is usually completed in August, and at this time growth has ceased and the final stages of hardening are taking place.

Fig. 14. *Lower.* When the antler has become completely hardened the velvet dries out and peels from the bony structure in long, thin ribbon-like strands.

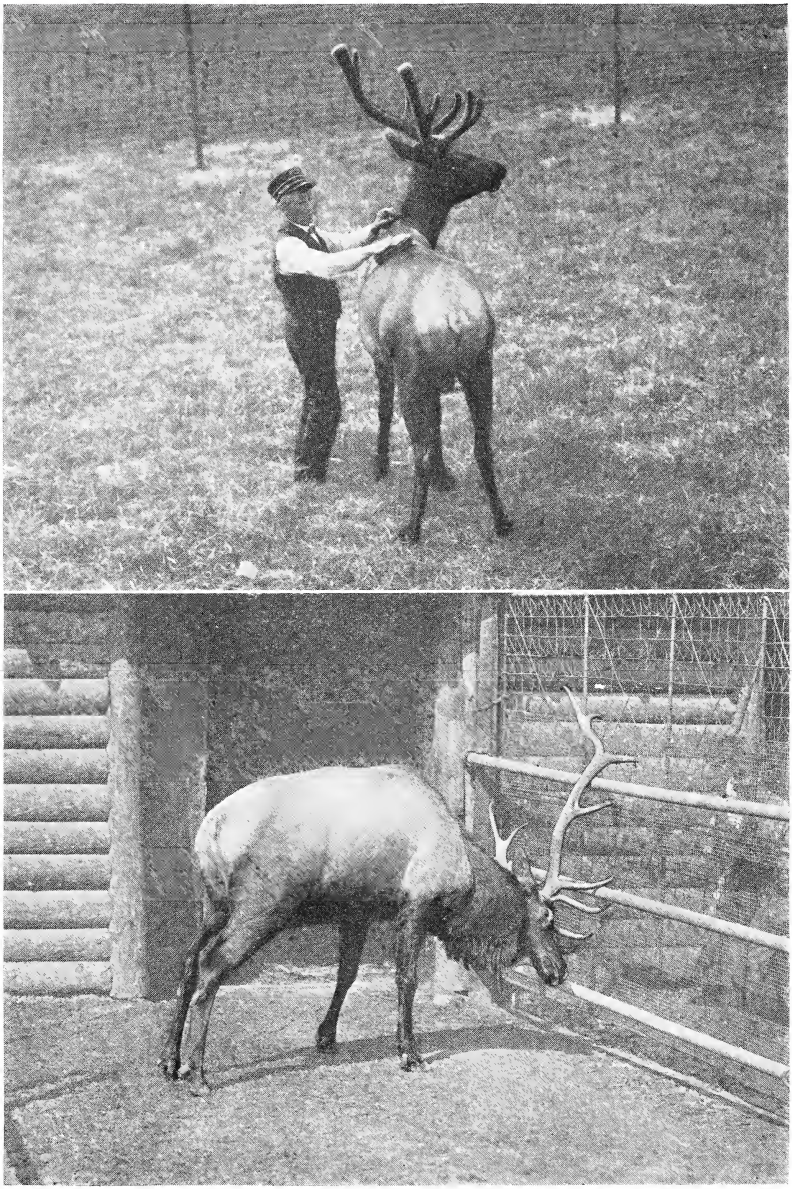


Fig. 15. *Upper.* During the early stages of antler development the animal is most docile. Fig. 16. *Lower.* When the velvet is shed and his old vigor returns, he then becomes very pugnacious and charges violently against any barrier.

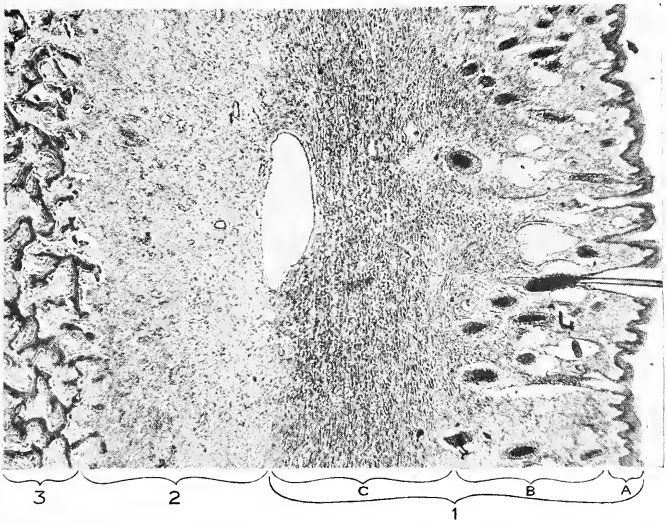


Fig. 17. Cross section of Wapiti antler, 5.0 cm. below tip. 1. Velvet; a. Epidermal layer; b. Corium with sebaceous glands; c. Coarse fibrous layer. 2. Undifferentiated connective tissue layer. The open space in center is a capillary. 3. Ossifying core. Obj. 48 mm. Ocular 8× comp.

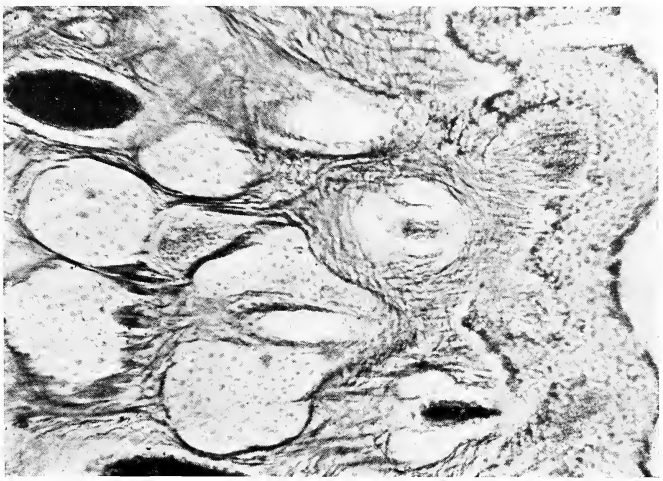


Fig. 18. Cross section of velvet showing fibrous structure of its corium. Obj. 32 mm. Ocular 8× comp.

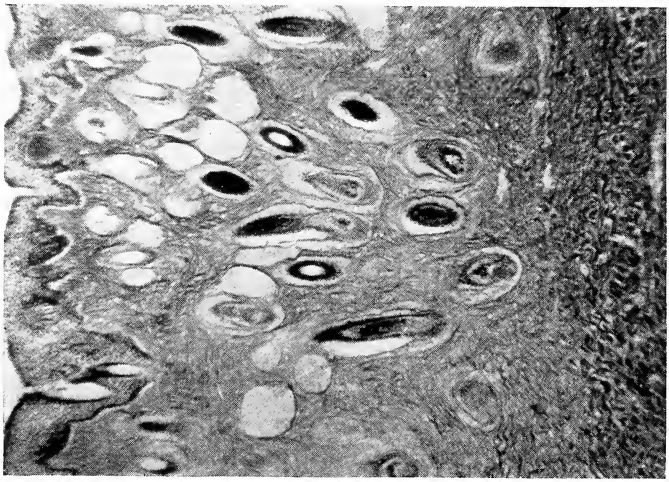


Fig. 19. Cross section of velvet. Obj. 32 mm. Ocular 8× comp.

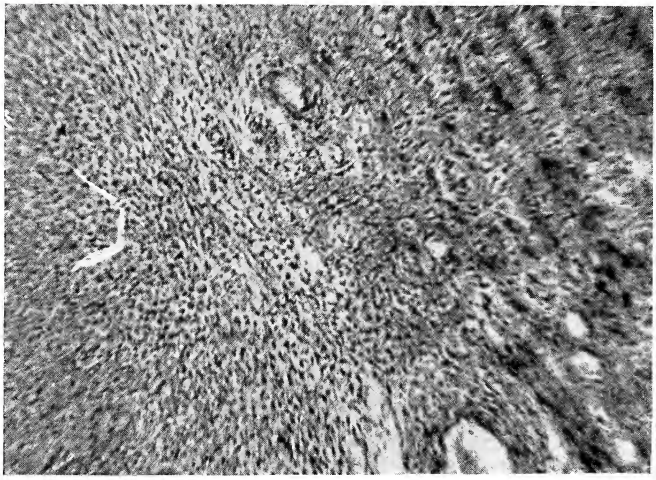


Fig 20. Cross section of antler showing the merging of the undifferentiated connective tissue with the fibrous layer of the velvet on the right. Obj. 16 mm. Ocular 8× comp.

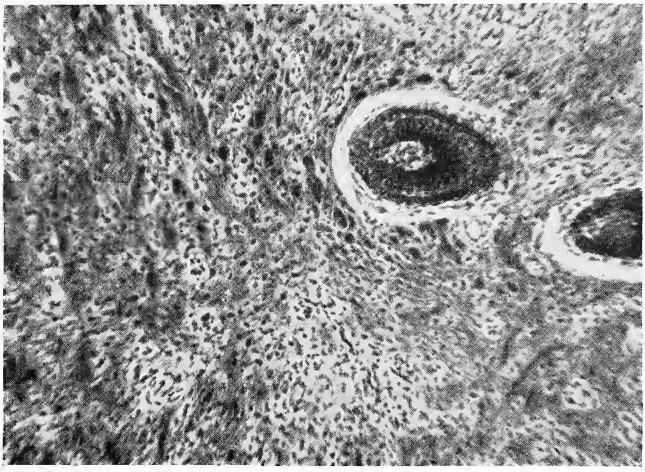


Fig. 21. Cross section of antler showing fibrous layer and corium of the velvet. Obj. 16 mm. Ocular 8× comp.

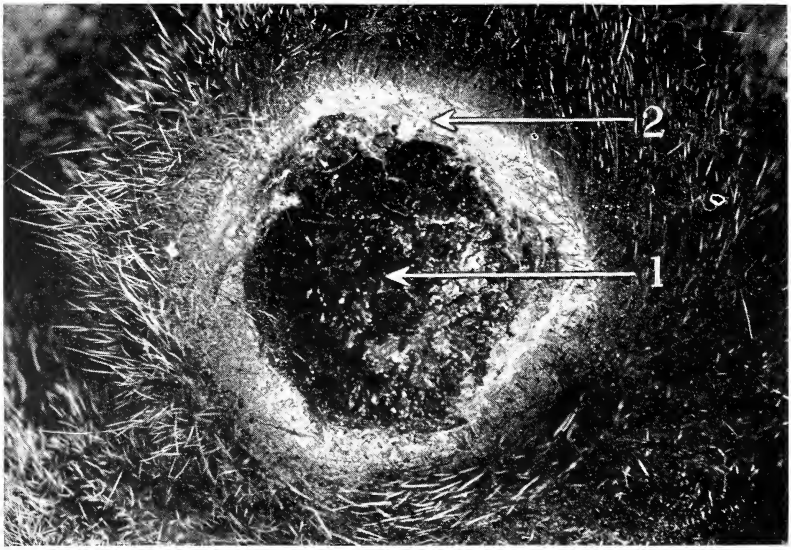


Fig. 22. Tip of pedicle of a Virginia deer two weeks after the antler had been shed. 1. A thin layer of dried blood, scab, covering the antler tip. Undifferentiated connective tissue, embryonic in character, is forming beneath the scab. 2. Edge of the pedicle skin surrounding the pedicle tip. The velvet, a form of skin, will evolve from this border to protect the delicate tip of the new antler.

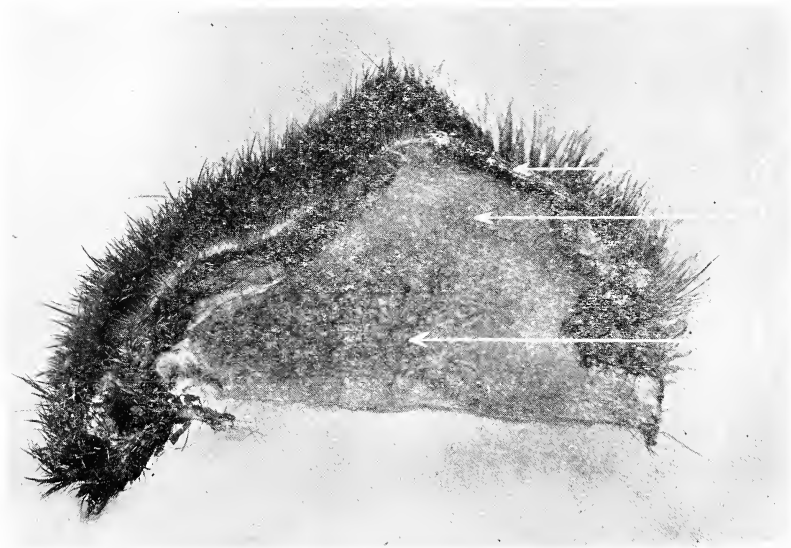


Fig. 23. A longitudinal section through the pedicle of fig. 22 (Virginia deer). 1. Frontal bone, from which the new antler will derive most of its blood supply. 2. The pedicle, a cylindrical growth of bone from and a part of the frontal bone; 3. A layer of dried blood covering the tip of the pedicle two weeks after antler had been shed.

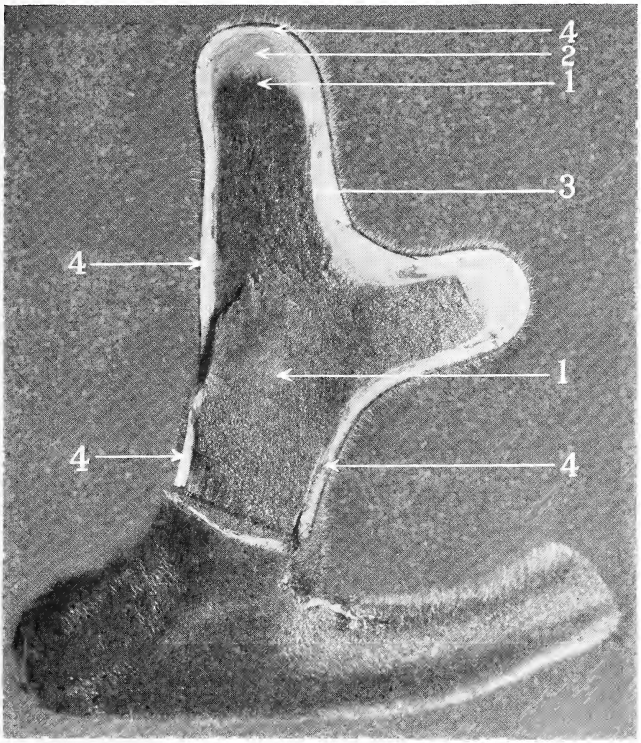


Fig. 24. Longitudinal section of a two months' old Virginia deer antler showing its gross internal structure. 1. The ossifying core of undifferentiated connective tissue, richly supplied with blood and containing areas in process of direct ossification together with spicules of newly formed bone; 2. Rapidly proliferating undifferentiated connective tissue, embryonic character, forming the growing tip of the antler; 3. Proliferating undifferentiated connective tissue continuing down the side of the antler tip; 4. The comparatively thick white border enveloping the antler is the velvet. The thin dark border of the velvet is the pigmented layer just beneath the hair.

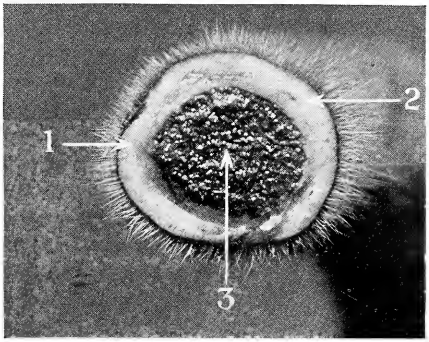


Fig. 25. Cross section of the two months' old antler of Fig. 24; 1. The velvet, a thick cutaneous structure; 2. A blood vessel within the velvet; 3. The ossifying core of undifferentiated connective tissue.

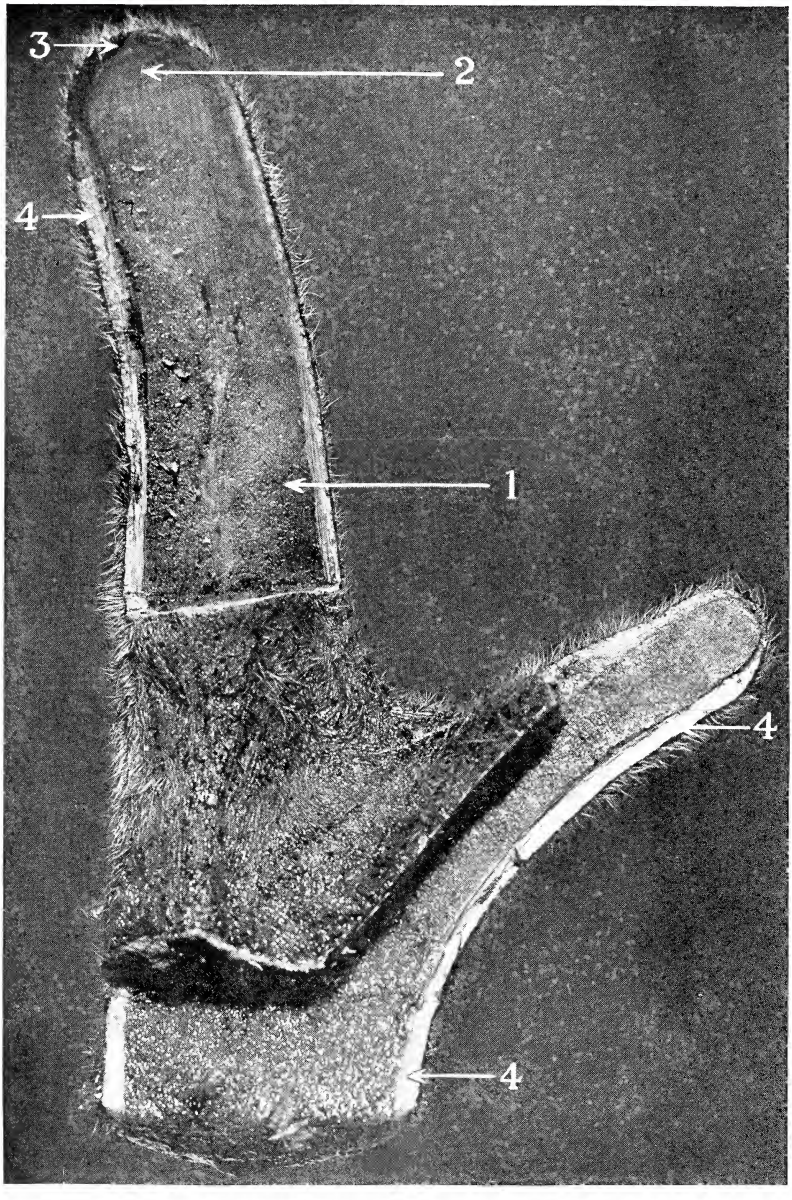


Fig. 26. Longitudinal section of a four months' old antler. The undifferentiated connective tissue tip has been replaced by new directly formed bone; 1. Body or core of new directly formed compact bone; 2. Complete hardening and ossification of undifferentiated connective tissue tip; 3. Velvet of tip is dark, shriveled and dead. This is a point at which shedding of velvet begins; 4. Living velvet below the tip.

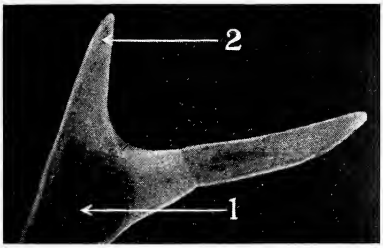


Fig. 27. Completely ossified tip of mature antler; 1. Spongy area of interior; 2. Completely ossified tip.

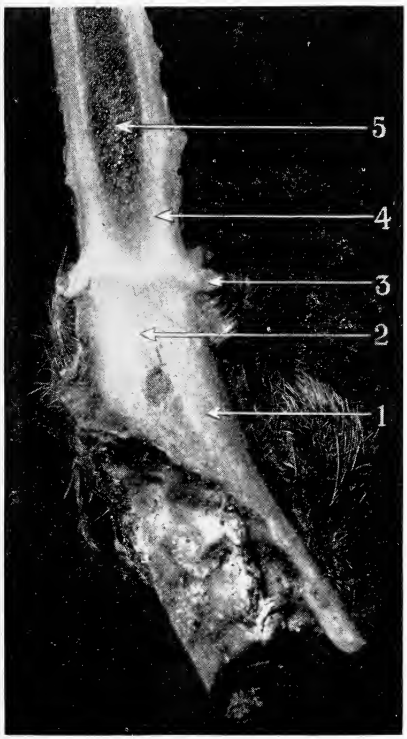


Fig. 28. Longitudinal section of mature antler and pedicle. (Six months' old); 1. Frontal bone; 2. Pedicle; 3. Burr or corona; 4. Compact bone wall and base of mature antler; no velvet is present; 5. Spongy porous character of interior of antler.

Fig. 29. External view of the tip of an elk antler 75 days old. Note the hair of the velvet.

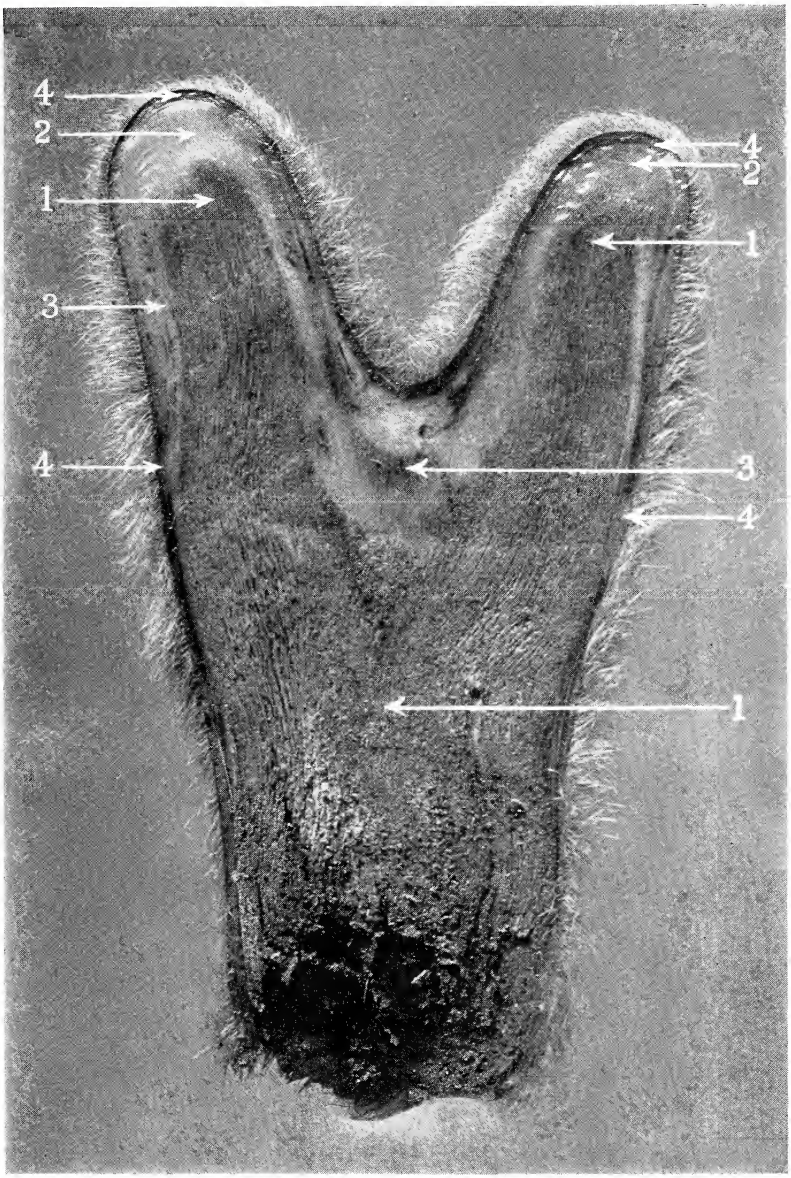


Fig. 30. Internal view of the antler of figure 29 on longitudinal section; 1. The ossifying core of undifferentiated connective tissue, richly supplied with blood and containing areas in process of direct ossification together with small areas of new formed bone; 2. Rapidly proliferating undifferentiated connective tissue, embryonic in character, forming the growing tip of the antler; 3. Proliferating undifferentiated connective tissue continuing down the side of the antler tip; 4. The layer of velvet enveloping the antler.

Fig. 31. Cross section 3.5 cm. from tip, ossification beginning peripherally. Obj. 16 mm. apochro. Ocular 8× comp.

Fig. 32. Cross section 4.5 cm. from tip showing pronounced peripheral ossification. Obj. 16 mm. apochro. Ocular 8× comp.

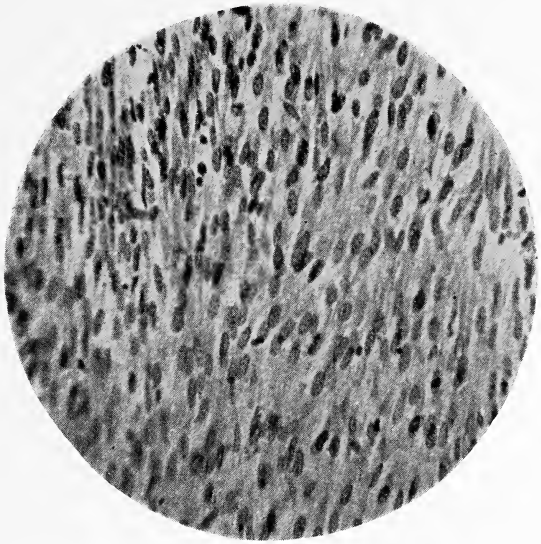


Fig. 33. Section through undifferentiated connective tissue showing typical spindle-shaped fibroblastic cells. Obj. 4 mm. Ocular 8× comp.

Fig. 34. Typical fibroblastic cells of the cap under oil immersion. Obj. 2 mm. (oil imm.). Ocular 8× comp.

Fig 35. Longitudinal section 1.5 cm. from tip showing evolving fibroblasts, endothelial cells and beginning blood channels. Obj. 32 mm. Ocular 8× comp.

Fig. 36. Longitudinal section 1.5 cm. from tip showing evolving fibroblasts, endothelial cells and beginning blood channels. Obj. 16 mm. Ocular 8× comp.

Fig. 37. Longitudinal section 2.0 cm from tip showing evolving fibroblasts and open blood channels. Obj. 32 mm. Ocular 8× comp.

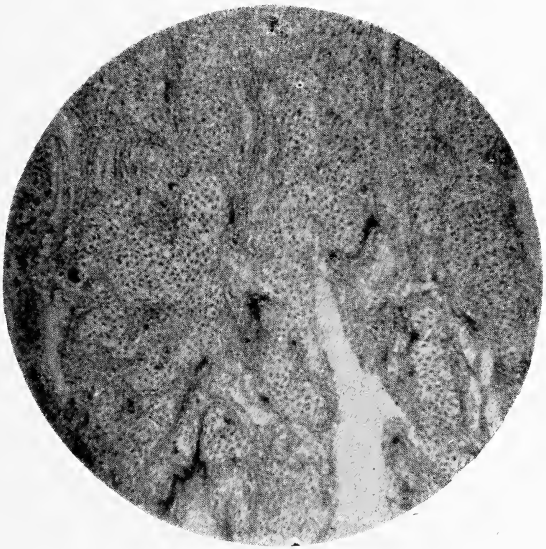


Fig. 38. Longitudinal section 2.5 cm. from tip showing maturing fibroblasts, open blood channels and slight centres of ossification. Obj. 32 mm. Ocular 8× comp.

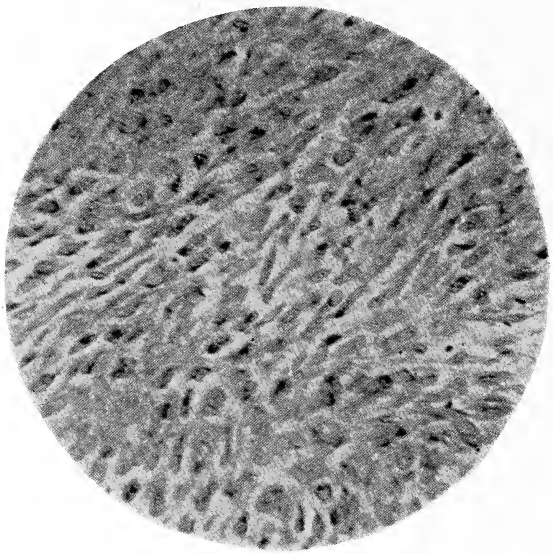


Fig. 39. Typical fibroblastic cells 1.5 cm. from tip. Obj. 4 mm. Ocular 8× comp.

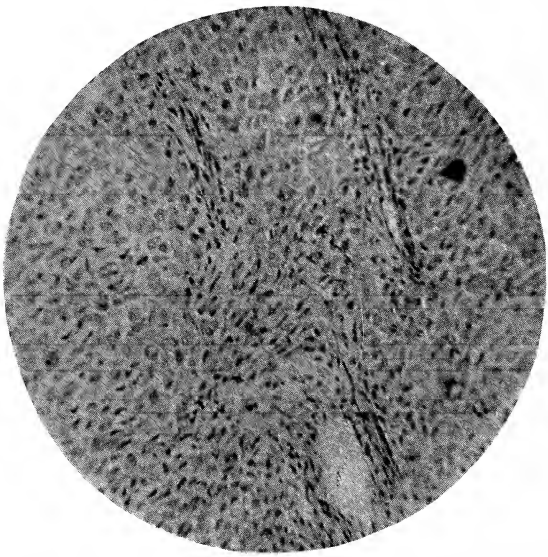


Fig. 40. Cells 2.5 cm. from tip showing maturing fibroblasts and endothelial cells. Obj. 16 mm. Ocular 8× comp.

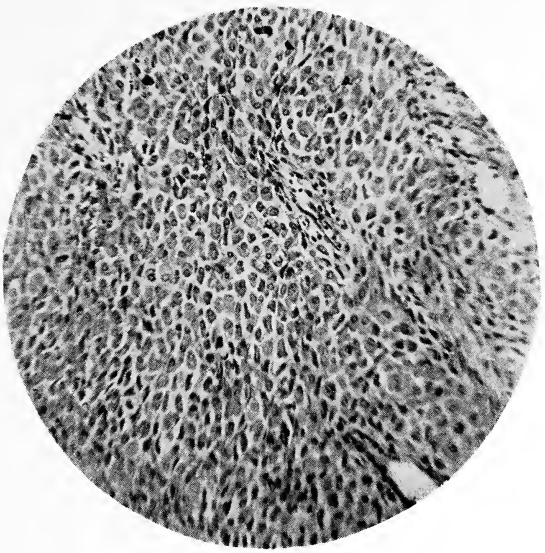
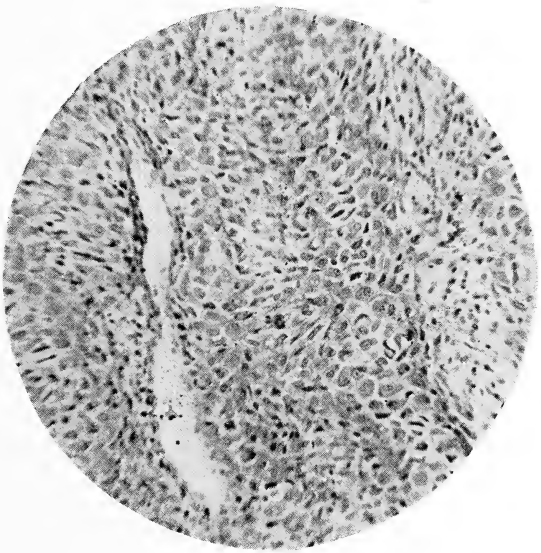


Fig. 41. Cells 2.5. cm. from tip showing matured fibroblasts and endothelial cells. Obj. 16 mm. Ocular 8× comp.



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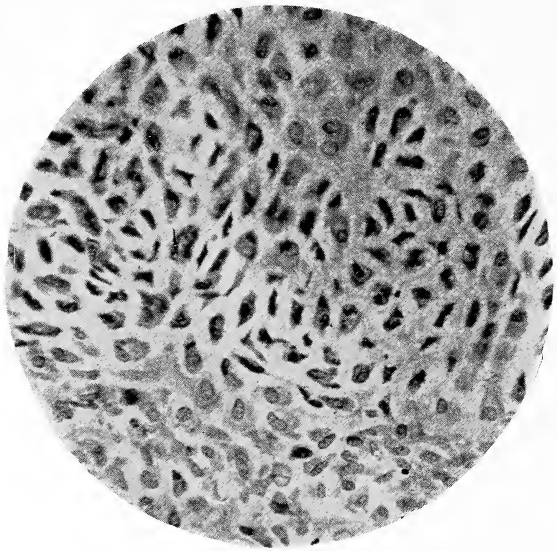

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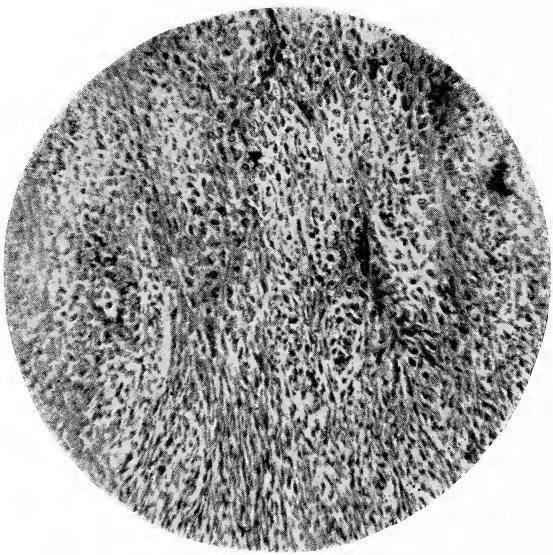


Fig. 44. Cross section 2.5 cm. from tip. Osteoblasts proliferating from periphery to centres of ossification. Obj. 16 mm. Ocular 8× comp.

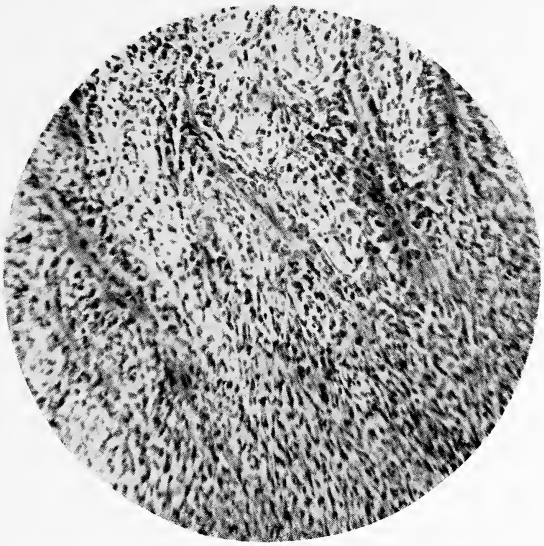
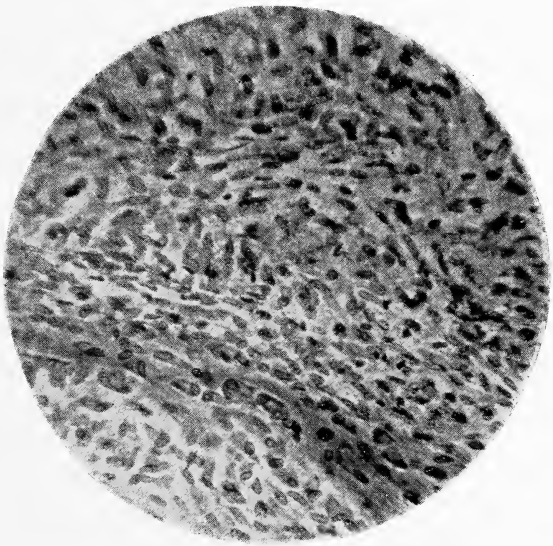


Fig. 45. Cross section 3 cm. from tip. Osteoblasts proliferating from periphery to centres of ossification. Obj. 16 mm. Ocular 8× comp.



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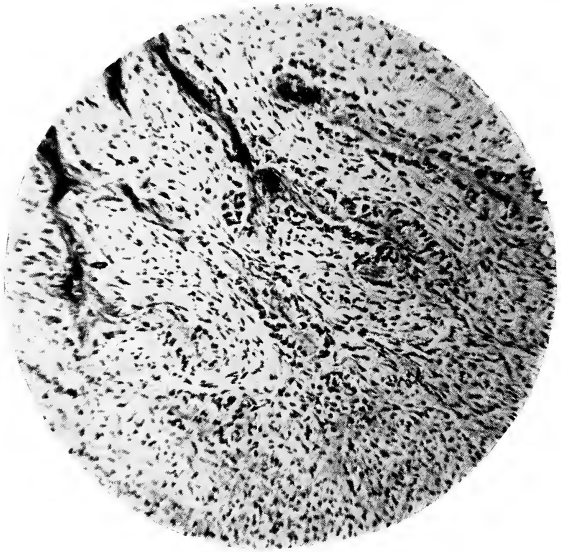

Fig. 47. Cross section 3.5 cm. from tip. Osteoblasts proliferating from periphery to centres of ossification. Obj. 16 mm. Ocular 8× comp.

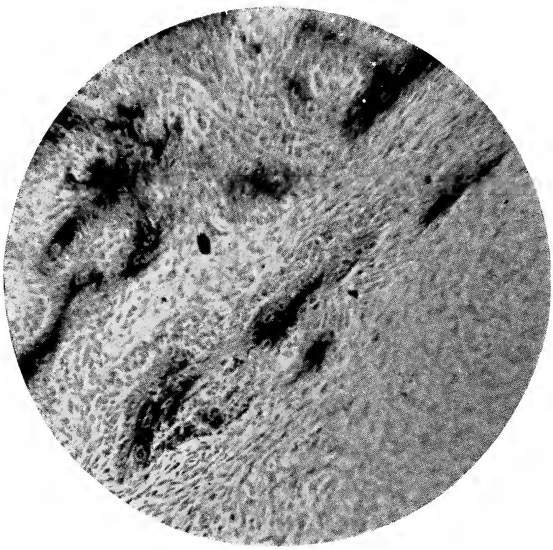

Fig. 48. Longitudinal section 4 cm. from tip showing proliferation of peripherally derived osteoblasts and lacunae in centres of ossification. Obj. 16 mm. Ocular 8× comp.

Fig. 49. Longitudinal section 5 cm. from tip showing proliferation of peripherally derived osteoblasts. Obj. 16 mm. Ocular 8× comp.

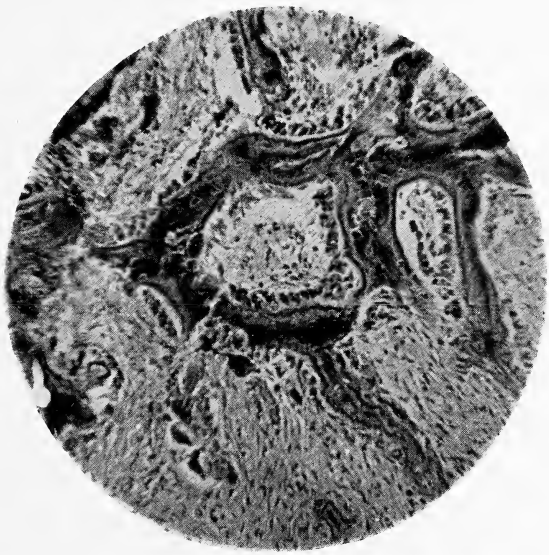

Fig. 50. Cross section 5.0 cm. from tip showing proliferation of osteoblasts and mature osteoblasts between blood channels and trabeculae. Obj. 16 mm. Ocular 8× comp.

Fig. 51. Showing fibrillar structure of cap continuous with fibers of velvet. Obj. 16 mm. Ocular 8× comp. Stain: Modified Del Rio Hortega's Silver Carbonate Method.

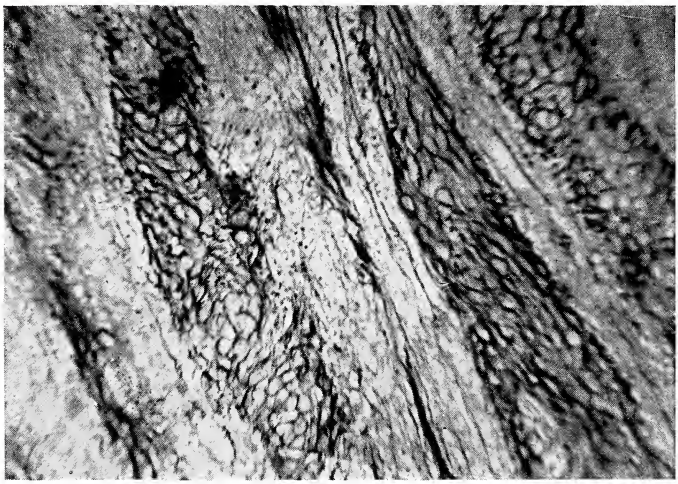

Fig. 52. Showing fibrillar ground-work 2.0 cm. from tip and longitudinal fibrillae of blood channels. Obj. 4 mm. Ocular 8× comp. Stain: Modified Del Rio Hortega's Silver Carbonate Method.

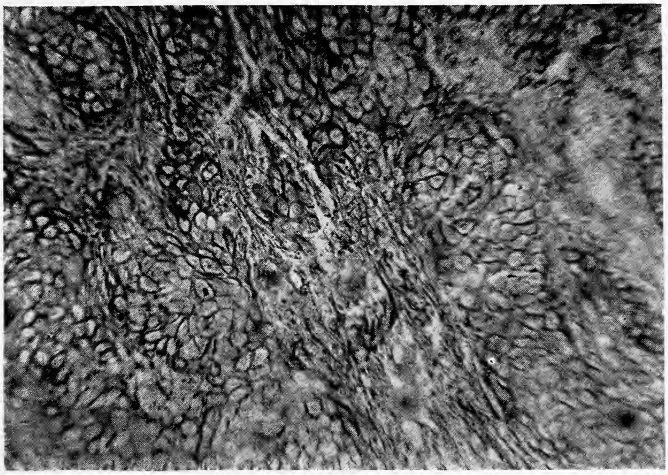

Fig. 53. Fibrillar network 3 cm. from tip. Obj. 4 mm. Ocular 8× comp. Stain: Modified Del Rio Hortega's Silver Carbonate Method.

Fig. 54. Fibrillar network 4 cm. from tip. Note blood in blood channels Obj. 4 mm. Ocular 8× comp. Stain: Modified Del Rio Hortega's Silver Carbonate Method.

Fig. 55. Cross section 3.5 cm. from tip showing atrophy of fibroblasts derived from the cap and slight centres of ossification.

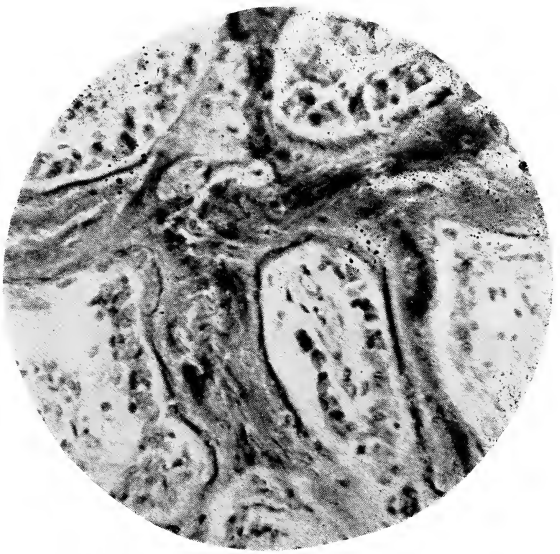

Fig. 56. Cross section 5.0 cm from tip showing definitive osteoblasts evolved from peripheral undifferentiated connective tissue. Obj. 4 mm. Ocular 8× comp.

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A LIST OF ANTILLEAN REPTILES AND AMPHIBIANS

By Thomas Barbour

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Zoologica, Vol. XI, No. 4.

A LIST OF ANTILLEAN REPTILES AND AMPHIBIANS

By Thomas Barbour

Introduction

Census makers are abroad in the world, far and wide, and this year, 1930 is a fitting time to list the species of West Indian Reptiles and Amphibians which I, for one, believe to be valid. This is a point on which no two persons are at present ready to agree but workers are nearer unanimity today than ever before. I have made this little list as concise as possible. I have avoided synonymys and citations and have not quoted authorities. I simply give a list of the species which at this moment I believe to be worthy of recognition and a list which I believe to be complete. For errors I am, therefore, wholly to blame and no doubt a number will be found.

There are some exquisite and precious zoologists who do not deign to recognize in the check-list anything but the most plebeian form of zoological choremanship. This, indeed, may be true. Nevertheless even those of the élite, οἱ ἄιρετοι or οἱ ἁλιτσκόμενοι as earlier colleagues would perchance have called them, admit the usefulness of such lists. Generally speaking utility is the poorest touchstone to apply to research, but it is the only test to determine the worthwhileness of compilations.

The few short remarks which I have added beneath each name may aid some future workers who become inquisitive concerning the status of species, as of today.

I published, not long ago, a little paper showing what the mongoose has accomplished in the way of reptile extirpation since its introduction. (Proc. N. Eng. Zool. Club, vol. 11, p. 73–85, 1930).

I have not included the fauna of Trinidad or Tobago in this list except as they support species which occur on the true Antillean islands. Nor do I include the islands off the South or Central American coast.

I have arranged the species in series endeavoring more or less to keep allied forms together. Everyone, however, knows that a linear list cannot be expected to express relationships beyond a certain point.

I have included introduced forms near their nearest native allies. I may not have the number of these by any means complete but they are uninteresting waifs at best in most cases. Many obviously erroneous records have been ignored.

SYSTEMATIC TABLE OF CONTENTS

A. Class—AMPHIBIA

Order—*SALIENTIA*

Family—HYLIDAE

Family—BUFONIDAE

Family—LEPTODACTYLIDAE

Class AMPHIBIA

Order *SALIENTIA*

Family HYLIDAE

Hyla septentrionalis Boulenger

Cuba; also (perhaps accidentally) the Cayman Islands and Northern Bahamas.

A common species.

Hyla dominicensis (Tschudi)

Hispaniola.

A common ally of *Hyla septentrionalis.*

Hyla brunnea Gosse

Jamaica.

The common vicarious representative of *H. dominicensis* and *H. septentrionalis.*

Hyla vasta Cope

Hispaniola.

Formerly little known, now well studied by Noble. Not uncommon in some wet mountainous ravines in San Domingo.

Hyla lichenata (Gosse)

Jamaica.

Probably of the stock of *Hyla vasta* but well differentiated. This species has been studied by Dunn who finds that it lives in hollow limbs of trees. Its head is modified to close the opening.

Cf. *Bufo empusus* and the discussion of phragmotic modifications in amphibians and reptiles. Barbour, Reptiles and Amphibians, Boston, Houghton Mifflin & Co., 1926, p. 73 et seg.

Hyla pulchrilineata Cope

Hispaniola.

Formerly considered to be related to the *Hyla arborea* series, but erroneously. It may have Jamaican affinity with *Hyla wilderi* or it may be anthocthonously developed from *Hyla dominicensis* as Dunn suspects.

Hyla wilderi Dunn

Jamaica.

I collected this species commonly in 1909 but did not realize that the specimens were adults of a new species, not young of the common *Hyla brunnea.* It is found in the "wild pines," epiphytic bromeliads.

Hyla marianae Dunn

Jamaica.

Apparently not common anywhere and found in the highlands only.

Hyla heilprini Noble

Hispaniola.

Found by Noble in 1922, among stones in the ravines of mountain torrents in Pacificador Province, San Domingo.

Hyla squirrella Latreille

Southeastern United States; Stranger's Cay, Northern Bahamas.

Found in the Bahamas in 1903 by Allen, Bryant and Barbour. Accidental, no doubt.

Hyla rubra Daudin

South America and St. Lucia.

Reported years ago, 1891, from St. Lucia where it was doubtless accidentally introduced. We have no recent information as to its persistence.

Family BUFONIDAE

Bufo longinasus Stejneger

Western Cuba.

Known from the type only, taken during the summer of 1900 on the bank of a stream in the lowlands near El Guamá, a ranch near Pinar del Rio city. This species and the two following vicarious forms are not closely related to any existing toad. Many characters, however, suggest an affinity with *Bufo quercicus*. It is possible that all may have descended from some common ancestral type which occurred in what is now Central America.

Bufo dunni Barbour

Central Cuba.

Found abundantly after heavy rains in the mountains between Trinidad and Cienfuegos.

Bufo ramsdeni Barbour

Eastern Cuba.

Found by C. T. Ramsden only. Taken after heavy rains in isolated localities in the mountains about the Guantanamo basin.

Bufo peltacephalus Tschudi

Cuba.

Generally distributed but nowhere abundant. I believe that this species may be a surviving representative of the same stock from which *Bufo punctatus* Baird & Girard is descended.

Bufo empusus (Cope)

Cuba.

This is the Cuban representative of the *Bufo lemur* series. It occurs in widely scattered colonies of burrows. I have described its mode of occurrence at some length elsewhere. (Mem. Mus. Comp. Zool. 44, 1914, p. 242).

Bufo gutturosus Latreille

Hispaniola.

A much more common species than its Porto Rican ally.

Bufo lemur Cope

Porto Rico.

For forty years after its description but six of these toads were found. Modern collectors have recently secured a larger number. The four toads of this series may be allied to *Bufo canaliferus* Cope of the mainland of Central America.

Bufo turpis Barbour

Virgin Gorda.

The type is still unique. No other toad has ever been found in the Virgin Islands. It is very closely allied to *Bufo lemur* of Porto Rico.

Bufo marinis (Linne)

Jamaica, Bermuda, Barbados, St. Lucia, St. Kitts, Martinique, Nevis and Montserrat, introduced. Native of South and lower Central America.

A favorite species for haphazard introduction.

Family LEPTODACTYLIDAE

Eleutherodactylus auriculatus (Cope)

Cuba.

Dunn believes that this form is confined to the Guantanamo region.

Eleutherodactylus sonans Dunn

Cuba.

An arboreal form of Central Cuba allied to *E. auriculatus* of Eastern Cuba.

Eleutherodactylus portoricensis Schmidt

Porto Rico.

The representative of *E. auriculatoides* and *E. auriculatus.*

Eleutherodactylus auriculatoides Noble

Hispaniola.

Found by Noble in bromeliads along the Constanza-Jarabacoa trail, Paso Bajito, Santo Domingo.

Eleutherodactylus jamaicensis Barbour

Jamaica.

Taken at Mandeville in 1908, it has since been found in many other parts of the Island.

Eleutherodactylus weinlandi Barbour

Hispaniola.

A lowland species widely distributed in the eastern areas.

Eleutherodactylus richmondi Stejneger

Porto Rico.

A virgin forest form allied to *E. weinlandi* of Hispaniola and *E. lentus* of St. Thomas.

Eleutherodactylus lentus Cope

St. Thomas and St. Croix.

This still seems to be a common species. Its subterranean habits protect it against capture by the mongoose.

Eleutherodactylus schmidti Noble

Hispaniola.

Another of Noble's interesting discoveries at Paso Bajito. He says it is allied to *E. weinlandi* of the Dominican Republic and to *E. richmondi* of Porto Rico and so on to *E. lentus* of the Virgin Island.

Eleutherodactylus inoptatus (Barbour)

Hispaniola.

A large species which barks when handled and which is found in both Haiti and San Domingo. This by far the largest and finest species of the genus was discovered by Dr. W. M. Mann at Diquini, Haiti. It resembles superficially *E. insignitus* from the Sta. Marta Mts. of Colombia. This may be a good case of convergence.

Eleutherodactylus ruthae Noble

Hispaniola.

Noble described this species from Samana, R. D., and he considers it allied to *E. inoptatus.*

Eleutherodactylus martinicensis (Tschudi)

Saba, Montserrat, St. Kitts, St. Eustatius, St. Martins, Martinique, Guadeloupe, Jamaica (introduced near Kingston about 1890).

This little frog is so easily carried about that its true original distribution will never be known.

Eleutherodactylus johnstonei Barbour

Grenada; ? St. Vincent (? extinct).

Said to have been brought to Grenada from Barbados about 1885. It has recently appeared in Bermuda.

All that can be said is that this frog from the south end of the Antillean chain is different from that found in the north and middle portions. Doubt will always exist as to the true original ranges of these two species. They have been carried far and wide with plants and have from time to time appeared in hot houses in Europe and North America.

Eleutherodactylus brittoni Schmidt

Porto Rico.

Another from the forest on El Yunque.

Eleutherodactylus abbotti Cochran

Hispaniola.

Said to be a very common species throughout San Domingo.

Eleutherodactylus montanus Schmidt

Hispaniola.

A species from the Cibao Mountains.

Eleutherodactylus minutus Noble

Hispaniola.

On ferns in palm thickets on trail near Paso Bajito, San Domingo; fide Noble.

Eleutherodactylus orcutti Dunn

Jamaica.

Another of the recently found and apparently very local forms; from Arntully in St. Thomas Parish.

Eleutherodactylus cunctator Dunn

Jamaica.

Known only from Arntully in St. Thomas Parish.

Eleutherodactylus nubicola Dunn

Jamaica.

Found high in the Blue Mountains, 3000-5100 feet.

Eleutherodactylus luteolus (Gosse)

Jamaica.

Common and widely distributed; from Port Antonio to Montego Bay.

Eleutherodactylus gossei Dunn

Jamaica.

Widespread at altitudes of about 1000 feet.

Eleutherodactylus pantoni Dunn

Jamaica.

The largest Jamaican species.

Eleutherodactylus junori Dunn

Jamaica.

Known only from Spaldings, Clarendon Parish, altitude 2900 feet.

Eleutherodactylus cundalli Dunn

Jamaica.

A woodland species, as yet but little known.

Eleutherodactylus grabhami Dunn

Jamaica.

A small species with a wide range, as to both area and altitude.

Eleutherodactylus varleyi Dunn

Cuba.

Known from Central and Eastern Cuba and said by Dunn to be allied to *E. minutus* and *E. abbotti* of San Domingo.

Eleutherodactylus atkinsi Dunn

Cuba.

A handsome species found throughout the Island.

Eleutherodactylus varians (Gundlach & Peters)

Cuba.

Known definitely only from Soledad, near Cienfuegos.

Eleutherodactylus eileenae Dunn

Cuba.

The "Kolin" of western and central Cuba.

Eleutherodactylus dimidiatus (Cope)

Cuba.

A widespread species.

Eleutherodactylus emiliae Dunn

Cuba.

Known only from the Mina Carlota, in the mountains not far from Cumanayagua, Sta. Clara Province.

Eleutherodactylus pinarensis Dunn

Cuba and Isle of Pines.

Known in Cuba from the Province of Pinar del Rio only.

Eleutherodactylus greyi Dunn

Cuba.

The largest Cuban species, so far known only from the mountains between Cienfuegos and Trinidad.

Eleutherodactylus brevipalmatus Schmidt

Cuba.

A form from the mountains of the Province of Oriente.

Eleutherodactylus sierrae-maestrae Schmidt

Cuba.

Another mountain species from eastern Cuba.

Eleutherodactylus ricordii (Duméril & Bibron)

Cuba and Bahama Islands; S. Florida.

Found in all parts of Cuba and on New Providence, Abaco and Andros Island. It is now extending its range in Florida as I reported some years ago. It has now reached Gainesville. (Proc. Biol. Soc. Wash., 23, 1910, p. 100.)

Eleutherodactylus cuneatus (Cope)

Cuba and Isle of Pines.

Common in western and central Cuba.

Eleutherodactylus gundlachii Schmidt

Cuba.

An eastern mountain form. I originally described this species but used the specific name *plicatus*, which proved to be preoccupied.

Eleutherodactylus casparii Dunn

Cuba.

Another species of the Trinidad Mountains.

Eleutherodactylus gryllus Schmidt

Porto Rico.

A minute, highland species.

Eleutherodactylus locustus Schmidt

Porto Rico.

Another species from El Yunque forest.

Eleutherodactylus cramptoni Schmidt

Porto Rico.

A rare species from the mountain forest on El Yunque Peak.

Eleutherodactylus antillensis (Reinhardt & Lütken)

Porto Rico, St. Thomas, Tortola, Vieques.

A widespread and common species.

Eleutherodactylus wrightmanae Schmidt

Porto Rico.

A form "probably confined to the coffee belt and the wet forest above it."

Eleutherodactylus unicolor Stejneger

Porto Rico.

From El Yunque.

Eleutherodactylus monensis (Meerwarth)

Mona Island.

Eleutherodactylus flavescens Noble

Hispaniola.

From bushes along streams near La Bracita, found by Noble in 1922.

Leptodactylus fallax Müller

Dominica, St. Kitts, Guadeloupe, St. Lucia.

The giant "crapaud" has been recently separated specifically from the mainland *L. pentadactylus*. Now to be found on Dominica only. Elsewhere it has been exterminated by the mongoose. It may have occurred upon other islands even, than those recorded above. I am not convinced that it is really very distinct from the mainland "species".

Leptodactylus dominicensis Cochran

Hispaniola.

The San Domingan representative of *L. albilabris* of Porto Rico and the Virgin Islands.

Leptodactylus albilabris (Günther)

St. Thomas, St. Croix, Tortola, Anegada, Just van Dyke, Porto Rico, Vieques, Culebra.

This common form no doubt occurs on other islets in this general area.

Leptodactylus validus Garman

St. Vincent, Grenada, Venezuela.

There is a great question whether this form is distinct or identical with *L. caliginosus* from Brazil and just what the relationship may be with *L. labialis* or *L. melanonotus* from Central America.

Family BRACHYCEPHALIDAE

Phyllobates limbatus (Cope)

Cuba.

Locally abundant. This species has been separated from the mainland species of this genus, as Sminthillus, on a trivial skeletal character of divergence. It is, however, I now believe essentially a Phyllobates in all important respects except perhaps in life history. The species of "Sminthillus" described from Peru is quite certainly wholly unrelated to the Cuban form. I believe that we may generally agree that Sminthillus (type *limbatus*) is a straight synonym of Phyllobates. The Peruvian species in any case requires a new name, and may be called Noblella, type *N. peruviana* (Noble).

Class REPTILIA

Suborder *SAURIA*

Family GEKKONIDAE

Gymnodactylus fasciatus Duméril & Bibron

Martinique.

I know nothing of this species and have often wondered what it is. The type in Paris was said to be from the Plée Collection and taken at Martinique. The Plée Collections have caused endless confusion by having so often erroneous data as to locality. I suspect that I had done better to omit this species altogether.

Gonatodes albogularis (Duméril & Bibron)

Martinique, Curaçao.

This, another Plée type from "Martinique," may have come from almost anywhere in the Caribbaean basin. Many of the members of this genus are in confusion and await a reviser.

Gonatodes notatus (Reinhardt & Lütken)

Hispaniola.

Apparently a valid species which may be confined to Haiti. It seems to be rare.

Gonatodes fuscus (Hallowell)

Cuba and Central America.

This house lizard is known from the seaports of Santiago, Havana and Mariel, which is in constant schooner communication with Havana. I suspect the species was long since accidentally introduced into Cuba.

Phyllodactylus spatulatus Cope

Barbados.

Collected years ago, about 1861 in fact, by Dr. Theodore Gill. I have no recent information as to its status.

Hemidactylus mabouia (Moreau de Jonnés)

Cuba, Jamaica, Hispaniola, Porto Rico, St. Thomas, St. Croix, Just van Dyke, Tortola, Dominica, St. Lucia, St. Vincent, Barbados, Martinique, Grenada and the Grenadines; Northern South America.

This lizard, one frequenting the street lamps of towns and cities, is, I believe, accidentally introduced. It is rare in the Greater Antilles, and in Cuba very local.

Hemidactylus brookii Gray

West Africa; Hispaniola.

I believe this is another accidental introduction.

Thecadactylus rapicaudus (Houttuyn)

Saba south to Grenada, tropical South and Central America.

Nocturnal or crepuscular. Found under bark, behind shutters and in old buildings, also in the forest in crevices of rocks and sometimes under decaying vegetable trash. It is known from almost every single island, all indeed which have been in any completely explored.

Aristelliger praesignis (Hallowell)

Jamaica, Grand Cayman and Cayman Brac.

An abundant, if not actually common, species.

Aristelliger lar Cope

Hispaniola.

Apparently rather widely distributed. It has recently been collected in larger numbers than the earlier investigators uncovered.

Tarentola cubana Gundlach & Peters

Cuba and Bahamas.

Shy and retiring in rocky crevices this species is rarely seen. I suspect it to be widespread in the Bahamas though I have seen it from Andros and Exuma Islands only. In Cuba it is more common in the northeastern region than elsewhere.

Sphaerodactylus decoratus Garman

Bahama Islands.

Common on Andros, rare on New Providence. The type came from Rum Cay.

Sphaerodactylus gibbus Barbour

Bahama Islands.

Known only from the Exuma Cays.

Sphaerodactylus torrei Barbour

Cuba.

Known from the Province of Oriente only. It is not rare.

Sphaerodactylus cinereus Wagler

Cuba, Navassa, Hispaniola and extreme south Florida.

A common form in houses and in woodlands. It passes through a number of color phases during growth and the young and half grown were once thought to be distinct species and bore specific names, *elegans* and *intermedius*.

Sphaerodactylus oxyrrhinus Gosse

Jamaica.

A rare form but one widespread through the Island.

Sphaerodactylus difficilis Barbour

Hispaniola.

Common and widely distributed.

Sphaerodactylus notatus Baird

Florida Keys and extreme southern Florida, Cuba, Isle of Pines and Bahama Islands.

A very common house lizard. No doubt often carried about and rapidly extending its range.

Sphaerodactylus macrolepis Günther

St. Croix, St. Thomas, Tortola, Virgin Gorda, Anegada, Porto Rico, Vieques and Mona.

Widespread and common.

Sphaerodactylus richardsoni Gray

Jamaica.

A fine big form but one which is distinctly rare.

Sphaerodactylus becki Schmidt

Navassa.

I am not sure, judging from the second known specimen recently collected, that this species is really separable from *S. scaber* of Cuba.

Sphaerodactylus gilvitorques Cope

Jamaica.

I know nothing of this species. I have never found it; nor has any of our various collectors in Jamaica. The types were taken "during the forties" by Dr. Pennock of Philadelphia.

Sphaerodactylus nigropunctatus Gray

Cuba.

A rare species from Eastern Cuba.

Sphaerodactylus carticolus Garman

Bahama Islands.

Known from New Providence, Watlings Island and Rum Cay. No doubt it occurs in many other islands beside these.

Sphaerodactylus festus Barbour

Martinique.

Known from but few specimens but no doubt common.

Sphaerodactylus goniorhynchus Cope

Jamaica.

A very common woodland species.

Sphaerodactylus argus Gosse

Jamaica.

An excessively common species both in houses and out of doors.

Sphaerodactylus argivus Garman

Cayman Brac.

A derivative of *S. argus* of Jamaica. A fairly well defined species. It is apparently known from the type series only.

Sphaerodactylus anthracinus Cope

Bahama Islands.

Only known from Andros Island.

Sphaerodactylus copei Steindachner

Hispaniola.

A fine, big, rough scaled species which is rare and apparently confined to Haiti.

Sphaerodactylus scaber Barbour & Ramsden

Cuba.

Found in the hills of central Cuba.

Sphaerodactylus fantasticus Dumèril & Bibron

Guadeloupe.

Very abundant.

Sphaerodactylus pictus Garman

St. Kitts.

Probably abundant.

Sphaerodactylus sputator (Sparrman)

St. Eustatius.

The types in Stockholm are the only specimens known.

No Sphaerodactli are as yet known from St. Martin, Saba, Redonda and other small islands in this neighborhood.

Sphaerodactylus elegantulus Barbour

Antigua.

An ally of *pictus* and *sputator*. Brilliantly banded when young and less ornamented in adult life — like so many of the curious little beasts.

Sphaerodactylus microlepis Reinhardt & Lütken

St. Lucia.

I know little of the status of this and several others of the Lesser Antillean forms.

Sphaerodactylus vincenti Boulenger

St. Vincent.

No information available.

Sphaerodactylus monilifer Barbour

Dominica.

Probably abundant but I have no real information about this species.

Family IGUANIDAE

Iguana rhinolopha Wiegmann

Central America and St. Thomas, Saba, St. Kitts, Dominica, St. Lucia, Grenada.

I am not certain of some of these records. A few may apply to the following species.

Iguana delicatissima Laurenti

St. Martin, St. Barts, Nevis, Guadeloupe, Martinique, swarming on Swan Island, Brazil.

Here again I am similarly uncertain. I believe both species have been widely carried about and introduced by the early Indians for food. They are well worth the trouble.

Chamaeleolis chamaeleontides (Dumèril & Bibron)

Cuba.

The most peculiar of all the offshoots from the Anoline stock. A rare species and beyond doubt a monotypic genus; in spite of several names applied with the idea of multiplying the forms.

Xiphocercus valenciennesii (Dumèril & Bibron)

Jamaica.

Not uncommon in woods and fruit plantations. It may be related to Phenocosaurus of Colombia or be simply a chance offshoot from Anolis in Jamaica and only fortuitously similar to the South American genus.

Chamaelinorops barbouri Schmidt

Navassa.

Not found during the careful exploration of Clench, Schevill and Rehder during January 1930. Possibly exterminated by introduced animals.

Chamaelinorops wetmorei Cochran

Hispaniola.

The unique type is from near Miragoane, Haiti.

Deiroptyx vermiculata (Duméril & Bibron)

Cuba.

Bank of streams of Pinar del Rio Province, taking refuge in the water and hiding among submerged rocks and stones when pursued.

Deiroptyx bartschi Cochran

Cuba.

Long unrecognized but not rare in western Cuba.

Anolis equestris Merrem

Cuba and Isle of Pines.

The finest and largest species of the genus. Rather uncommon but wide ranging. Less common than its allies *A. garmani* of Jamaica and *A. ricordii* of Hispaniola and about equally abundant with *A. cuvieri* of Porto Rico. These are the "Giant Anoles" of the Antilles and they may be related to the *A. insignis* group of Central America.

Anolis cuvieri Merrem

Porto Rico, Vieques and Tortola.

A rather uncommon member of the series of "Giant Anoles."

Anolis ricordii Duméril & Bibron

Hispaniola.

One of the "Giant" series. Found throughout the whole Island and next to *A. garmani* of Jamaica the most abundant of the tribe.

Anolis garmani Stejneger

Jamaica.

The beautiful great green or barred "Venus Lizard" of Jamaica. A common woodland form by far the most abundant of the group of the "Giant Anoles."

Anolis porcatus Gray

Cuba and Isle of Pines.

A very abundant species. The "Chamaeleon" now sold iniquitously by thousands at "the circus." It has replaced its ally, our southern "Chamaeleon," *A. carolinensis* (Voight) in this hateful traffic.

Anolis maynardi Garman

Grand Cayman.

This extraordinary lizard, the most extreme member of the long-headed *A. porcatus-carolinensis* series, is by no means common.

Anolis brunneus Cope

Bahamas.

The most widespread Bahaman species, from Crooked Island to Abaco. A species of gardens and verandahs, frequenting broad leaved plants and resting often on the leaves.

Anolis longiceps Schmidt

Navassa.

Apparently the only species at present to be found in any number on this Island.

Anolis chloro-cyanus Duméril & Bibron

Hispaniola.

A widespread and not uncommon form.

Anolis mestrei Barbour & Ramsden

Cuba.

A rather rare species of the higher woods in the limestone hills of western Cuba. It belongs with *A. ahli* and *A. allogus*.

Anolis allogus Barbour & Ramsden

Cuba.

This fine form has a wide distribution in the mountains of eastern Cuba. Its ally in western Cuba is *A. mestrei*, in Central Cuba, *A. ahli*.

Anolis ahli Barbour

Cuba.

Confined to the mountains between Trinidad and Cienfuegos. It is related to *A. mestrei* and *A. allogus*. Not uncommon in high damp woods.

Anolis abatus Ahl

Cuba.

This species may be valid, it is more probably a synonym of *Anolis mestrei*.

Anolis bimaculatus Sparrman

St. Eustatius, St. Kitts and Nevis.

Abundant. A strictly arboreal species.

Anolis newtonii Günther

St. Croix.

I have never seen this species and know nothing about it.

Anolis evermanni Stejneger

Porto Rico.

A highland species which may be related to *A. leucophaeus* of Inagua. An abundant form.

Anolis krugi Peters

Porto Rico.

A little, well dispersed species belonging to what I call the rupicolous as against the arboreal Lesser Antillean series—viz. *A. wattsi*, *A. sabanus*, and allies.

Anolis acutus Hallowell

St. Croix.

This is still be an abundant form. I have just received a fine series.

Anolis wattsi Boulenger

St. Kitts, Nevis, St. Eustatius and Antigua.

A pretty little species found on the outcrops of igneous rock and, in so far as my experience goes, not in trees. It is one of the *A. acutus* allies.

Anolis forresti Barbour

Barbuda.

Only known from the types but obviously a small rock-inhabiting species most nearly allied to the species standing directly before it.

Anolis gundlachi Peters

Porto Rico.

Apparently an abundant species.

Anolis gingivinus Cope

St. Martins, St. Barts, Anguilla and St. Eustatius.

Common. A member of the series of small sized Lesser Antillean species.

Anolis sabanus Garman

Saba.

A most remarkably differentiated form, a rock lizard, pure and simple. The males with fine leopard-like spotting. It is one of the *A. wattsi-A. acutus* tribe but very distinct and uniquely marked.

Anolis antiquae Barbour

Antiqua.

A beatiful and common arboreal species.

Anolis lividus Garman

Montserrat.

All the lizards are said still to be common on this Island.

Anolis barbudensis Barbour

Barbuba.

Known from the type only but no doubt common as are its relatives on Antigua and Nevis.

Anolis asper Garman

Marie Galante.

A bizarre and gorgeous species common on the old mango trees—about the only trees still standing over a large part of this hurricane stricken isle.

Anolis leachii Duméril & Bibron

Guadeloupe.

One of the large species. Found abundantly by Noble in 1914, it was rare after the fearful hurricane of Sept. 12, 1928.

Anolis terrae-altae Barbour

Les Saintes; near Guadeloupe.

A fine big species which Noble found abundant in 1914.

Anolis alliaceus Cope

Dominica.

I was surprised in 1929 to find that this species seemed much less conspicuous and common than its allies on other islands nearby. So much for what may have been a most erroneous conclusion drawn from the visit of a few days only. It is, however, by no means rare.

Anolis nubilus Garman

Redonda.

A beautiful great lizard; one of the finest in the genus. It is known only from the original series.

Anolis griseus Garman

St. Vincent.

This lizard was formerly abundant. It is now rare. It may have been more or less terrestrial and hence have been a prey to the mongoose.

Anolis richardii Duméril & Bibron

Grenada and Tobago.

A splendid great lizard; a strict tree dweller.

Anolis rubribarbus Barbour & Ramsden

Cuba.

Known only from a very few specimens from Puerto Cananova on the north coast of the oriental province.

Anolis quadriocellifer Barbour & Ramsden

Cuba.

Known only from the Cape San Antonio region of extreme western Cuba. Cuba.

Anolis patricius Barbour

Only known from a series taken by Dr. Ramsden at Mina Piloto, near Sagua de Tanamo, northern coast of Oriente Province. The eastern representative of *A. quadriocellifer*.

Anolis cristatellus Duméril & Bibron

Porto Rico, Culebra, Vieques, St. Thomas, Anegada, Tortola, Virgin Gorda, Water Island and Mosquito Island.

A common and handsome species. It has been suggested that a separate genus be established for the fin-tailed species, but as a matter of fact this character appears in various phyla and it may not always be a token of relationship.

Anolis monensis Stejneger

Mona.

The local derivative of *A. cristatellus*. Apparently, like it, a common species.

Anolis alutaceus Cope

Cuba and Isle of Pines.

Known from all parts of the Island but nowhere abundant. A species of the low scrublands.

Anolis spectrum Peters

Cuba.

A not uncommon lizard in woodlands during the rainy season. It disappears completely during the dry portion of the year. It ties in with one of the *A. semilineatus, A. olsoni, A. hendersoni* series of Haiti as does also, I think, *A. alutaceus* and PERHAPS *A. cyanopleurus.*

Anolis cyanopleurus Cope

Cuba.

A marvelously beautiful species which Dr. Ramsden has rediscovered in the old type locality, the mountains about Guantanamo. I suspect from its habit that it may be largely terrestrial. It is said to be local and uncommon.

Anolis semilineatus Cope

Hispaniola.

An abundant, cursorial grass living form.

Anolis olssoni Schmidt

Hispaniola.

Apparently a not uncommon member of the group of slender terrestrial species long confused with *A. semilineatus* and allied to *A. spectrum* of Cuba.

Anolis hendersoni Cochran

Hispaniola.

A small terrestrial species mostly, if not wholly, from the western portion of the Island.

Anolis pulchellus Duméril & Bibron

Porto Rico, Vieques, Virgin Gorda, Tortola, Anegada, St. Thomas, St. Croix, Just van Dyke.

A common ground living species. Doubtfully recorded from Haiti.

Anolis poncensis Stejneger

Porto Rico.

A rare local species. One which is terrestrial and almost Norops-like in habit.

Anolis latirostris Schmidt

Navassa.

Known from the unique type only.

Anolis stratulus Cope

Porto Rico, Vieques, Culebra, St. Thomas, Tortole, Just van Dyke.

A common lowland species.

Anolis coelestinus Cope

Hispaniola.

I have seen this form from Haiti only and have no recent information to offer.

Anolis dominicensis Reinhardt & Lütken

Hispaniola and La Gonave Island.

This species is not uncommon in Haiti but seems to be rare on La Gonave. I secured a small series in 1929—but in a very dry time.

Anolis distichus Cope

Bahama Islands.

Common on the ceiba trees of New Providence Island. I think it occurs on other islands as well but upon trying to find why I have this impression I cannot lay hands on a bit of evidence. It may be confined to New Providence.

Anolis distichoides Rosén

Andros Island.

A poorly defined form replacing *A. distichus*. It is very abundant.

Anolis sagrei Duméril & Bibron

Cuba and Isle of Pines; probaly introduced in Jamaica and Belise.

The commonest Anolis and, as its range is wide in Cuba, perhaps this form has the largest species population in the genus. The commonest fence, house-wall and brush lizard in Cuba, by far.

Anolis ordinatus Cope

Bahamas.

Known from Turks Island to New Providence. Common everywhere. This is a derivative of the *A. sagrei* stock and only a moderately well defined species. It is much more distinct in life than in preserved form.

Anolis luteosignifer Garman

Cayman Brac.

Probably as abundant as it ever was.

Anolis longitibialis Noble

Beata Island.

The apparently rare but quite well defined local representative of the *A. cybotes* stock.

Anolis lineatopus Grey

Jamaica.

The common fence lizard of the dry Liguanea Plain about Kingston. It swarms here but occurs nowhere else, so far as anyone knows at present.

Anolis homolechis Boulenger

Cuba and Isle of Pines.

A widespread and not uncommon species found in wooded ravines or lowland woods and heavy scrub.

Anolis greyi Barbour

Cuba.

Only known from a small number taken in the town of Camaguey and in the Cubitas range of hills not far away.

Anolis doris Barbour

La Gonave.

I have only seen a very few specimens of this lizard, a contrast to its ally *A. cybotes*, which is very abundant in Haiti.

Anolis cybotes Cope

Hispaniola.

Common as are the allies of *A. sagrei* wherever they occur. This is one of a series of dominant and successful species.

Anolis angusticeps Hallowell

Cuba and Isle of Pines.

I consider this a really rare species in western Cuba where, however, it occurs quite widely. It is more abundant in the Isle of Pines.

Anolis oligaspis Cope

New Providence.

A rare representative of *A. angusticeps* of Cuba. It may occur also upon other islands. Much intensive herpetological work remains to be done in the central and southern Bahama Islands.

Anolis isolepis Cope

Cuba.

An excessively rare species. It occurs in the mountains of Oriente Province and apparently replaces *A. angusticeps.*

Anolis lucius Duméril & Bibron

Cuba.

The abundant lizard of the limestone cliffs and open caves of central Cuba from Matanzas and Santa Clara Provinces, especially.

Anolis argenteolus Cope

Cuba.

Found in the Province of Oriente. Far from rare, it occurs on rocks,

cliffs and often also on building walls and fences. I have taken it on the trunks of the great *Ficus nitida* (Sp. Laurél de la India) trees which used to stand in the Plaza at Santiago.

Anolis argillaceus Cope

Cuba.

I have never seen this species in life. Dr. Ramsden says it is not uncommon in the old coffee plantations high in the mountains about Guantanamo.

Anolis bremeri Barbour

Cuba.

A fine striking species, known only from the type which I took years ago at Herradura in Pinar del Rio Province.

Anolis loysiana Cocteau

Cuba.

A rare and bizarre little lizard. It is found sparingly all over Cuba on light colored tree barks. It is extraordinary like rough bark in appearance. Some believe that the genus Acantholis proposed to contain this species is really valid. It becomes more common during the summer rains, than it is in the dry season, our winter.

Anolis leucophaeus Garman

Inagua, Turks and Caicos Islands.

A common species. I have not seen it from Caicos but am told that the same Anolis occurs there that is so common on Grand Turk.

Anolis speciosus Garman

Marie Galante.

Known from Garman's types only. I did not find it in 1929.

Anolis marmoratus Duméril & Bibron

Desirade.

I know nothing of this form. Garman found it abundant in 1882.

Anolis roquet (Lacépède)

Martinique.

An abundant representative of the *A. vincenti-A. luciae* set of allied forms.

Anolis luciae Garman

St. Lucia.

Apparently like so many Antillean species whether from one reason or another much less common than formerly.

Anolis vincentii Garman

St. Vincent.

Like most of the reptiles of this Island this species is now rare. It may descend to the ground from time to time and so fall prey to the mongoose. I should have said that most of the species of this Island are extinct.

Anolis gentilis Garman

Grenada and the Grenadines.

A rather small inconspicuous lizard which is still abundant.

Anolis opalinus Gosse

Jamaica.

A rather rare, woodland species, most often seen in western Jamaica.

Anolis iodurus Gosse

Jamaica.

A beautiful and not uncommon little woodland species. It is found widely distributed on the Island.

Anolis grahami Gray

Jamaica.

Common in the woods of Eastern Jamaica.

Anolis conspersus Garman

Grand Cayman.

A derivitive of *A. grahami* of Jamaica. It is probably not rare.

Norops ophiolepis (Cope)

Cuba and Isle of Pines.

A common terrestrial species usually found hiding in the heavy tufts or bunches of pasture grasses.

Cyclura cristata Schmidt

White Cay, near Watlings Island.

A small colony in danger if not already lost.

Cyclura figginsi Barbour

Bitter Guana Cay, near Great Guana Cay, Exuma group.

This little colony is now, I learn, almost certainly exterminated.

Cyclura portoricensis Barbour

Porto Rico.

Extinct but relatively recent bones found in several caves.

Cyclura mattea Miller

St. Thomas.

Recently extinct, known from recent osseous remains only.

Cyclura pinguis Barbour

Anegada.

Excessively rare if not now gone.

Cyclura stejnegeri Barbour & Noble

Mona.

Another rare species. This may be the same as *C. cornuta.*

Cyclura nigerrima Cope

Navassa.

Extinct. I am not sure that this was really distinct from *C. cornuta,* in fact I rather doubt it, but material is lacking to settle the question.

Cyclura cornuta (Bonnaterre)

Hispaniola, La Gonave, Petit Gonave and Beata Island.

Persisting only in isolated colonies on the larger island but very common on Beata.

Cyclura collei Gray

Jamaica.

Almost extinct. There are a few on Goat Island, off the Bushy Park property and a few on the Cays about Montego Bay.

Cyclura carinata Harlan

Turks Island.

Abundant still on some Cays near Turks Island and in the Caicos group.

Cyclura nuchalis Barbour & Noble

Fortune Island.

Said now to be extinct.

Cyclura rileyi Stejneger

Two small Cays in the lagoon of Watlings Island.

A few are said to persist.

Cyclura inornata Barbour & Noble

U Cay in Allen's Harbor near Highborn Cay, Bahamas.

Once widespread, no doubt now extirpated through use by the negros for food. This was the only specimen which Maynard could find—a relict on a tiny islet.

Cyclura baeolopha Cope

Andros Island.

Reported to be considerably decreased in numbers.

Cyclura caymanensis Barbour & Noble

Cayman Brac and Little Cayman.

Reported still to be not uncommon.

Cyclura macleayi Gray

Cuba and Isle of Pines.

Rare. Persisting in only the wildest and most inaccessible districts.

Cyclura ricordii (Duméril & Bibron)

Hispaniola.

Long known from the type only, until rediscovered by Dr. W. L. Abbott. Now known to be not uncommon in a few scattered localities in San Domingo.

Leiocephalus carinatus Gray

Cuba, Isle of Pines, Bahamas and Cayman Brac.

Widespread about rocky shores, headlands and sea cliffs. So far as I am aware seldom or never seen inland, certainly never in Cuba. With its tail tightly curled over its back this lizard jumps and hops about its haunts in a most unreptilian-like manner. The Cayman Brac specimens may represent a separate form but material is too scant to be sure.

Leiocephalus melanochlorus Cope

Hispaniola.

Known from Jeremie in southwest Haiti to Puerto Plata in Northern San Domingo.

Leiocephalus schreibersii (Gravenhorst)

Hispaniola and Great Inagua.

A common species on Inagua and Haiti. We have not seen it from San Domingo.

Leiocephalus personatus Cope

Hispaniola.

Allied to *L. cubensis* it is apparently common and widespread over the whole Island. I SUSPECT *L. lherminieri* (Duméril & Bibron) to be a synonym of this species. It was said to have come from Trinidad and Martinique, L'herminier, and Plée collectors, but both these gentlemen caused confusion on more than one occasion by either labelling their material incorrectly or else by shipping the results of a visit to several islands home to Paris in one lot shipment, after receipt of which the whole consignment was entered in the records of the Jardin

des Plantes as having been *collected* at the point of shipment. This sort of thing has caused confusion for modern workers on a host of occasions.

Leiocephalus eremitus Cope

Navassa.

Not found by Beck or the Clench party last year. Cats and dogs, now feral, may be to blame for the disappearance of this and other species.

Leiocephalus cubensis Gray

Cuba and Isle of Pines.

The common lizard of the canefields. I believe that investigation will show it to be very highly beneficial in controlling insects which are injurious to the industry.

Leiocephalus psammodromus Barbour

Turks Island.

A common species and one which I at first called *L. arenarius* but found that that name had been obscurely given by Tschudi to a Peruvian species that apparently had escaped all notice by subsequent authors.

Leiocephalus varius Garman

Grand Cayman.

When on Grand Cayman three years ago, I could not find this species but that may have been owing to the terrific drought, widespread that year, over the whole Antillean region.

Leiocephalus virescens Stejneger

Green Cay, Bahamas.

Said still to be common.

Leiocephalus raviceps Cope

Cuba.

I once doubted the validity of this species but it seems to be really well defined and confined to Eastern Cuba.

Leiocephalus loxogrammus Cope

Rum Cay and Watlings Island, Bahamas.

This species will probably prove to be much more widespread than we now know it to be.

Leiocephalus macropus Cope

Cuba.

A species found abundantly throughout the Province of Oriente but so far as we now know not westward, of, let us say, a vertical line drawn north and south and passing about through Holguin.

Leiocephalus semilineatus Dunn

Hispaniola.

Known only from Thomazeau, Haiti.

Leiocephalus barahonensis Schmidt

Hispaniola.

Known only from the southeastern portion of San Domingo.

Leiocephalus beatanus Noble

Beata Island.

Common and the only representative of the genus which either Noble or I were able to find on the Island.

Leiocephalus vinculum Cochrane

Gonave Island, Haiti.

I visited Gonave in 1929 during a very prolonged drought and saw but one of this species. This does not mean that it may not be abundant.

Hispaniolus pratensis Cochran

Hispaniola.

Taken by Milles at St. Michel, Haiti.

Family ANGUIDAE

Celestus de la sagra (Cocteau)

Cuba.

A widespread but excessively rare and perhaps disappearing species.

Celestus rugosus Cope

Hispaniola.

Whether or not this species is really valid remains to be determined when more material comes to hand.

Celestus costatus (Cope)

Hispaniola.

This species may be the same as *C. occiduus* of Jamaica. These species all change greatly during growth and are rather in confusion taxonomically.

Celestus badius Cope

Navassa.

This species may still occur on Navassa. I have a specimen taken but a few years ago. It may be identical with *C. costatus*.

Celestus maculatus (Garman)

Cayman Brac.

A rather poorly defined but, I think, valid form apparently known from the type only.

Celestus occiduus (Shaw)

Jamaica.

A form which was once common and of which old adults reached a great size—like Tiliqua of Australia or Corucia of the Solomon Islands. No such giants now occur and the species is rare.

Celestus impressus Cope

Jamaica.

A smaller and commoner species than *C. occiduus* but still one of which we know very little.

Celestus pleii (Duméril & Bibron)

Porto Rico.

A species which is much like its Cuban congener but apparently even now rather less rare.

Sauresia sepoides Gray

Hispaniola.

I once sunk this genus into Celestus but the concensus of opinion is that I was wrong. It seems really to be not uncommon.

Wetmorena haetiana Cochran

Hispaniola.

Known from a few examples taken by Wetmore in the higher regions of the La Selle massif in Haiti.

Family XANTUSIIDAE

Cricolepis typica (Gundlach & Peters)

Cuba.

Confined to the area, of a few square miles at most, between Belig and Cabo Cruz, Oriente, Cuba.

Family TEIIDAE

Kentropyx intermedius Gray

South America. Trinidad, Barbados.

What was probably this species was formerly common on Barbados but it is now wholly extinct on that Island. Garman named (*K. copei*) but did not describe this species. I have not material to settle the validity of the name.

Ameiva aquilina Garman

St. Vincent and Grenada.

Extinct on St. Vincent but still persisting on Grenada.

Ameiva fuscata Garman

Dominica.

Owing to the absence of the mongoose this, the finest of all the Antillean Ameivas, is still a common species.

Ameiva cineracea Barbour & Noble

Guadeloupe.

Extirpated except for a few individuals which persist on the tiny islets off the coast.

Ameiva atrata Garman

Redonda.

A black species superficially like *A. corvina* and living under similar conditions. It has not been collected recently, probably only because the Island is now almost never visited.

Ameiva pluvianotata Garman

Montserrat.

I have just learned that this species is still very common all over the Island.

Ameiva erythrops Cope

St. Eustatius.

Peters found this form abundant in 1922.

Ameiva griswoldi Barbour

Antigua and Nevis.

Extinct on Nevis, it is also almost gone on Antigua where it persists only right in the town of St. John in yards and gardens.

Ameiva erythrocephala (Daudin)

St. Kitts.

Extirpated from the wilder parts of the Island; it still occurs in the gardens and yards of Basseterre. Here it is safe from the mongoose.

Ameiva garmani Barbour

Anguilla.

This species is still abundant. It is closely allied to *A. pleii*.

Ameiva pleii Duméril & Bibron

St. Barts and St. Martin.

We have again no recent information to indicate that this is not still an abundant species.

Ameiva corvina Cope

Sombrero.

A black form which, like so many Lacertids and some species of Cnemidophorus and indeed another Ameiva, has assumed this peculiar coloration as a result of isolation on a very small, arid, sunbaked and rocky island.

Ameiva polops Cope

St. Croix.

Extinct, but very few specimens have been preserved.

Ameiva wetmorei Stejneger

Porto Rico.

Rare and confined to the arid zone about Guanica. Schmidt defines its range as the limestone hills about Ensenada and on Caja de Muertos Island. This species also belongs to the *lineolata, maynardi, polops* stock, which thrives only in arid areas.

Ameiva maynardi Garman

Great Inagua.

A beautiful species of the *A. lineolata* series.

Ameiva alboguttata Boulenger

Mona Island.

According to recent accounts still abundant. Closely related to the Porto Rican form next following.

Ameiva exsul Cope

St. Thomas, Water Island, St. John, Vieques, Anguilla, St. Croix and Porto Rico.

Now exterminated on St. Thomas. I have always doubted the St. Croix record. It is common where it still occurs at all.

Ameiva vittipunctata Cope

Hispaniola.

A very beautiful and apparently not very common form.

Ameiva taeniura Cope

Hispaniola.

When Dr. Noble and I prepared our Revision of Ameiva in 1915, I think I was principally to blame for concluding that this species was the young of *A. lineolata.* Miss Cochran has shown that this is untrue and that the species is perfectly valid.

Ameiva lineolata Duméril & Bibron

Hispaniola.

Widespread and abundant.

Ameiva chrysolaema Cope

Hispaniola.

A very common and widely spread species.

Ameiva thoracica Cope

Bahama Islands.

Now known to be widespread in the northern and central portion of the Bahama archipelago.

Ameiva dorsalis Gray

Jamaica

Formerly abundant, then, after the mongoose came, pretty well reduced—almost exterminated. Now recovering slightly in numbers in the cities and settlements where the mongoose population is kept in hand.

Ameiva auberi Cocteau

Cuba and Isle of Pines.

Nowhere abundant but very widely distributed. Perhaps most frequently seen along railway enbankments.

Ameiva barbouri Cochran

La Gonave Island.

Taken only by Eyerdam in 1927. I did not find it when on La Gonave in 1929.

Ameiva beatensis Noble

Beata Island.

I found this species much less common that *A. abbotti* on a recent visit to Beata.

Ameiva abbotti Noble

Beata Island.

Common on this beautiful but generally uninhabited Island.

Ameiva navassae Schmidt

Navassa.

Known from the type only, taken by R. H. Beck in 1917. Not found by the last collectors in 1930.

Scolecosaurus alleni Barbour

Grenada.

A distinct and not uncommon species of the wet spice gardens. This little creature is most commonly found under heaps of half decayed cocoa pods.

Gymnophthalmus pleei Bocourt

St. Lucia and Martinique.

Extinct.

Whether *G. luetkenii*, also of Bocourt, from "St. Lucia" is really distinct or whether it ever came from St. Lucia will, in part, be solved by examination of the type. Only *pleei* was found on these two islands by Garman, who took a good series before it was exterminated.

Family AMPHISBAENIDAE

Cadea palirostrata Dickerson

Isle of Pines.

A very distinct and abundant species.

Cadea blanoides Stejneger

Cuba.

Rare and confined to Matanzas, Havana and Pinar del Rio Provinces.

Amphisbaena fenestrata Cope

St. Thomas, St. Croix and St. John.

I know of no recent information on the status of this species.

Amphisbaena bakeri Stejneger

Porto Rico.

Rare and local.

Amphisbaena caeca Cuvier

Porto Rico.

Not very uncommon.

Amphisbaena manni Barbour

Hispaniola.

This form seems to be about equally abundant with *innocens*.

Amphisbaena innocens Weinland

Hispaniola.

Not uncommon in Haiti.

Amphisbaena cubana Peters

Cuba.

Common in Central Cuba. Best found by following plows.

Amphisbaena caudalis Cochran

Grande Cayemite Isl., Haiti.

Known from but two examples taken by Eyerdam in 1927. It is allied to *A. innocens*.

Family SCINCIDAE

Mabuya aenea Gray

St. Vincent, Grenada and Trinidad.

Probably extinct on the first two and rare and disappearing in Trinidad.

Mabuya luciae Garman

St. Lucia.

Extinct.

Mabuya dominicana Garman

Dominica.

During a visit to Dominica during March, 1929, I saw several skincs in and about the Botanical Gardens at Roseau. I am told that they are not rare elsewhere.

Mabuya lanceolata Cope

Barbados.

Extinct.

Mabuya sp. indet.

Skincs occurred on Guadeloupe surely and probably on several other of the lesser Antilles from which they have disappeared without being described. There are skincs from Guadeloupe in the Paris Museum and perhaps preserved elsewhere.

Mabuya mabouia (Duméril & Bibron)

Martinique.

Extinct.

Mabuya spilonota Wiegmann

Jamaica.

Now excessively rare. It has lately been shown to feed on Sphaerodactyls.

Mabuya sloanii (Daudin)

St. Thomas, St. Croix, Porto Rico, Mona, St. John, Just van Dyke, and Culebra. Possibly also Hispaniola.

Much more material is needed to settle the status of many of the Antillean Mabuyas. At least two species are probably included under this name.

Suborder *OPHIDIA*

Family TYPHLOPIDAE

Typhlops tenuis Salvin

Mexico, Guatemala and Andros Island.

Rosén got what he called this species at Mastic Point in 1910. I have never felt very sure that it was not an undescribed form wrongly identified.

Typhlops rostellatus Stejneger

Porto Rico.

Seems to be related to *T. dominicana.* Perhaps other species remain to be uncovered in the Lesser Antilles.

Typhlops pusillus Barbour

Hispaniola.

Not uncommon in Haiti.

Typhlops dominicana Stejneger

Dominica and Guadeloupe.

The specimens from Martinique should belong here, one would suppose, rather than to *T. jamaicensis.* More material is highly desirable from any of the islands.

Typhlops sulcatus Cope

Navassa.

May not really be a valid species. It has not been found by the most recent collectors.

Typhlops jamaicensis (Shaw)

Jamaica, St. Thomas, Porto Rico and Martinique.

This is a strange and anomalous distribution. Either these species have been carried far and wide by chance or some future revision based on more material will be desirable. No reptile has this distribution naturally. With more material available from St. Thomas and perhaps St. Croix it is not unlikely that *T. richardii* Duméril & Bibron, type locality St. Thomas, may be reestablished.

Much aid has been derived from Miss Cochran's recent synopsis of this group of blind snakes.

Typhlops monensis Schmidt

Mona Island.

A little known member of the *T. lumbricalis* series. The species is not

very sharply defined. Only two specimens are known and more material is desirable and no doubt still obtainable.

Typhlops lumbricalis (Linne)

Cuba, Hispaniola, Andros, New Providence and Abaco.

Common everywhere and no doubt fortuitously introduced into the Bahamas.

Family LEPTOTYPHLOPIDAE

Leptotyphlops albifrons (Wagler)

Watlings Island, Antigua, Grenada and with a wide range in Tropical America.

This tiny burrowing snake has an erratic distribution and has probably been carried about by primitive man, being occasionally introduced with material intended for garden planting.

Leptotyphlops bilineata (Schlegel)

Martinique, St. Lucia, Guadeloupe and Barbados.

This, another tiny species, may have a considerably wider range among the islands than we now know.

Family BOIDAE

Epicrates angulifer Bibron

Cuba and Isle of Pines.

Formerly common everywhere, now confined to the wilder regions although individuals occasionally stray into the cultivated areas. The great extension of cane cultivation has decimated this species. Every cane cutter carries a machete all the time and uses it on every snake.

Epicrates subflavus Stejneger

Jamaica.

I had supposed this species gone in Jamaica itself until a recent letter from Mr. Frank Cundall of Kingston tells me that one from the southeast part of the Island was recently brought to the Institute of Jamaica alive. It persists on Goat Island off the south coast in small numbers.

Epicrates striatus (Fischer)

Hispaniola and Andros and New Providence in the Bahamas.

This boa is rather rare in Haiti and San Domingo but quite abundant in the Bahamas.

Epicrates monensis Zenneck

Mona.

A very little known species but one which I believe to be most closely allied to *E. fordii*.

Epicrates gracilis (Fischer)

Hispaniola.

I have never seen a specimen of this form in all the Haitian material which has passed through my hands. As described it has a very peculiar and unique color pattern but modern material would be very welcome.

Epicrates fordii (Günther)

Hispaniola.

More information concerning this species will be awaited with interest. Is it well differentiated from *E. gracilis* and *E. chrysogaster*?

Epicrates chrysogaster (Cope)

Turks Island.

Of this form I have no recent information. It is related to the little boas of Mona and Hispaniola, *E. fordii* or *E. gracilis*.

Epicrates inornatus (Reinhardt)

Porto Rico.

Now a really rare species and one which is related to the large boas of Cuba, Jamaica and Hispaniola.

Boa grenadensis Barbour

Grenada.

I may not have been justified in separating this form from *B. cookii*. I am, however, inclined to believe that it is fairly well differentiated and stabilized.

It is not very rare.

Boa hortulana Linne

St. Vincent, Grenada, The Grenadines and Trinidad, widespread on the mainland.

The species still occurs on Grenada and may, being arboreal, persist on St. Vincent. This, however, I am inclined now to doubt.

Constrictor orophias (Linne)

St. Lucia, Dominica.

The "tête chien" is rare on St. Lucia but still occurs—and even occasionally at least eats a mongoose. On Dominica it is less uncommon. There is a Zoological Park (Phila.) record for St. Kitts which I believe to be incorrect, captive snakes get carried far and wide and dealers convey notoriously inaccurate locality records. There are also records from Trinidad but my friend, Mr. Urich, a most competent resident authority, told me that the species does not occur in Trinidad. It is confined to two islands only.

Tropidophis maculatus (Bibron)

Cuba and Isle of Pines. Found sparingly in Western Cuba and the Isle of Pines.

I am following Miss Stull's conclusions in the taxonomy of this genus. I am not wholly convinced of the relationships implied but her work has been most painstaking and is based on all available material.

Tropidophis maculatus jamaicensis Stull

Jamaica.

Excessively rare, almost extinct, since the introduction of the mongoose.

Tropidophis maculatus haetianus (Cope)

Hispaniola.

Not uncommon all over the Island.

Tropidophis pardalis pardalis (Gundlach)

Cuba and Great Abaco Island.

This is a most unlikely distribution. Artificial introduction is possible but most improbable. Convergence to identity or persistence of a type on Abaco, which has differentiated on other Bahama Islands from a once widespread form is a scarcely satisfactory explanation either.

Tropidophis pardalis canus (Cope)

Inagua and Eleuthera Islands.

This species seems to be common where it occurs. It may also be found on others of the southern islands.

Tropidophis pardalis curtus (Garman)

New Providence, Bahamas.

A common form. It occurs under stones of walls and in the rocks heaped about the orange trees. Since it at times sallies forth after heavy rains it is locally called "thunder snake." Like all its congeners it is nocturnal.

Tropidophis pardalis androsi Stull

Andros Island.

Apparently abundant but I have never happened to see a specimen.

Tropidophis pardalis bucculentus (Cope)

Navassa.

Known from but three specimens, it has not been found by recent expeditions.

Tropidophus wrighti Stull

Cuba.

Known, so far as I am aware, from the type only. This was taken by Charles

Wright the botanist who collected for a long time in the Guantanamo Basin and, I think, nowhere else in Cuba.

Tropidophis melanurus (Schlegel)

Cuba.

The largest member of the genus, reaching a length of nearly a yard. It is abundant and widespread. It feeds on frogs, lizards and birds. Although more inclined to be arboreal than the other species of the genus, it is equally nocturnal and perhaps the most abundant of them all.

Tropidophis semicinctus (Gundlach & Peters)

Cuba and Isle of Pines.

Widespread but distinctly uncommon.

Family COLUBRIDAE

Natrix compressidauda Kennicott

Cuba, Florida Keys, extreme southwestern Florida.

My finding this species on the north coast of Cuba established the specific identity of the excessively rare Cuban Natrix and relegated several long questioned names to a definite synonymy.

Tretanorhinus variabilis Duméril & Bibron

Cuba.

Not uncommon in fresh water ponds and rivers. A nocturnal species. Its mainland ally *T. nigroluteus* is rather partial to mangrove swamps.

Tretanorhinus insulae-pinorum Barbour

Isle of Pines.

This species seems to have regularly 19 rows of scales while the Cuban snakes have 21. This is, at first sight, a trivial character but one which is apparently really diagnostic.

Drymobius boddaerti (Sentzen)

St. Vincent, Grenada and having elsewhere a vast neotropical distribution.

Extinct on St. Vincent and very rare in Grenada.

Uromacer oxyrhynchus Duméril & Bibron

Hispaniola and Isle Tortue.

A form found all over the Island, i. e. both Haiti and San Domingo. I have seen it from Port au Prince and Samana.

Uromacer frenatus (Günther)

Hispaniola and Isle Tortue.

I have only seen specimens from Haiti and know little of the abundance or distribution of this species.

Uromacer catesbyi (Schlegel)

Hispaniola and La Gonave.

A widespread but rather rare species.

Uromacer scandax Dunn

Isle Tortue, near Haiti.

An abundant ally of *U. catesbyi.*

Uromacer dorsalis Dunn

La Gonave Island.

Apparently a derivative of the Haitian *U. frenatus.*

Hypsirhynchus ferox Günther

Hispaniola.

A common widespread species, and one which is strictly nocturnal and oviparous.

Alsophis anomalus (Peters)

Hispaniola.

I have but little information to give concerning this species. Dr. G. M. Allen took one at Port au Prince in 1919. I have received no other recent specimen.

Alsophis sanctorum Barbour

Les Saintes Is. near Guadeloupe.

No doubt abundant still.

Alsophis sibonius Cope

Dominica.

With no mongoose on this island, the species should be abundant still. There are still great areas of wild land on Dominica.

Alsophis leucomelas (Duméril & Bibron)

Guadeloupe and Marie Galante.

Extinct on both islands. This may have been the species reported from Montserrat but it is more probable that this Island supports an undescribed form—if snakes are still to be found.

Alsophis sanctae-crucis Cope

St. Croix.

Extinct.

Alsophis melanichnus Cope

Hispaniola.

We await more informatiom concerning this snake with great interest. Its rarity in the collections which have come before me is perhaps indicative that it is fast disappearing.

Alsophis rijgersmaei Cope

St. Martins.

No herpetologist has visited St. Martins in recent years.

Alsophis cinereus Garman

St. Barts. and Anguilla.

Abundant in Anguilla but of St. Barts. we have no recent news.

Alsophis variegatus (Schmidt)

Mona Island.

Still probably abundant.

Alsophis portoricensis (Reinhardt & Lütken)

Porto Rico, Desecheo and Caja de Muertos Island.

A distinctly rare form.

Alsophis anegadae Barbour

Anegada.

I still feel that this form warrants recognition as valid. Its peculiar pattern is characteristic of every Anegada specimen which I have seen, even though it occurs very sporadically elsewhere, where other patterns are the place mode.

Alsophis antillensis (Schlegel)

St. Thomas, St. John, Virgin Gorda and Porto Rico.

Extinct on St. Thomas, rare on Porto Rico, elsewhere abundant.

Alsophis rufiventris (Duméril & Bibron)

Saba, St. Kitts, St. Eustatius and Nevis.

Still abundant on Saba and St. Eustatius but extinct on the other two islands. This may have been the form which occurred on Antigua but which became extinct before any specimens were ever secured.

Alsophis vudii Cope

Bahama Islands.

This racer is common on most of the middle group of Bahama Islands:—

New Providence, Eleuthera, Long Island, Green Cay, the Exuma Cays, and no doubt upon many others.

Alsophis fuscicauda Garman

Cayman Brac.

I do not feel certain of the status of this species until much more material is secured.

Alsophis caymanus Garman

Grand Cayman.

I have never seen sufficient material to decide whether this form is really different from that of Cuba.

Alsophis angulifer Bibron

Cuba and Isle of Pines.

A very common species in all open plains, pastures and savannas.

Dromicus andreae Reinhardt & Lütken

Cuba.

A common snake at pastures and open fields.

Dromicus nebulatus (Barbour)

Isle of Pines.

Another common form. It is closely related to the foregoing species, indeed closely similar specimens occur also in extreme eastern Cuba. We should probably recognize three races or abandon this name.

Dromicus callilaemus Gosse

Jamaica.

Small and more retiring, this species is not so near extermination as *L. ater*. Nevertheless it is a distinctly rare snake.

Dromicus ater Gosse

Jamaica..

Very rare indeed. A species which has suffered fearful ravages from the mongoose.

Dromicus juliae Cope

Dominica.

Probably still not uncommon.

Dromicus melanotus (Shaw)

Grenada, Trinidad and Venezuela.

Extinct apparently on Grenada but common elsewhere.

Dromicus perfuscus Cope

Barbados.

Extinct.

Dromicus mariae (Barbour)

Marie Galante.

Extinct.

Dromicus boulengeri (Barbour)

St. Lucia.

Extinct.

Dromicus cursor (Lacépède)

Martinique.

Extinct.

Dromicus anegadae Barbour

Anegada.

We have no recent information concerning this form but no reason to suppose that it is not still abundant.

Dromicus exiguus Cope

St. Thomas, St. John and Culebra.

Extinct on St. Thomas, it is probably not uncommon on the other islands.

Dromicus stahli (Stejneger)

Porto Rico.

Still not uncommon, widely distributed and confined to this Island.

Dromicus tortuganus (Dunn)

Isle Tortue, near Haiti.

Another well marked form of which, however, but two specimens have been taken, so far as I am aware.

Dromicus alleni (Dunn)

La Gonave Island.

A distinct and striking island form.

Dromicus parvifrons niger (Dunn)

Hispaniola.

This form inhabits most of San Domingo and I have found it on Beata Island.

Dromicus parvifrons protenus (Jan)

Hispaniola.

A common widespread form. Known from many localities in northern and central Haiti and the higher plateau of San Domingo.

Dromicus parvifrons parvifrons (Cope)

Hispaniola.

One of several races which appear to be common, reasonably well localized in southwest Haiti and probably valid.

Arrhyton taeniatum Günther

Cuba.

An uncommon species, like its fellow, found by day under stones or while plowing. At night it is sometimes met with abroad.

Arrhyton vittatum (Gundlach & Peters)

Cuba.

I now consider that there are but two species of this genus peculiar to Cuba. Several other names have been given, as I believe to individuals variants only. These snakes are close allies of Contia of the mainland.

Clelia cloelia (Daudin)

Dominica, St. Lucia, Grenada, Trinidad and tropical America generally.

This species is surely extinct in St. Lucia, probably excessively rare on Grenada and its status on Dominica is still, no doubt, unchanged. I have never, however, seen or heard of recent specimens from any of the islands. Nevertheless, I think the records are really based on valid wild caught specimens.

Pseudoboa neuweidii (Duméril & Bibron)

Grenada, Trinidad and with a wide range in tropical America.

Garman took three examples on Grenada during the Blake Expedition about 1883. So far as I can learn it has never been taken before or since.

Ialtris dorsalis (Günther)

Hispaniola.

A large and uncommon species which has been found in both Haiti and San Domingo. It seems to have no close allies among Antillean reptiles and to be very rarely collected indeed.

Family CROTALIDAE

Bothrops atrox (Linne)

Martinique and St. Lucia.

What ever may be the origin of the Fer-de-lance's appearance on these islands, one thing Amaral has definitely proved,—the snake is the common wide ranging form of tropical America.

Order *CHELONIA*

Family TESTUDINIDAE

Pseudemys rugosa (Stahl)

Cuba, Jamaica, Hispaniola and Porto Rico.

I am not yet convinced that Schmidt's *P. stejnegeri* is valid nor am I by any means sure that the many local ideas as to multiplicity of species have any foundation in fact but I am often too conservative and hence wrong in such matters. Every Cuban *guajiro* believes that there is more than one species in Cuba.

Order *LORICATA*

Family CROCODYLIDAE

Crocodylus rhombifer Cuvier

Cuba and Isle of Pines.

Found in the Zapata Swamp in Cuba and no doubt still also in the Cienaga of the Isle of Pines. Specimens over six feet long are less often seen now than a generation ago.

Crocodylus acutus Cuvier

Cuba, Jamaica and Hispaniola; as well as Florida and Central America.

Crocodylus intermedius Graves

Orinoco Basin.

Accidental in Grenada, 6 Sept. 1910.

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DIGITAL EPIPHYSES AND CARPAL BONES IN THE GROWING INFANT FEMALE GORILLA

WITH SITTING HEIGHT, WEIGHT AND ESTIMATED AGE

BY CHARLES V. NOBACK
New York Zoological Park

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DIGITAL EPIPHYSES AND CARPAL BONES IN THE GROWING INFANT FEMALE GORILLA WITH SITTING HEIGHT, WEIGHT AND ESTIMATED AGE*

By CHARLES V. NOBACK
New York Zoological Park.

(Figs. 57 to 72 incl.)

It is the purpose of the writer to present the results of some observations on growth in the infant female gorilla based upon a study of four dead and one living specimen. Each of the specimens is apparently referrable to Gorilla gorilla.

The observations have been confined to the growth changes in the bones of the hand as revealed by means of a radiographic examination, and to the sitting height, weight, dentition, and the estimated age. As the chronological age is estimated it naturally follows that it is subject to correction.

The Material.

The material observed consists of four dead specimens and one living female gorilla, "Janet Penserosa." Their ages range from about 9 to 42 months, and the sitting height (Crown-rump) from 37.5 to 63.5 centimeters. Janet Penserosa, the living specimen, is at the New York Zoological Park and at the present time appears to be in good physical condition.

Method of Presentation.

The observations will be presented in eight arbitrary stages of physical growth based upon the material observed. Starting with the smallest and youngest, each specimen will be described

*Presented at the Second Annual Meeting of the American Association of Physical Anthropologists at Cleveland, Ohio, December 30, 1930, at the 87th Meeting of the American Association for the Advancement of Science.

separately in the order of its sitting height and dentition. Observations which will serve to show growth changes in the same living individual were made upon Penserosa at four successive periods of time. In conclusion a summary of the observations will be tabulated in a composite table.

Specimen No. 1.

History.

The preserved body of this specimen (C. A. 1105) is in the collection of the Department of Comparative Anatomy at the American Museum of Natural History.

This young gorilla was captured by natives in the Cameroon of West Central Africa sometime during the spring of 1928 and was brought to Duala on the west coast of Central Africa. It was purchased at this port by a sea captain and taken on board a freight steamer to Brooklyn, N. Y., arriving at the latter port about July 22, 1928. During the voyage at sea, about twelve weeks, its food consisted of bananas (plantain) and diluted condensed milk. It had apparently become infected on board ship, since at the time of arrival it was suffering from a "common cold," according to the history given by the ship's captain. The captain had treated the suffering baby gorilla for a "cold" with home remedies and simple cough mixtures for about a week, after which the writer was called to examine the sick gorilla. On the night of July 29, 1928, an emaciated infant female gorilla was seen gasping for breath, with a mucopurulent discharge from the eyes and nostrils. Its gums were tender and swollen as the result of teething. The pharynx was congested and contained a mucopurulent exudate. Respiration was labored and painful. On auscultation increased sibilant bronchial tones were heard while on percussion dullness over the upper right lobe was present, with tenderness and pain in the lower parts of the chest wall. A diagnosis of broncho-pneumonia and pleurisy was made. Since the infant gorilla was very weak and unable to move about or sit up, a very unfavorable prognosis was made. It died the next morning, on July 30, 1928. Cause of death: Broncho-pneumonia and complications following a "common cold."

No autopsy was performed, but instead the remains were sent to the Department of Comparative Anatomy at the American Museum of Natural History in New York City, where it is now known as C. A. 1105. It is hoped that the viscera will be examined for gross pathological changes whenever the specimen may be dissected. It is believed that this is the youngest and

smallest specimen of an infant female gorilla in the United States.

The weight of its body at the time of death was 8½ pounds, or 3.86 kg. Its sitting height was 37.5 cm. Schultz[1] has reported as follows on this preserved specimen: "The preserved body of a small gorilla at the American Museum of Natural History (C. A. 1105) has eight incisors and four molars and weighs 4.5 kg. . . . its sitting height measures only 368 mm. and its head length 115 mm. as compared with the corresponding dimensions of Famelart's gorilla, etc." The writer wishes to call attention to an apparent discrepancy in the weight of the specimen as given by Schultz, i. e., 4.5 kg. and the weight of 3.86 kg. as recorded in this paper. This difference in weight can readily be explained by stating that the weight of 3.86 kg. was made before the specimen had been injected and placed in preserving fluid.

Since this gorilla was emaciated and evidently underweight as the result of disease, its weight cannot be considered as normal.

TABULATION OF OBSERVATIONS ON GORILLA NO. 1.

Estimated Age	9 to 12 months.
Sitting Height	37.5 cm. (According to Schultz, 36.8 cm.)
Weight	3.86 kg. (8½ pounds.)
Dentition	12 teeth. 4 upper and 4 lower incisors; 2 upper and 2 lower premolars.

Radiographic Record of the bones of the hand (Figs. 57-58).

Radius	Slight bowing.
Ulna	Relatively straight.
Distal Epiphyses of Radius	Visible in right and left hand.
Distal Epiphyses of Ulna	Visible in right hand only.
Carpal Bones	Os Capitatum (Magnum) and Os Hamatum (Unciform) visible.
Proximal Epiphyses of First Metacarpal	None visible.
Distal Epiphyses of Metacarpal Bones	Spherical and porous in appearance, and present in 2-3-4. The third is the largest.
Proximal Epiphyses First Phalanx	2-3-4 visible.
Proximal Epiphyses Second Phalanx	None visible.
Proximal Epiphyses Third Phalanx	None visible.

The above observations represent the stage of growth and development of the parts examined at the time of this gorilla's death.

Specimen No. 2.

History.

An infant female gorilla was obtained from natives by the captain and steward of a freight steamer at a port on the west coast of Central Africa on May 28, 1930. It was a very young specimen, which was teething at the time of purchase and had been quite ill during the sea voyage. The diet consisted of diluted whole dried milk and bananas. During the trip it was kept in a hot, poorly ventilated room, with one chimpanzee as a companion. This specimen arrived at Brooklyn, New York, on the night of August 5, 1930. Mr. Ellis S. Joseph, an animal importer and dealer, saw the weak, ailing infant gorilla on the night of August 6, 1930, and received permission to take it to his home for medical treatment. He described it as being in a state of exhaustion since it was panting for air in the hot, stifling atmosphere of a cabin room which had been fumigated. A denuded area the size of a half dollar, caused by the bite of the chimpanzee companion, was found on the left side of the head over the parietal bone.

The writer was called and saw the ailing infant gorilla, named "Trixie," at ten o'clock at night. It was found lying on its back in a weakened condition, unable to get up except with the greatest difficulty, when it would attempt to sit up only to fall to one side from sheer weakness. It seemed to be most comfortable lying on its back. Respiration was irregular, at first deep and labored, then gradually becoming weaker and almost fading out, then the respiration would become deeper again. A slight mucopurulent discharge was present from both eyes and nostrils, indicating the presence of a "common cold." Reddened tender gums with teeth in the process of eruption were present, indicating that the milk dentition was being completed.

A diagnosis of myocardial degeneration resulting from exhaustion and a "common cold" was made. Prognosis was very unfavorable as the gorilla was practically in a moribund state. There were several attacks of cardiac weakness during the night, with severe dysponea. Artificial respiration was resorted to twice with only slight temporary relief. At six o'clock in the morning of August 7, 1930, the creature died without a struggle during an attack of cardiac failure.

No autopsy was performed. The body was embalmed with 10% formalin. The writer is indebted to Mr. Ellis S. Joseph

for permission to have radiographs made and to make the observations tabulated below.

The embalmed body was received by Dr. Adolph Schultz of Johns Hopkins University from Mr. Joseph on November 12, 1930, at the New York Zoological Park hospital.

TABULATION OF OBSERVATIONS ON GORILLA NO. 2.

Estimated Age	14 to 16 months.
Sitting Height	41 centimeters.
Weight	4.66 kg.
Dentition	20 teeth. All incisors (8) and first premolars (4) completely erupted. The canines (4) and 2 upper second premolars in process of eruption. The two lower second premolars erupted.

Radiographic Record of the bones of the hand. Volar aspect. (Figs. 59-60).

Radius	Bowing present.
Ulna	Relatively straight.
Distal Epiphyses of Radius	Right and left visible.
Distal Epiphyses of Ulna	Right and left visible. (Left is larger than right.)
Carpal Bones	Os Capitatum (Magnum) visible. Os Hamatum (Unciform) visible.
Proximal Epiphyses of First Metacarpal	Both visible, one in each hand. (Small).
Distal Epiphyses of Metacarpal Bones	Large, spherical and porous. All four visible. 2-3-4-5.
Proximal Epiphyses First Phalanx	2-3-4-5. Flat, ovoid, webbed discs.
Proximal Epiphyses Second Phalanx	2-3-4. Flat, ovoid, webbed discs.
Proximal Epiphyses Third Phalanx	None visible.

SPECIMEN NO. 3.

History.

The third infant female gorilla of this series belongs to Dr. J. H. McGregor of Columbia University, from whom permission to examine it was obtained. He secured this young specimen in the Cameroon district at Vimili in West Central Africa during December, 1929. It was suffering from an attack of pneumonia, to which it succumbed in January, 1930. After embalming, the remains were brought to New York.

Tabulation of Observations on Gorilla No. 3.

Estimated Age	16 to 18 months.
Sitting Height	43.5 centimeters.
Weight estimated	5.2 kg.*
Dentition	20 teeth. Full set milk teeth.

Radiographic Record of the bones of the hand. (Figs. 61-62.)

Radius	No record.
Ulna	No record.
Distal Epiphyses of Radius	Radiograph poor.
Distal Epiphyses of Ulna	Radiograph not clear.
Carpal Bones	Os Capitatum (Magnum), Os Hamatum (Unciform).
Proximal Epiphyses of First Metacarpal	One visible in each hand.
Distal Epiphyses of Metacarpal Bones	Spherical and webbed 2-3-4-5 visible.
Proximal Epiphyses First Phalanx	All visible as ovoid discs. 2-3-4-5.
Proximal Epiphyses Second Phalanx Proximal Epiphyses Third Phalanx	On account of the contraction of the hands and hardening by formalin, the radiograph is not satisfactory.

Specimen No. 4.

History.

The body of the fourth specimen in this series is in the collection of the Department of Comparative Anatomy of the American Museum of Natural History in New York City and is labelled C. A. 1216. On account of the rufous color of the hair it is apparently referrable to Gorilla gorilla castaniceps.

It arrived on board a freight steamer, from a port on the west coast of Central Africa, at Brooklyn, New York, about July 1, 1929, and was obtained by a dealer in animals. The dealer had it about ten days, attempting to cure a profuse diarrhoea from which the gorilla had apparently been suffering during the voyage and after its arrival in Brooklyn. The writer saw the ailing infant female gorilla during the late afternoon of July 11, 1929, and found it to be extremely emaciated, anemic and weak, with a profuse diarrhoea and virtually moribund. Diagnosis: Enteritis—exact cause not determined; probably parasitic.

The prognosis was very unfavorable. Death occurred before midnight. As the remains were sent to the American Museum of Natural History, no autopsy was made.

*The weight of the embalmed specimen is 13¼ pounds and by allowing 2 pounds for the weight of the preserving fluid, its weight is estimated at 11½ pounds or 5.2 kg.

Tabulation of Observations on Gorilla No. 4.

Estimated Age	24 to 30 months.
Sitting Height	53 centimeters.
Weight	(22 pounds) 10.9 kg. (Underweight-emaciated.)
Dentition	20 teeth. Full set of milk teeth. The canine teeth were quite large and protruded beyond the incisors.

Radiograph Record of the bones of both hands. (Figs. 67-68).

Radius	No record.
Ulna	No record.
Distal Epiphyses of Radius	Visible and definite in right and left hand.
Distal Epiphyses of Ulna	Right and left visible.
Carpal Bones	Os Capitatum (Magnum), Os Hamatum (Unciform), Os Navicular (Scaphoid), Os Triquetrum (Cuneiform) Os Multangular Major (Trapezium).
Proximal Epiphyses of First Metacarpal	Both present—very definite—one in each hand.
Distal Epiphyses of Metacarpal Bones	Spherical and webbed. 2-3-4-5 all visible and very definite.
Proximal Epiphyses First Phalanx	1-2-3-4-5. Ovoid, flat, webbed discs visible in both hands.
Proximal Epiphyses Second Phalanx	2-3-4-5. Ovoid, flat, webbed discs.
Proximal Epiphyses Third Phalanx	1-2-3-4-5. Ovoid, flat, webbed discs.

Specimen No. 5.

The fifth specimen of this series is the young female gorilla at the New York Zoological Park, known as "Janet Penserosa."

History.

Early in the summer of 1928, Rev. W. Reginald Wheeler sailed from the port of Duala situated on the west coast of Central Africa, with three baby gorillas (two females and a male) and a baby white-faced female chimpanzee. The gorillas were apparently referrable to Gorilla gorilla, the chimpanzee to *Pan chimpanzee.*

They had been in captivity for about three months before leaving Duala for New York via France. Their food consisted of milk from a nursing bottle, some bananas and white bread.

Two of the gorillas died and were buried at sea on the way from Duala to Bordeaux while the remaining infant female gorilla suffered from a "cold" and a digestive disturbance. As

soon as they arrived at Bordeaux both the gorilla and the chimpanzee were taken to the Jardin des Plantes in Paris, where they were nursed for several days while arrangements were being made to bring them to New York.

During the night of October 30, 1928, they landed at Pier 59, North River, on board the S. S. *Olympic* of the White Star Line. At 10:30 A. M. the next morning, October 31, 1928, an emaciated sick infant gorilla and chimpazee were received by Mr. William White Niles, Secretary of the New York Zoological Society, in order that they might be properly taken care of and protected.

Since both of the apes were in a very poor condition, suffering from the effects of the journey, a severe cold and an unsightly skin disease (dermatitis), they were placed in charge of the writer by Dr. W. Reid Blair, Director of the New York Zoological Park.

At noon they were taken from the pier and arrived at the Hospital in the New York Zoological Park at one o'clock. Examination revealed that both were extremely emaciated and suffered from an intense itch accompanying Dermatitis which caused them to scratch themselves incessantly. Their skin was completely covered with rough, dry, scaly, encrusted tenaceous masses of a honey-like, purulent character. A mucopurulent discharge from both eyes and nostrils was present. The eyelashes were stuck together with a purulent mass while the borders of the lids were granular. The conjunctivae were reddened and the eyes contained small flaky, purulent masses. In spite of their condition both apes were fairly active. The gorilla would refuse to come to anyone and would bite, squirm and cry if anyone attempted to separate her from the chimpanzee. She clung firmly to the chimpanzee and the chimpanzee in turn "mothered" and protected the baby gorilla. The gorilla weighed 17¼ pounds (7.84 kg.). The chimpanzee weighed 18 pounds (8.18 kg.).

The right nostril of the gorilla was completely occluded and the borders of both nostrils were eroded. A denuded, ulcerated area was present on the right thigh, and other parts of the body were tender. An examination of the mouth was very difficult due to the resistance of the gorilla, which would fight by biting and screaming. Its scream resembled the cry of an irritated angry child. All of the incisor and canine teeth were visible, and since the canine teeth were present it is very probable that she was in possession of a full set of 20 milk teeth. The height of the canine teeth was not much above that of the incisor teeth.

Comfortable quarters in one of the sanitary cages at the Hospital were provided for the patients, with fresh clean straw

as bedding. They were fed some oranges and bananas soon after arrival.

The occluded nostrils were cleared with cotton and a mild antiseptic solution, while their eroded margins were covered with some carbolated petrolatum.

There was some improvement until December 26, 1928, when bronchitis and bronchopneumonia developed and lasted until the middle of January, 1929. From that period on improvement was steady, as indicated by the weight record.

Table showing estimated age and weight record of infant female Gorilla "Janet Penserosa."

Age—Estimated	Date weighed	Weight—Kilograms
.....	10/31/28	7.84
20 months	11/ 9/28	8.93
.....	11/18/28	8.75
21 months	12/ 4/28	10.00
.....	12/26/28	10.34
22 months	1/15/29	10.34
23 months	2/ 5/29	10.68
.....	2/15/29	11.12
.....	3/28/29	11.13
25 months	4/13/29	11.47
26 months	5/ 1/29	11.70
.....	5/22/29	11.53
27 months	6/ 6/29	12.30
.....	6/24/29	12.95
28 months	7/ 5/29	13.18
.....	7/20/29	13.56
29 months	8/12/29	13.86
.....	8/30/29	14.10
30 months	9/10/29	15.00
.....	9/30/29	15.00
31 months	10/11/29	15.34
32 months	11/10/29	16.13
33 months	12/ 5/29	16.93
.....	12/27/29	17.60
34 months	1/21/30	18.30
35 months	2/13/30	18.86
36 months	3/ 7/30	19.54
.....	3/18/30	19.43
.....	3/30/30	19.77
37 months	4/21/30	20.45
38 months	5/ 9/30	20.34
39 months	6/ 2/30	21.36
40 months	7/10/30	22.20
.....	7/24/30	22.70
41 monthe	8/12/30	23.63
42 months	9/ 2/30	23.80
43 months	10/ 1/30	23.90
.....	10/20/30	24.09
45 months	12/ 9/30	24.65

Without going into the details of the care of the infant gorilla, it is of significance to note that it was irradiated with ultraviolet light from a mercury vapor lamp, at a distance of four to five feet for from 20 to 40 minutes daily during November and December, 1928 and the first five months of 1929. The only visible external effect seemed to be that the hair coat improved in appearance. As the skin on the gorilla's face is black no visible effect on its skin was observed. The bare face of the chimpanzee took on a tan as its skin is light and hairless. After May 28, 1929, irradiation was discontinued because they were kept out of doors each day from that date on.

Their nutritional requirements have been adequately provided for, as can be seen from their diet. The feeding schedule has remained the same from the time of arrival to the present date. Their food is plain and wholesome. It was not necessary to resort to the use of specially cooked or expensive foods for these apes at any time in order to maintain them in good condition.

FEEDING SCHEDULE.

8:00 A.M. Two to three cups diluted condensed milk.
Two teaspoonfuls whole dried milk.
One to two teaspoonfuls of a baby wheat food for flavoring.
Two raw eggs.

The above mixture is beaten with an egg beater and the gorilla is allowed to take as much as it desires.

9:00 A.M. Three teaspoonfuls of cod liver oil with one to two teaspoonfuls of a mixture of finely ground bone and blood meal.

12:30 P.M. Bananas with skins on. All anthropoid apes like to eat the inner white lining (the endocarp) of banana peels, especially of bananas which contain a tinge of green coloring in the skins. They prefer a banana which to the human has a slightly acrid taste rather than a sweet, fully ripe banana.
Oranges are an important item in the diet. Two or three oranges are fed daily. At times orange juice alone is given, about a cupful at a time.
Raw carrots.
Lettuce.
Boiled potatoes with skins on.

Simple rice pudding with a liberal supply of raisins.
Apples.
Celery.
Stale rye bread.
When available, the leaves and green burrs of the sweet gum tree (*Liquidambar styraciflua*) are enjoyed by the gorilla and chimpanzee. Young oak (*Quercus*) or wild cherry (*Betula lenta*) leaves are also relished.
At times they have eaten small quantities of cheese.
While they like peanuts we have not fed them except on rare occasions.

5:00 P.M. The evening meal is the same as the morning meal.

The following tabulations are made for comparison with the other observations in this series.

"Janet Penserosa." Gorilla No. 5.
November 3, 1928.

Estimated Age	18 to 20 months (Brandes[2], Krogman[3] quoting Keith).
Sitting Height	No record for this date.
Weight	7.84 kg.
Dentition (Noback[4])	20 teeth. Since the canines were present a full set of milk teeth is assumed to have been present.

Radiographic Record of the bones of the right hand only. (Figs. 63-64.)

Radius	No record.
Ulna	No record.
Distal Epiphyses of Radius	Right visible.
Distal Epiphyses of Ulna	Right visible.
Carpal Bones	Os Capitatum (Magnum) and Os Hamatum (Unciform) show marked centers of ossification. Os Multangular major (Trapezium) and Os Triquetrum (Cuneiform) not so pronounced as first two and Os Navicular (Scaphoid) has a faint center of ossification.
Proximal Epiphyses of First Metacarpal	Visible in right hand. No record of left hand.
Distal Epiphyses of Metacarpal Bones	Spherical and webbed. Visible in 2-3-4-5.
Proximal Epiphyses of First Phalanx	Ovoid, flat, webbed discs in 2-3-4-5.
Proximal Epiphyses of Second Phalanx	Ovoid, flat, webbed discs in 2-3-4-5.
Proximal Epiphyses of Third Phalanx	Negative; not clear.

March 10, 1929.

Estimated Age.....24 to 26 months.
Sitting Height.....47.5 centimeters.
Weight .....11.1 kg.
Dentition .....20 teeth. A full set of milk teeth. The canines larger than the incisors.

Radiographic Record of the bones of the left hand. (Fig. 65.)

Radius .....No record.
Ulna .....No record.
Distal Epiphyses of Radius...Visible.
Distal Epiphyses of Ulna.....Visible.
Carpal Bones .....Os Capitatum (Magnum), Os Hamatum (Unciform), Os Triquetrum (Cuneiform), Os Navicular (Scaphoid), Multangular major (Trapezium).
Proximal Epiphyses of First Metacarpal.....One visible.
Distal Epiphyses of Metacarpal Bones .....Spherical and webbed. 2-3-4-5 visible.
Proximal Epiphyses of First Phalanx.....Flat, ovoid, webbed discs. 1-2-3-4-5.
Proximal Epiphyses of Second Phalanx.....Flat, ovoid, webbed discs. 2-3-4-5.
Proximal Epiphyses of Third Phalanx .....Flat, ovoid, webbed discs in 2-3-4-5.

March 2, 1930.

Estimated Age.....34 to 38 months.
Sitting Height .....54.5 centimeters. March 18, 1929.
Weight .....19.43 kg.
Dentition .....24 teeth. The four first permanent molars erupted during February and March, 1930. None of the milk teeth have been shed.

Radiographic Record of the bones of both hands. (Figs. 69-70.)

Radius .....Bowed.
Ulna .....Relatively straight.
Distal Epiphyses of Radius...Visible in right and left hand.
Distal Epiphyses of Ulna.....Visible in right and left hand.
Carpal Bones .....Os Capitatum (Magnum), Os Hamatum (Unciform), Os Triquetrum (Cuneiform), Os Navicular (Scaphoid), *Os Multangular major (Trapezium), *Os Multangular minor (Trapezoid), *Os Lunatum (Lunar), *Os Pisiforme (Pisiform), *Os Centralia (Centrale).
Proximal Epiphyses of First Metacarpal.....One visible in each hand and very definite.

*Appeared since March 10, 1929. The gorilla normally has eight carpal bones (Sonntag[5]), therefore the presence of nine carpal bones in Penserosa is apparently unusual.

March 2, 1930 (*Cont.*)

Distal Epiphyses of Metacarpal Bones ..... Spherical, webbed—2-3-4-5 visible. Fusion with metacarpal bones is visible in right hand.

Proximal Epiphyses First Phalanx ..... Flat, ovoid, webbed discs in 1-2-3-4-5.

Proximal Epiphyses Second Phalanx ..... Flat, ovoid, webbed discs in 2-3-4-5.

Proximal Epiphyses Third Phalanx ..... Flat, ovoid, webbed discs in 1-2-3-4-5.

July 25, 1930.

Estimated Age ..... 40 to 42 months.
Sitting Height ..... 63.5 centimeters.
Weight ..... 24 kg. September 3, 1930.
Dentition ..... 24 teeth. 1 set of milk teeth 20
First permanent molars 4
24

Radiographic Record of the bones of both hands. (Figs. 71-72.)

Radius ..... Bowed.
Ulna ..... Relatively straight.
Distal Epiphyses of Radius ... Visible in right and left hand.
Distal Epiphyses of Ulna ..... Visible in right and left hand.
Carpal Bones ..... No fusion between Centralia and Navicular.

Proximal Epiphyses of First Metacarpal ..... Same as March 2, 1930.

Distal Epiphyses of Metacarpal Bones ..... Spherical and webbed in 2-3-4-5. Fusion with metacarpal bones present in both hands.

Proximal Epiphyses First Phalanx ..... Flat, ovoid, webbed discs in 1-2-3-4-5.

Proximal Epiphyses Second Phalanx ..... Flat, ovoid, webbed discs. 2-3-4-5.

Proximal Epiphyses Third Phalanx ..... Flat, ovoid, webbed discs. 1-2-3-4-5.

LENGTH, SITTING HEIGHT AND SPAN.
"Janet Penserosa."

	Length Crown-Heel	Sitting Height Crown-Rump	Span Lying on back—arms outstretched.
May 18, 1929	72 cm.	47.5 cm.	106 cm.
March 18, 1930	86 cm.	54.5 cm.	122 cm.
September 3, 1930	No record.	63.5 cm.	130 cm.

The following composite table on pages 150-151 contains a summary of the observations on the appearance of centers of ossification for the carpal bones and epiphyses in the hands of five infant female gorillas as determined by radiographic examination.

SUMMARY.

1. All the carpal bones (9), in the wrists of the living female gorilla under observation, were present before the fourth year. One other female gorilla, about five years of age, which will be reported on later, has been radiographed and all of its (8) carpal bones were present.

2. The development of the carpal bones, as shown in this study is very rapid in comparison with the human hand where the carpal bones are not normally present until about the tenth to the twelfth year. (Baldwin[6]).

3. The epiphyses of the bones of the hand appeared very early. Fusion had begun to take place between the metacarpal bones and their distal epiphyses at about the third year, the same time that the first permanent molars appeared.

4. The first permanent molar teeth (six-year molars of man) appeared at about the third year.

5. The total body weight of the living infant female gorilla increased steadily from 7.84 kg. on October 31, 1928, to 24.09 kg. on October 20, 1930. Its weight on arrival was less than the average weight of a one year old human female but after two years the weight was greater than the average weight of an eight year old child. (Davenport[7]).

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"Briefly summarizing the results of our investigations we may use the following data to determine or fix the age (Altersstufen) of the gorilla, the lower values to be used for the female."

Age	Weight	Dentition
1 year	6 to 7 kg.	20 milk teeth, canines still short.
1½ "	9 to 12 kg.	Canines and 2 milk molars grow to their full height.
2 "	15 to 18 kg.	M_1 erupts, and grows to full height.
2½ "	20 to 23 kg.	Shedding of incisors.
3 "	26 to 30 kg.	M_2 erupts, premolars shed.
4 "	40 to 50 kg.	Canines shed, M_3 erupts, color change in the hair,
5 "	70 to 80 kg.	particularly in the dorsal region.
6 "	80 to 100 kg.	

Dr. Gustav Brandes, Director of the Dresden Zoological Garden, in a communication to the writer, believes Penserosa to be six months younger than her estimated age. He bases his estimate on the assumption that the first permanent molar erupts in the gorilla at 2½ years of age, as indicated in his formula quoted above.

Krogman[3] states that "the deciduous teeth, completely erupted, according to Keith, by the end of the second year in the anthropoids, erupt, variably, in the order of central and lateral incisors, first and second (pre?) molars, and canine. The first molar is the first permanent tooth to erupt, presumably at or shortly before the age of four years."

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(6.) Baldwin, Bird T., Busby, Laura M. and Garside, Helen V.
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A SERIES OF SIXTEEN RADIOGRAPHS SHOWING THE DEVELOPMENT OF THE DIGITAL EPIPHYSES AND CARPAL BONES IN THE GROWING INFANT FEMALE GORILLA

Radiographs made by L. T. Le Wald, M.D.,
Professor of Roentgenology, Medical College, New York University

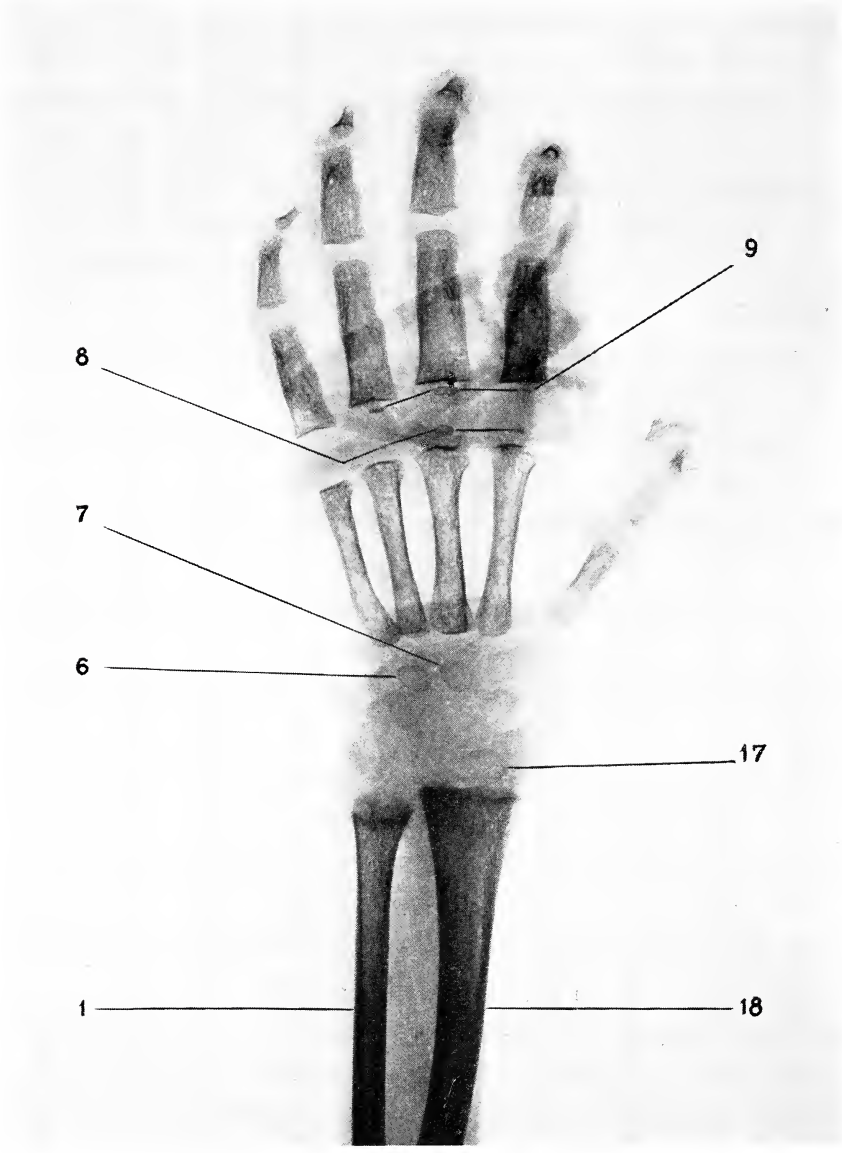

Fig. 57. Left Hand. Dorsal Aspect. 1. Ulna. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4 metacarpal bones, the third being the largest. 9. Proximal epiphyses of the first phalanx in 2-3-4, the third being the largest. 17. Distal epiphyses of radius. 18. Radius.

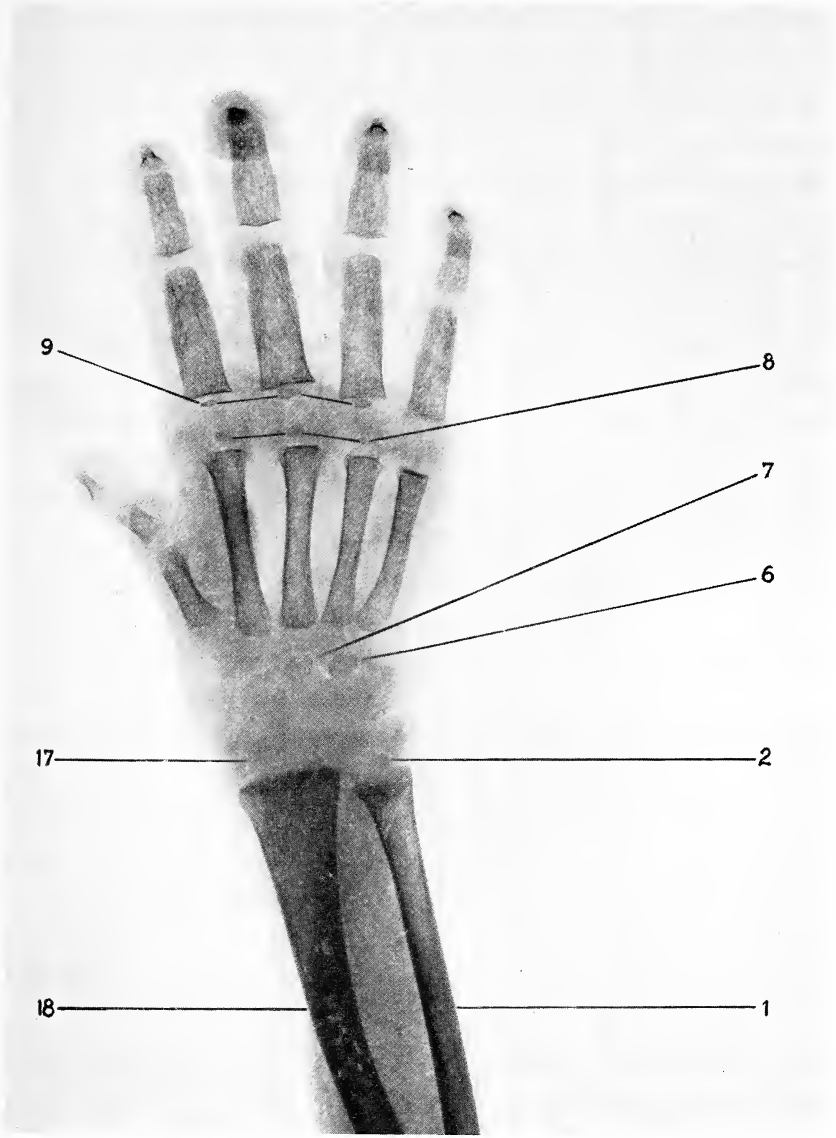

Fig. 58. Right Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4 metacarpal bones, the third being the largest. 9. Proximal epiphyses of first phalanx in 2-3-4, the third being the largest. 17. Distal epiphyses of radius. 18. Radius.

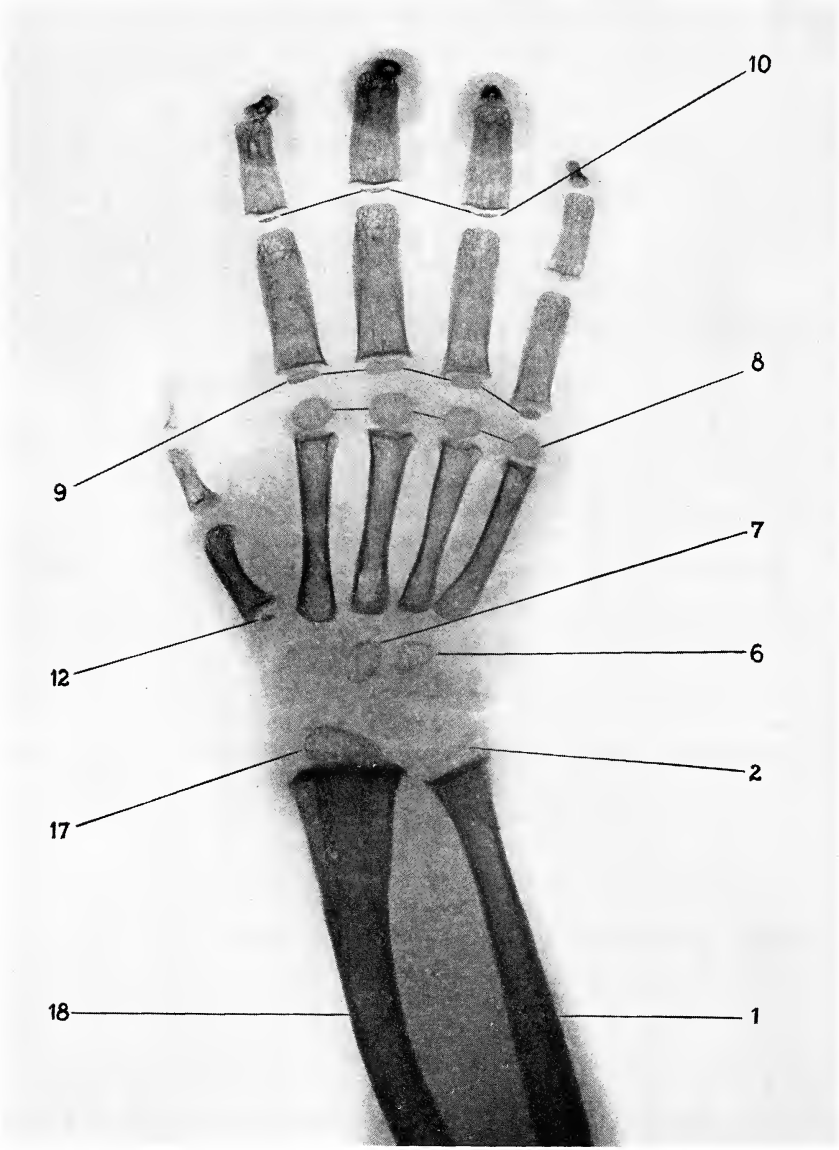

Fig. 59. Left Hand. Volar Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. In this stage the epiphyses are larger and spherical. 9. Proximal epiphyses of first phalanx in 2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4. 12. Proximal epiphyses of first metacarpal. 17. Distal epiphyses of radius. 18. Radius.

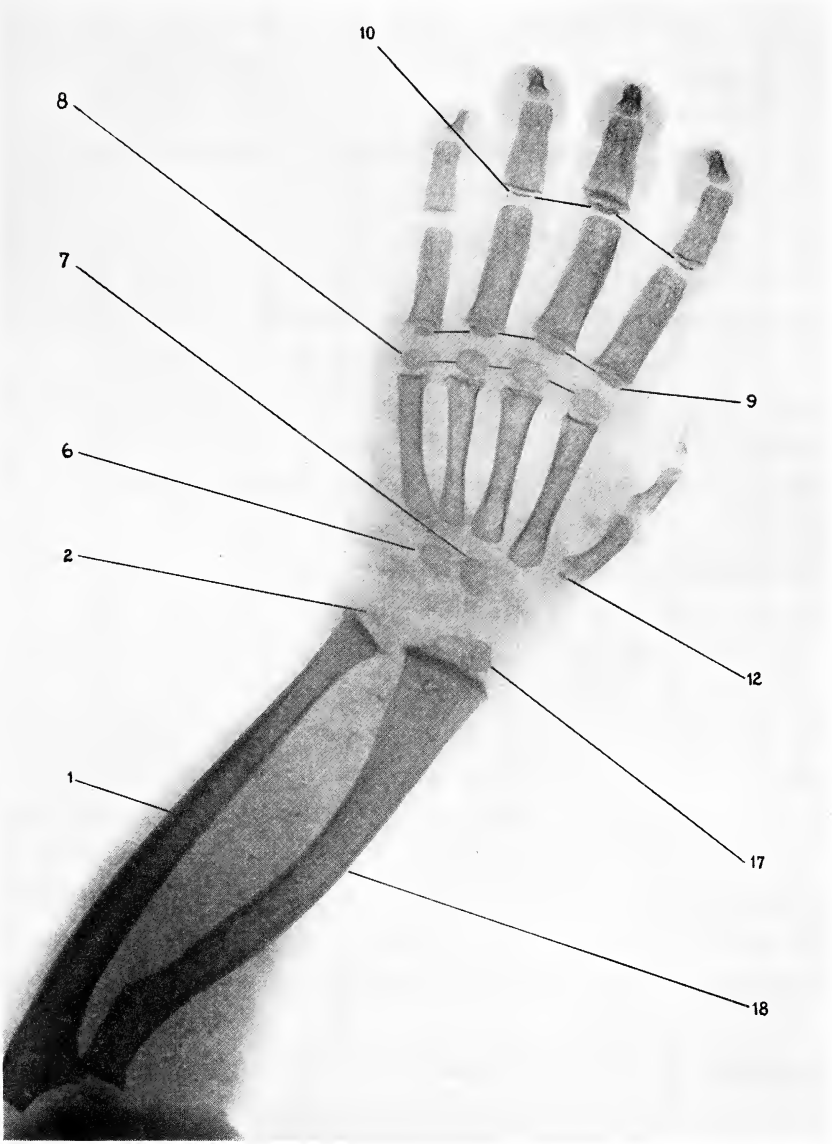

Fig. 60. Right Hand. Volar Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. The epiphyses are larger and spherical. 9. Proximal epiphyses of first phalanx 2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4. 12. Proximal epiphyses of first metacarpal. 17. Distal epiphyses of radius. 18. Radius.

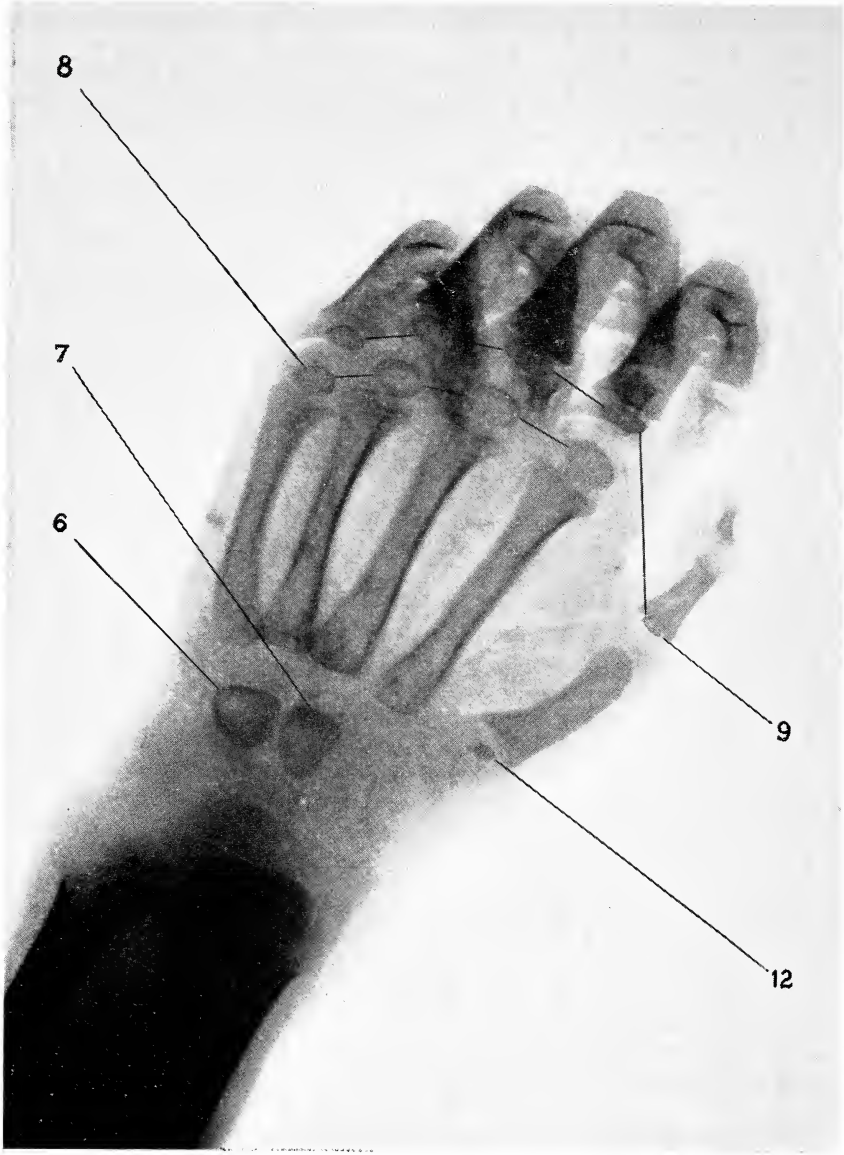

Fig. 61. Left Hand. Dorsal Aspect. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal.

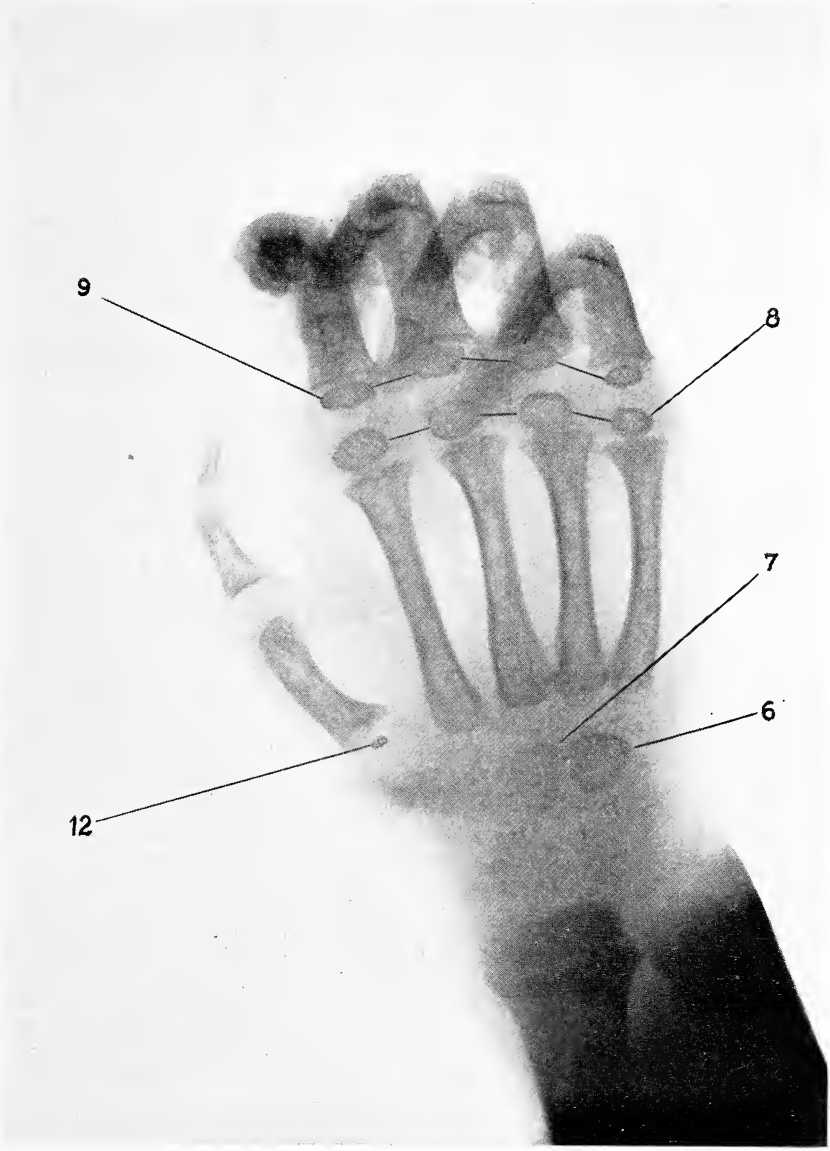

Fig. 62. Right Hand. Dorsal Aspect. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 2-3-4-5. 12. Proximal epiphyses of first metacarpal.

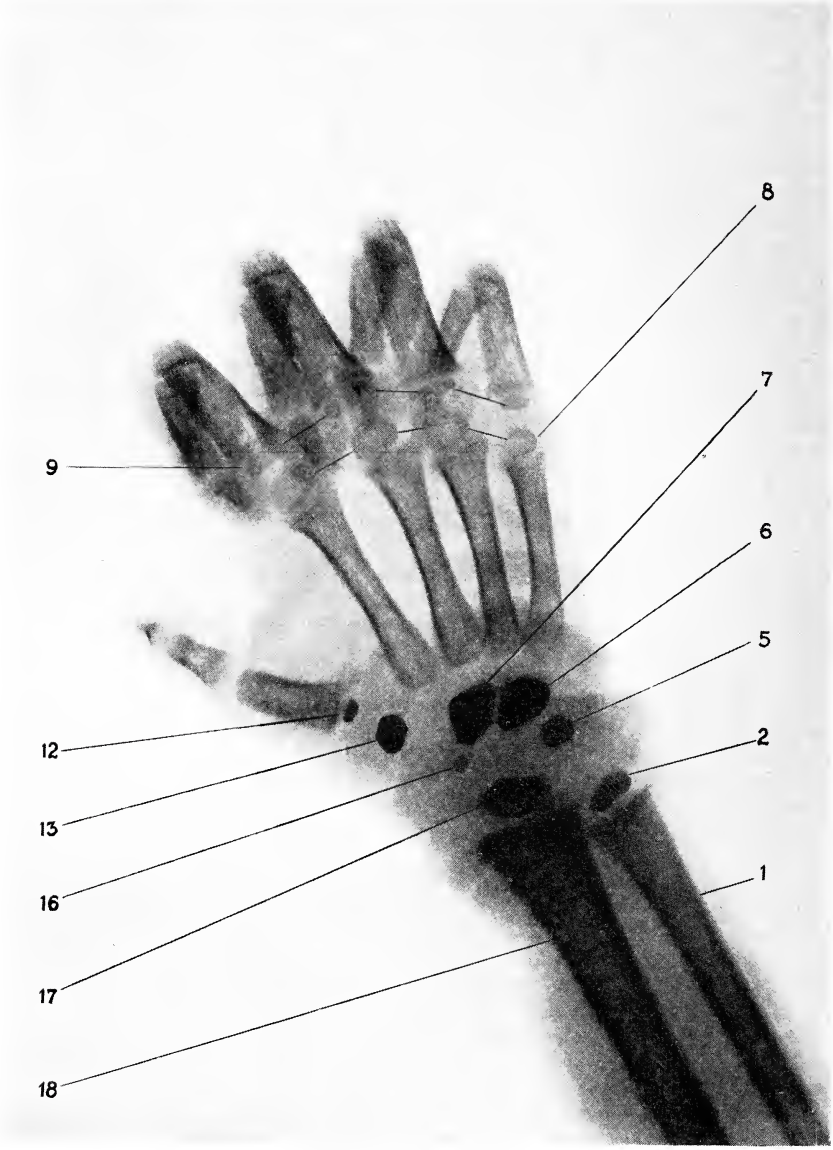

Fig. 63. Right Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

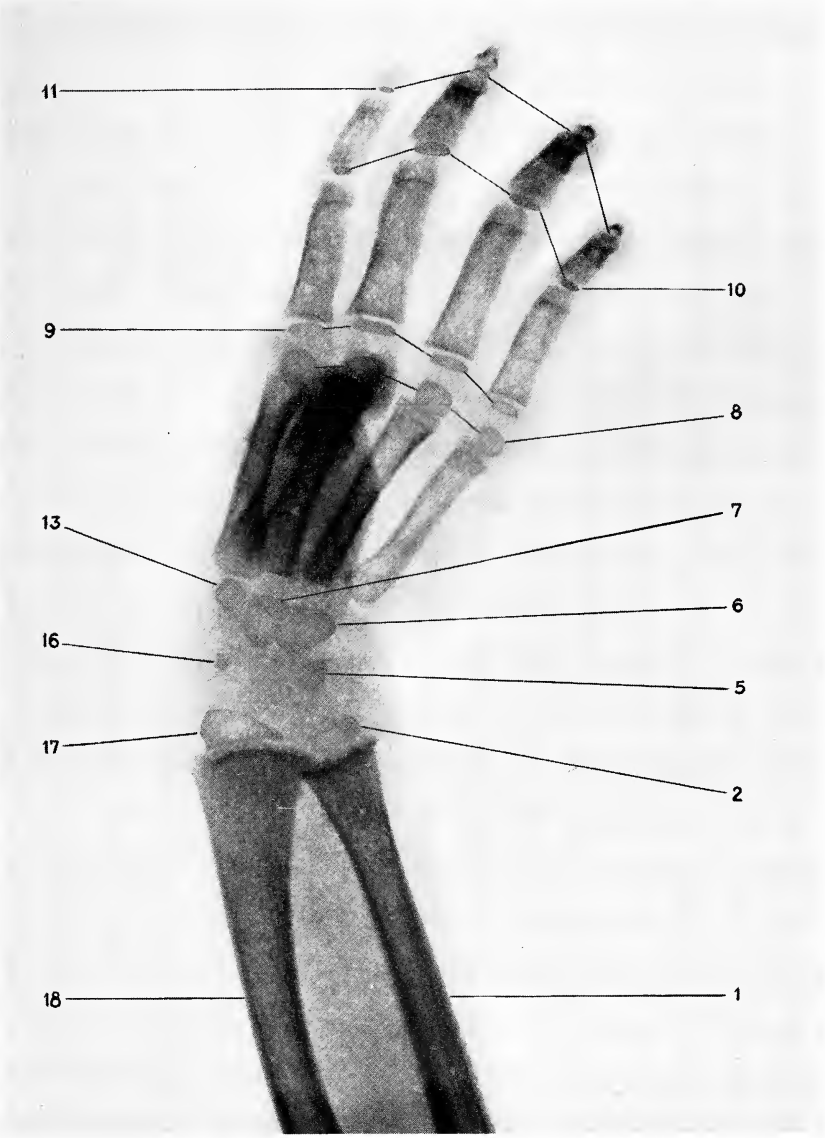

Fig. 64. Right Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 2-3-4-5. 13. Multangular major. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

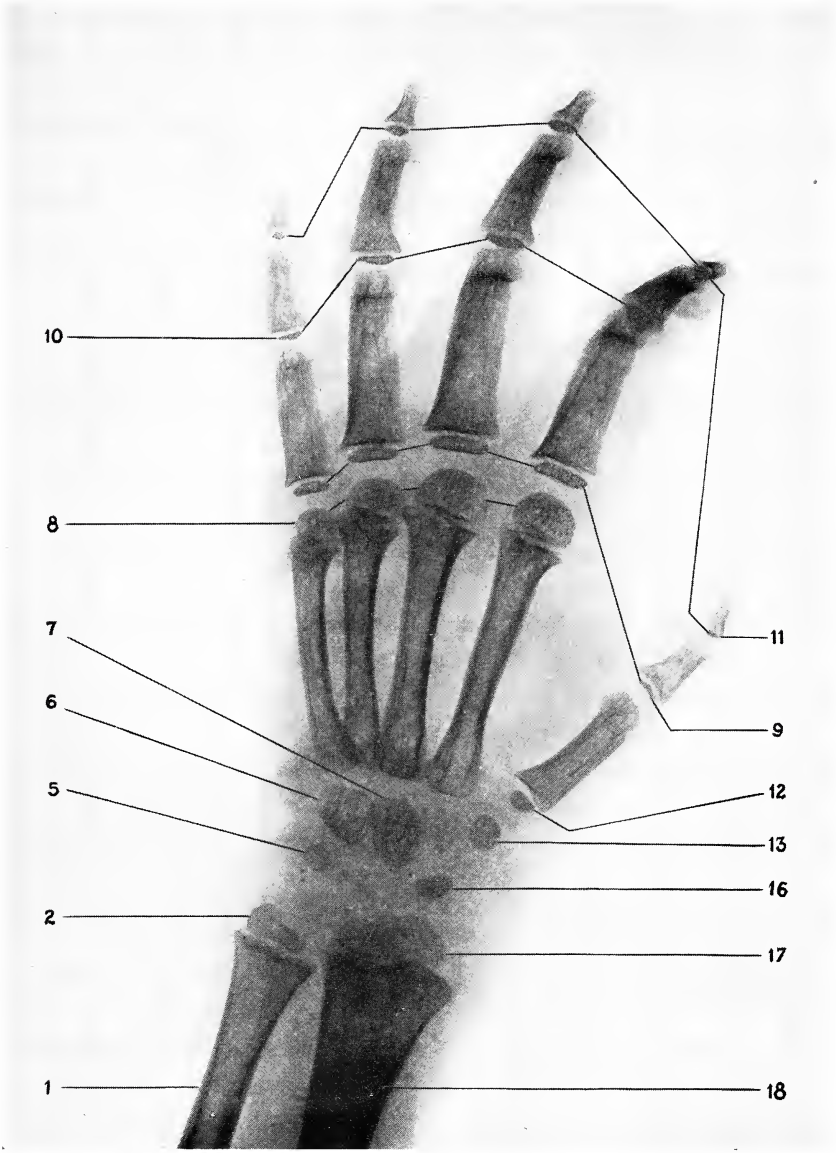

Fig. 65. Left Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

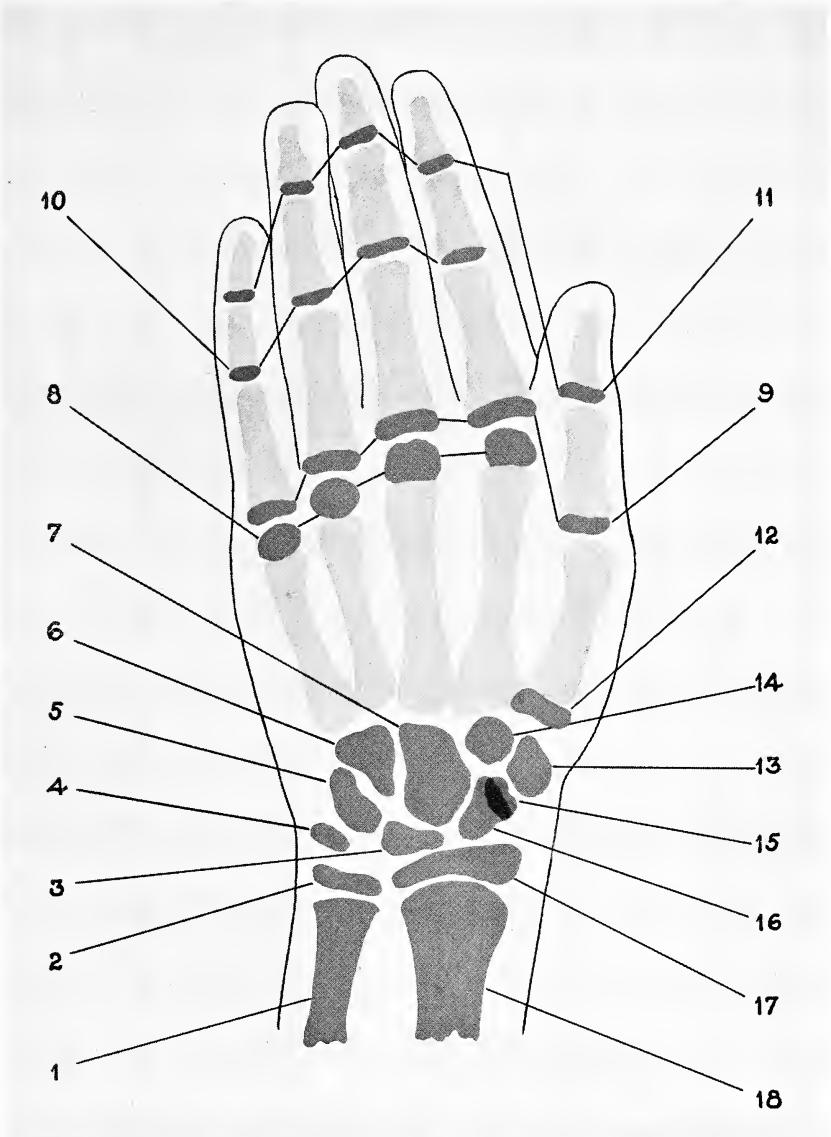

Fig. 66. Outline of Bones of Hand. 1. Ulna. 2. Distal epiphyses of ulna. 3. Lunatum. 4. Pisiform. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 14. Multangular minor. 15. Centrale. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

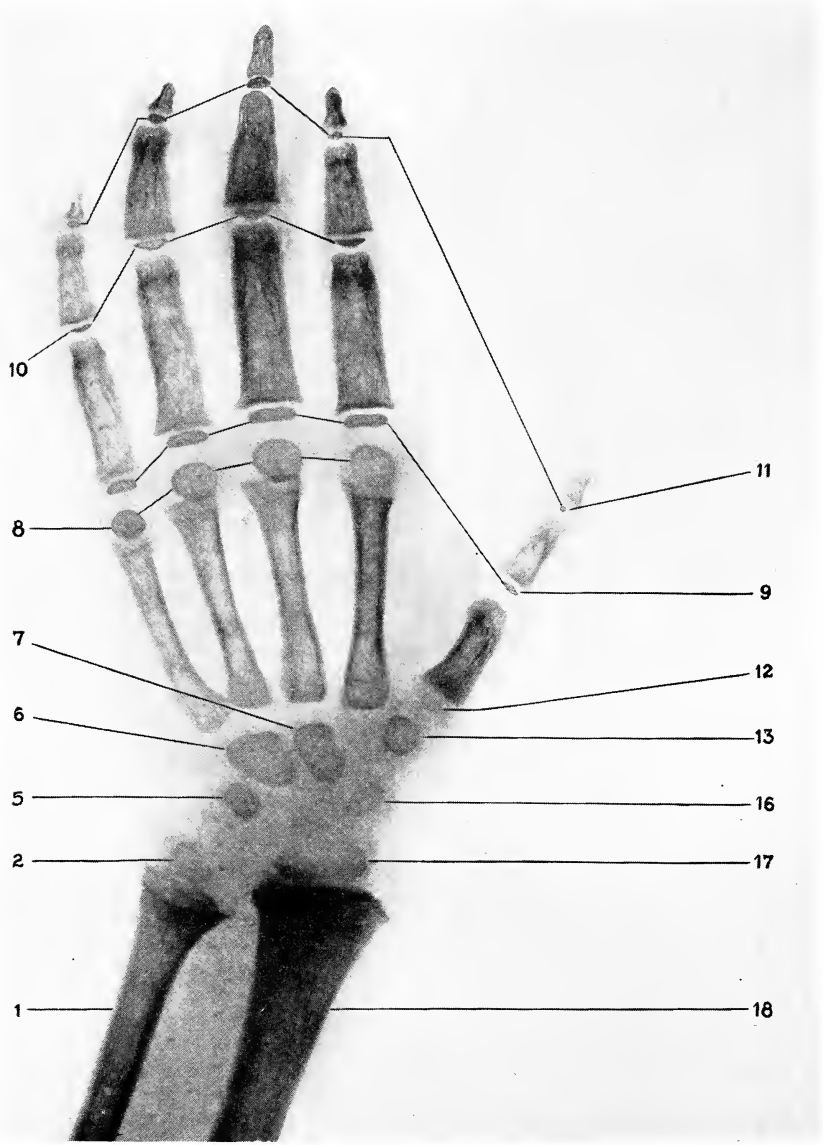

Fig. 67. Left Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

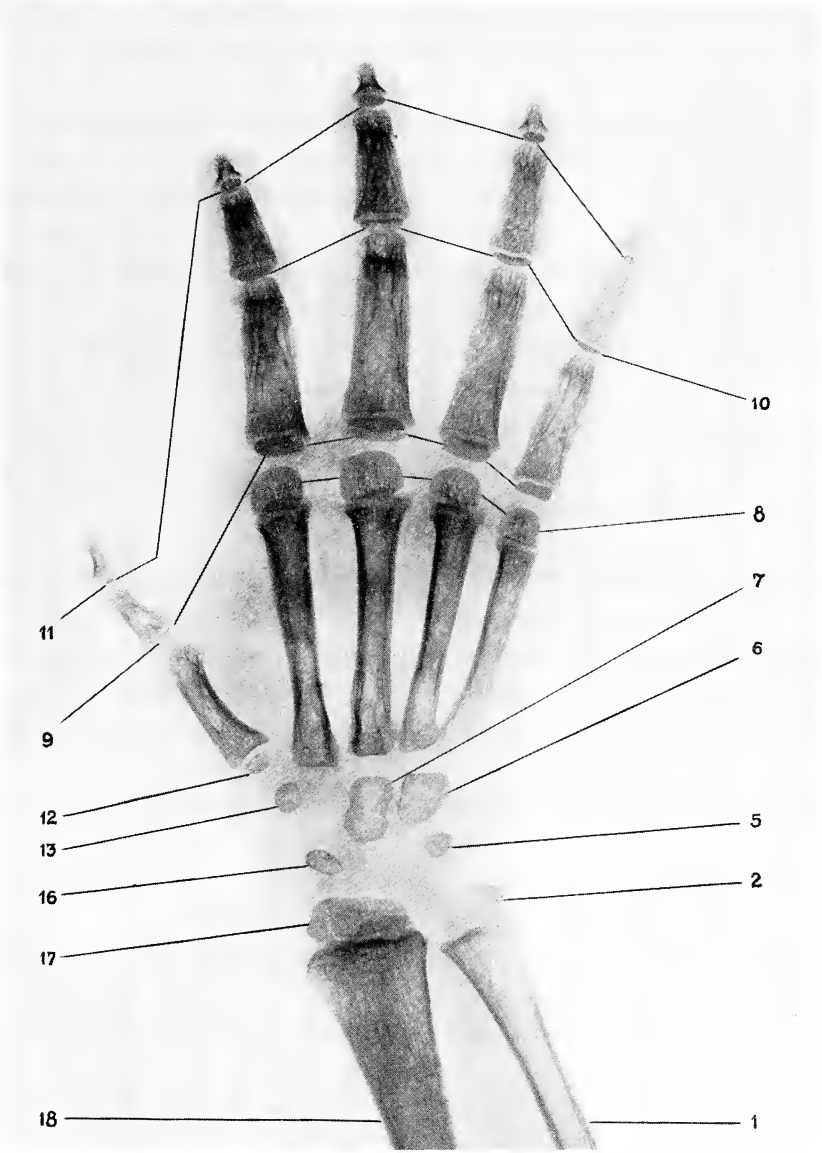

Fig. 68. Right Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

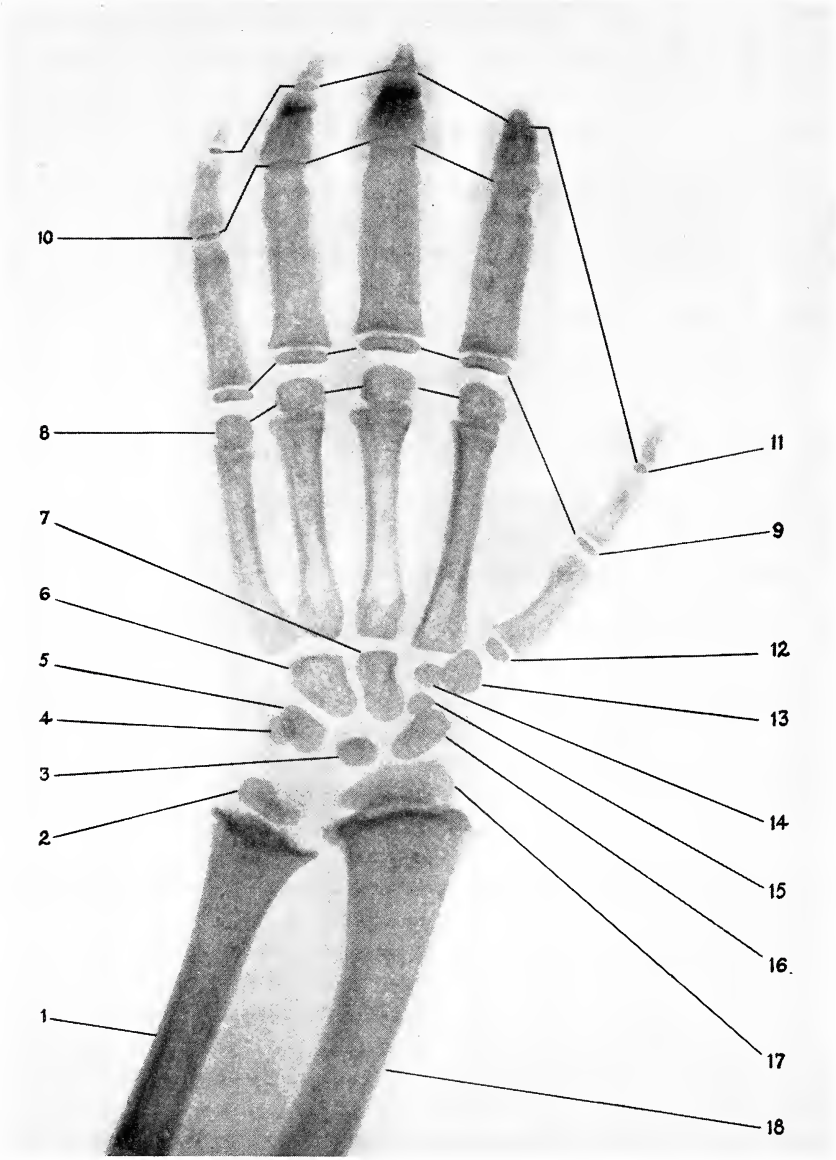

Fig. 69. Left Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 3. Lunatum. 4. Pisiform. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 14. Multangular minor. 15. Centrale. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

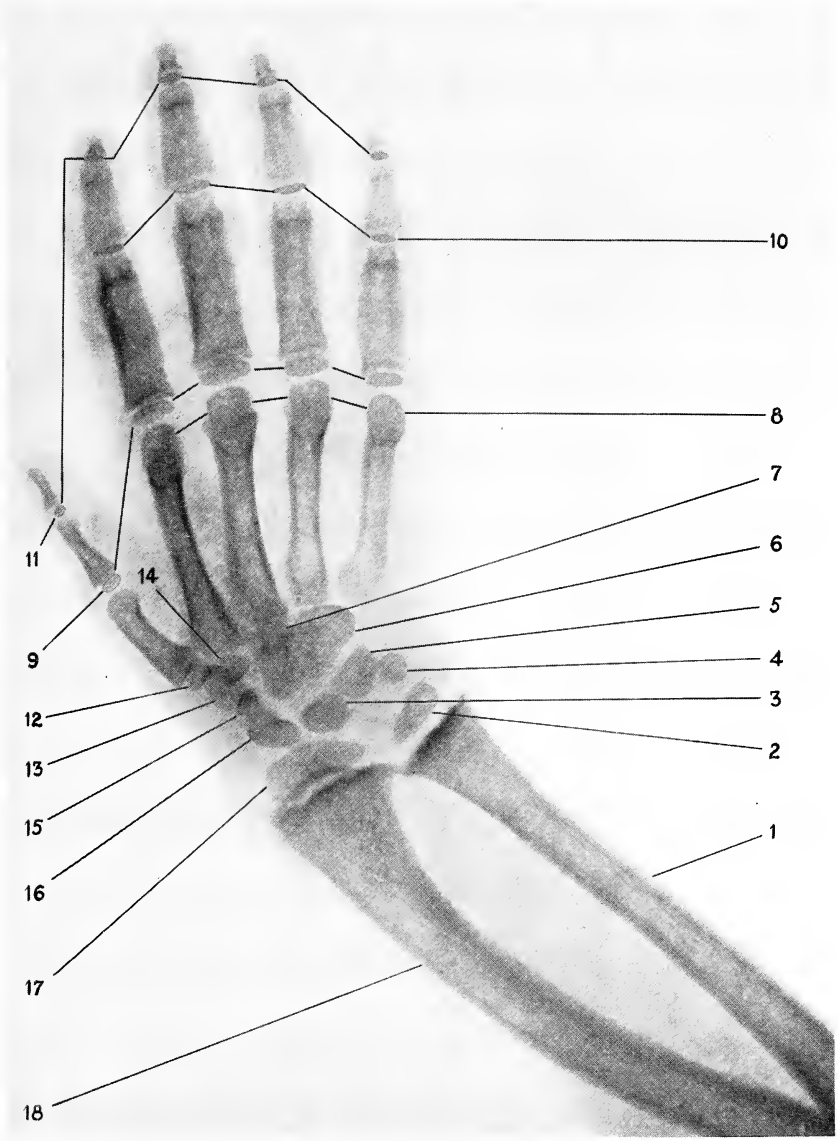

Fig. 70. Right Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 3. Lunatum. 4. Pisiform. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 14. Multangular minor. 15. Centrale. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

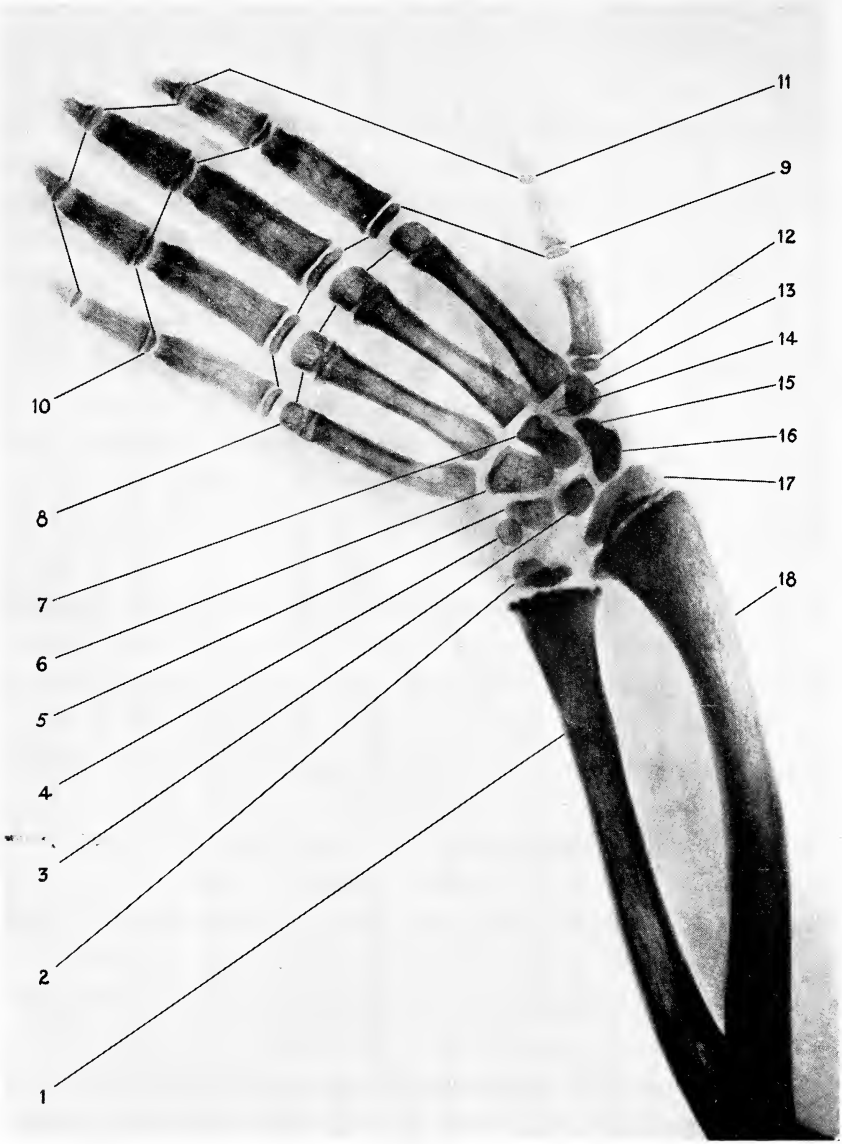

Fig. 71. Left Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 3. Lunatum. 4. Pisiform. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 14. Multangular minor. 15. Centrale. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

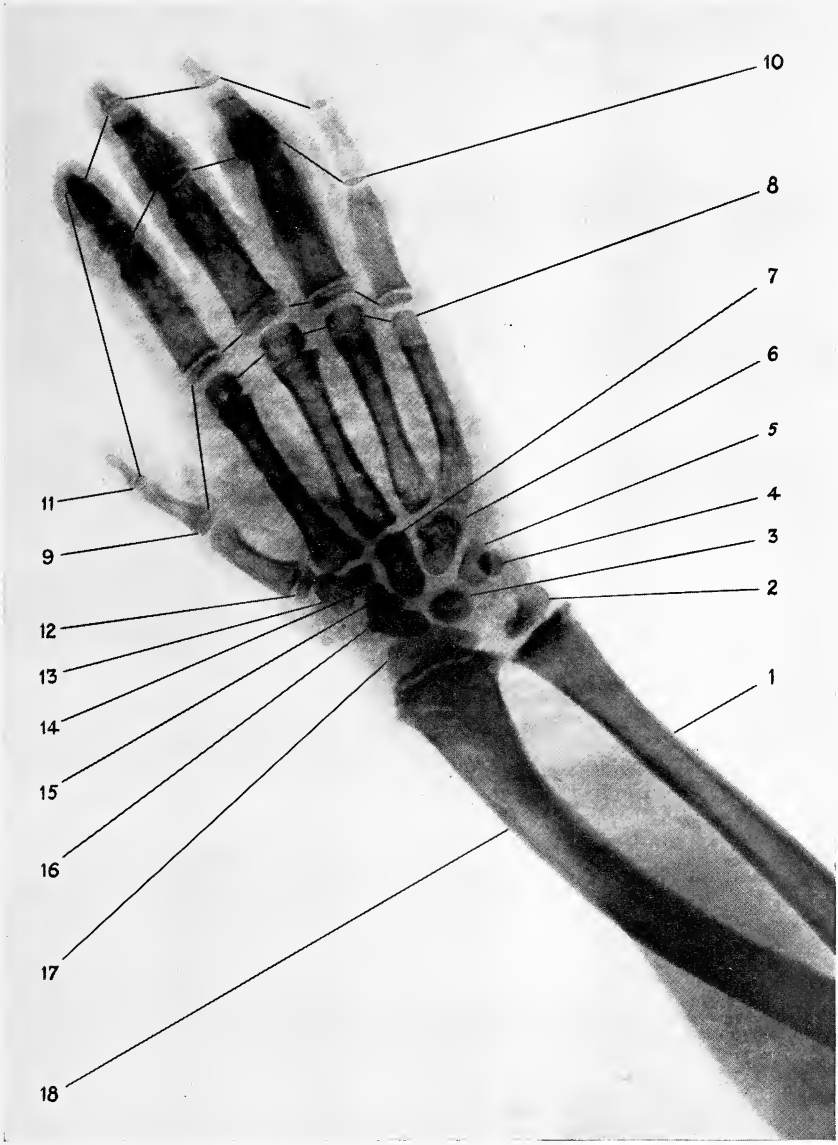

Fig. 72. Right Hand. Dorsal Aspect. 1. Ulna. 2. Distal epiphyses of ulna. 3. Lunatum. 4. Pisiform. 5. Triquetrum. 6. Hamatum. 7. Capitatum. 8. Distal epiphyses of 2-3-4-5 metacarpal bones. 9. Proximal epiphyses of first phalanx 1-2-3-4-5. 10. Proximal epiphyses of second phalanx 2-3-4-5. 11. Proximal epiphyses of third phalanx 1-2-3-4-5. 12. Proximal epiphyses of first metacarpal. 13. Multangular major. 14. Multangular minor. 15. Centrale. 16. Navicular. 17. Distal epiphyses of radius. 18. Radius.

DIGITAL EPIPHYSES AND CARPAL BONES IN THE GROWING INFANT F

CHARLES V. N

	Estimated Age in Months	Sitting Height in Centimeters	Weight in Kilograms	Dentition	Radius	Ulna	E
Stage 1. Specimen 1. C.A. 1105. Figs. 57 and 58	9 to 12	37.5	3.86	8 incisors 4 premolars Total 12	Slight Bowing	Relatively Straight	Ri Le
Stage 2. Specimen 2. Trixie Figs. 59 and 60	14 to 16	41.0	4.66	8 incisors 4 canines 4 1st premolars 4 2nd premolars milk dentition in process of completion See Note #1 Total 20	Slight Bowing	Relatively Straight	Ri Le
Stage 3. Specimen 3. McGregor Figs. 61 and 62	16 to 18	43.5	5.2	8 incisors 4 canines 4 1st premolars 4 2nd premolars Total 20	No Record	No Record	N N
11/3/28 Stage 4. Specimen 5. Penserosa Figs. 63 and 64	18 to 20	See Footnote No. 2. No record.	7.84	8 incisors 4 canines (Note #3) 4 1st premolars 4 2nd premolars Total 20	No Record	Radiograph of No Record	righ
3/10/29 State 5. Specimen 5. Penserosa Fig. 65	24 to 26	47.5	11.10	8 incisors 4 canines 4 1st premolars 4 2nd premolars Total 20	No Record	Radiograph of No Record	left R Le
Stage 6. Specimen 4. C.A. 1216 Figs. 67 and 68	24 to 30	53.0	Emaciated 10.9	Full set of milk teeth canines large. Total 20	No Record	No Record	R Le
3/2/30 Stage 7. Specimen 5. Penserosa Figs. 69 and 70	34 to 38	54.5	19.43	The four first permanent molars erupted during February and March 1930 Milk Teeth 20 Permanent Molars 4 Total 24	Bowed	Relatively Straight	R Le
7/25/30 Stage 8. Specimen 5. Penserosa Figs. 71 and 72	40 to 42	63.5	24.00	Milk Teeth 20 Permanent Molars 4 Total 24	Bowed	Relatively Straight	R Le

1. The upper right canine tooth has just erupted—
erupted—its tip is breaking through the gums.
Both upper second premolar teeth (right and left

2.

Date	Leng Crown-
May 18, 1929	72 centi
Mch. 3, 1930	86
Sept. 3, 1930	no recor

3. The canine teeth are not much higher than the

LA, WITH SITTING HEIGHT, WEIGHT, DENTITION AND ESTIMATED AGE
k Zoological Park

tal yses na	Carpal Bones in Probable Order of Appearance	Proximal Epiphyses First Metacarpal	Distal Epiphyses 2-3-4-5 Metacarpals	Proximal Epiphyses First Phalanx 1-2-3-4-5	Proximal Epiphyses Second Phalanx 2-3-4-5	Proximal Epiphyses Third Phalanx 1-2-3-4-5
Right ble	Capitatum (Magnum) Hamatum (Uneiform) Total 2	None Visible 0	Spherical and porous 2-3-4 Visible 3	Ovoid discs 2-3-4 Visible 3	None Visible 0	None Visible 0
and sible. arger.	Capitatum (Magnum) Hamatum (Unciform) Total 2	Both visible. One in each hand 1	Spherical and porous. 2-3-4-5. Visible 4.	Ovoid webbed discs in 2-3-4. The 5th is spherical and webbed Visible 4	Ovoid webbed discs. 2-3-4 Visible 3	None Visible 0
tive lear	Capitatum (Magnum) Hamatum (Unciform) Total 2	Both visible. One in each hand 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs 2-3-4-5 Visible 4	Contracted hand renders Negative poor
ht ble	Capitatum (Magnum) Hamatum (Unciform) Triquetrum (Cuneiform) Navicular (Scaphoid) Multangular major (Trapezium). Total 5	Right Visible 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 2-3-4-5 Visible 4		Ovoid webbed discs 2-3-4-5 Visible 4
and sible	Capitatum (Magnum) Hamatum (Unciform) Triquetrum (Cuneiform) Navicular (Scaphoid) Multangular major (Trapezium). Total 5	Both Visible Right and Left 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs 2-3-4-5 Visible 4
and sible	Capitatum (Magnum) Hamatum (Unciform) Triquetrum (Cuneiform) Navicular (Scaphoid) Multangular major (Trapezium). Total 5.	Both Visible Right and Left 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5
and isible	Capitatum (Magnum) Hamatum (Unciform) Triquetrum (Cuneiform) Navicular (Scaphoid) Multangular major (Trapezium) Multangular minor (Trapezoid) Lunatum (Lunar) Pisiforme (Pisiform) Centralia (Centrale) Total 9	Both Visible Right and Left 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5
and isible	Same—no fusion of centralia and navicular Total 9	Both Visible Right and Left 1	Spherical and webbed 2-3-4-5 Fusion in right hand Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs. 1-2-3-4-5 Fusion in second Visible 5

e gums. The upper left canine tooth has not quite
f lower canine teeth are just coming through the
l gums. All the lower premolar teeth (4) have erupted.

Sitting Height Crown-Rump	Span (Lying on Back, Arms Outstretched)
47.5 centimeters	106 centimeters
54.5 "	122 "
63.5 "	130 "

DIGITAL EPIPHYSES AND CARPAL BONES IN THE GROWING INFANT FEMALE GORILLA, WITH SITTING HEIGHT, WEIGHT, DENTITION AND ESTIMATED AGE

CHARLES V. NOBACK, New York Zoological Park

	Estimated Age in Months	Sitting Height in Centimeters	Weight in Kilograms	Dentition	Radius	Ulna	Digital Epiphyses Radius
Stage 1. Specimen 1. C.A. 1105. Figs. 57 and 58	9 to 12	37.5	3.86	8 incisors 4 premolars Total 12	Slight Bowing	Relatively Straight	Right Left
Stage 2. Specimen 2. Trixie Figs. 59 and 60	14 to 16	41.0	4.66	8 incisors 4 canines 4 1st premolars 4 2nd premolars milk dentition in process of completion See Note 1 Total 20	Slight Bowing	Relatively Straight	Right Left
Stage 3. Specimen 3. McGregor Figs. 61 and 62	16 to 18	43.5	5.2	8 incisors 4 canines 4 1st premolars 4 2nd premolars Total 20	No Record	No Record	Not clear
11/3/28 Stage 4. Specimen 5. Penserosa Figs. 63 and 64	18 to 20	See Footnote No. 2. No record.	7.84	8 incisors 4 canines (Note 3) 4 1st premolars 4 2nd premolars Total 20	No Record	Radiograph of right hand No Record	Right Visible
3/10/29 State 5. Specimen 5. Penserosa Fig. 65	24 to 26	47.5	11.10	8 incisors 4 canines 4 1st premolars 4 2nd premolars Total 20	No Record	Radiograph of left hand No Record	Right Left
Stage 6. Specimen 4. C.A. 1216 Figs. 67 and 68	24 to 30	53.0	Emaciated 10.9	Full set of milk teeth canines large. Total 20	No Record	No Record	Right Left
3/2/30 Stage 7. Specimen 5. Penserosa Figs. 69 and 70	34 to 38	54.5	19.43	The four first permanent molars erupted during February and March 1930 Milk Teeth 20 Permanent Molars 4 Total 24	Bowed	Relatively Straight	Right Left
7/25/30 Stage 8. Specimen 5. Penserosa Figs. 71 and 72	40 to 42	63.5	24.00	Milk Teeth 20 Permanent Molars 4 Total 24	Bowed	Relatively Straight	Right Left

Carpal Bones in Probable Order of Appearance	Proximal Epiphyses First Metacarpal	Distal Epiphyses 2-3-4-5 Metacarpals	Proximal Epiphyses First Phalanx 1-2-3-4-5	Proximal Epiphyses Second Phalanx 2-3-4-5	Proximal Epiphyses Third Phalanx 1-2-3-4-5
Capitatum (Magnum) Hamatum (Unciform) Total 2	None Visible 0	Spherical and porous 2-3-4 Visible 3	Ovoid discs 2-3-4 Visible 3	None Visible 0	None Visible 0
Capitatum (Magnum) Hamatum (Unciform) Total 2	Both visible. One in each hand 1	Spherical and porous. 2-3-4-5. Visible 4	Ovoid webbed discs in 2-3-4. The 5th is spherical and webbed Visible 4	Ovoid webbed discs. 2-3-4 Visible 3	None Visible 0
Capitatum (Magnum) Hamatum (Unciform) Total 2	Both visible. One in each hand 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs 2-3-4-5 Visible 4	Contracted hand renders Negative poor
Capitatum (Magnum) Hamatum (Unciform) Triquetrum (Cuneiform) Navicular (Scaphoid) Multangular major (Trapezium). Total 5	Right Visible 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 2-3-4-5 Visible 4		Ovoid webbed discs 2-3-4-5 Visible 4
Capitatum (Magnum) Hamatum (Unciform) Triquetrum (Cuneiform) Navicular (Scaphoid) Multangular major (Trapezium). Total 5	Both Visible Right and Left 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs 2-3-4-5 Visible 4
Capitatum (Magnum) Hamatum (Unciform) Triquetrum (Cuneiform) Navicular (Scaphoid) Multangular major (Trapezium). Total 5.	Both Visible Right and Left 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5
Capitatum (Magnum) Hamatum (Unciform) Triquetrum (Cuneiform) Navicular (Scaphoid) Multangular major (Trapezium) Multangular minor (Trapezoid) Lunatum (Lunar) Pisiforme (Pisiform) Centralia (Centrale) Total 9	Both Visible Right and Left 1	Spherical and webbed 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5
Same—no fusion of centralia and navicular Total 9	Both Visible Right and Left 1	Spherical and webbed 2-3-4-5 Fusion in right hand Visible 4	Ovoid webbed discs 1-2-3-4-5 Visible 5	Ovoid webbed discs 2-3-4-5 Visible 4	Ovoid webbed discs. 1-2-3-4-5 Fusion in second Visible 5

1. The upper right canine tooth has just erupted—[illegible] gums. The upper left canine tooth has not quite erupted—its tip is breaking through the gums. [illegible] lower canine teeth are just coming through the gums. Both upper second premolar teeth (right and left [illegible] crime. All the lower premolar teeth (4) have erupted.

2.

Date	Length Crown-Rump	Sitting Height Crown-Rump	Span (Lying on Back, Arms Outstretched)
May 18, 1929	72 centimeters	47.5 centimeters	106 centimeters
Mch. 3, 1930	86 "	54.5 "	122 "
Sept. 3, 1930	no record	63.5 "	130 "

3. The canine teeth are not much higher than the [illegible]

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ZOOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE
NEW YORK ZOOLOGICAL SOCIETY

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THE GREAT SMOKY MOUNTAINS
WITH PRELIMINARY NOTES ON THE SALAMANDERS OF MT. LECONTE AND LECONTE CREEK

By GERVASE W. MCCLURE, M. A.

Research Fellow
New York Zoological Society
New York University

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THE GREAT SMOKY MOUNTAINS
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Research Fellow
New York Zoological Society
New York University

(Figs. 73-82 incl.)

OUTLINE

I. Introduction.

During the year 1928-29, the writer submitted a thesis entitled, "An Ecological Study of the Distribution of Animals on Mt. LeConte, and along LeConte Creek," to the Graduate Committee of the University of Tennessee in partial fulfillment of the requirements for the degree of Master of Arts. The thesis was the result of a study of the Great Smoky Mountains and a preliminary ecological survey of the distribution of its fauna, based on observations and collections. The collection is composed of a large number of snails, crayfishes, spiders, insects, salamanders, toads, lizards, snakes, and others. From this collection the identification of the salamanders has been made, and it was thought advisable to publish a brief description of the Smoky Mountains, together with the notes on salamanders.

II. Acknowledgments.

The writer wishes to express his gratitude to Dr. E. B. Powers, Department of Zoology, University of Tennessee, who has offered many helpful suggestions throughout the year; and to Dr. G. K. Noble, and associates, Department of Herpetology, American Museum of Natural History, New York City, who identified the various specimens of the collection.

Thanks are due to Mr. James E. Thompson, Knoxville, Tennessee, who furnished photographs illustrating the various habitats.

Grateful acknowledgments are due the New York Zoological Society for the publication; and Dr. Horace W. Stunkard, New York University, for assisting in the preparation of the manuscript.

III. The Great Smoky Mountains.

Location.

The term Smoky Mountains is somewhat synonymous with the Unaka Mountains which continue westward along the entire border line between Tennessee and North Carolina to Georgia. But that part of this range bounded by the Pigeon River which breaks through from North Carolina on the northwest, and the

Little Tennessee River on the southwest can be called the Great Smoky Mountains proper.

Physiography.

The entire length of the Smoky Mountains, which is approximately sixty miles, for the most part, forms the water divide between Tennessee and North Carolina. The width of the mountains varies extensively, but is approximately thirty miles. The acreage has been estimated to be more than 450,000. The altitude varies from 1,500 to over 6,600 feet above sea level, forming the steepest vegetative slopes in America. The temperature varies from 100 degrees F. at the base in the hot summer days to 20 degrees F. below zero on the summit in the coldest winter nights.

Geology.

Geologically the Great Smoky Mountains are the oldest mountains in America. They are composed of limestones, shales, slates, sandstones, quartzites, conglomerates, gneisses, schists, and perhaps granite. They range from the Mississippian to the Archean period, and most of them are Pre-Cambrian. They are apparently non-fossiliferous. So far as is known there are no mineral or ore deposits of economic importance found in this locality.

Peaks.

For more than twenty-eight miles, the crest of the mountain rises more than a mile above sea level. Among the most important peaks are Mount Cuyot, Clingman's Dome, Siler's Bald, Thunderhead, Laurel Top, Mount Collins, Briar Knob, and many others. But the most outstanding is Mount LeConte.

Streams.

The region as a whole is mesophytic. Scarcely does a day pass that there is not a drenching rainfall in some section. Hence there are numerous streams throughout the whole mountain region. Among the largest, as known by the natives, are Little Tennessee, Little River, Little Pigeon, and Pigeon, with their tributaries.

Coves.

There are numbers of rich coves at the base of the mountains that are inhabited by Anglo-Saxon stock. Among these are Jones Cove, Emerts Cove, Wears Cove (Valley), Tuckaleechee Cove, Cades Cove, Cosby Cove, and many others.

Trees.

The forest as a whole may be classed as deciduous, although coniferous trees dominate the summits of the higher peaks and may be found throughout the slopes. The hard woods include many species, chief of which are poplar, basswood, white oak, black oak, chestnut, sugar maple, buckeye, birch, and beech. The soft woods consist of white pine, shortleaf yellow pine, hemlock, spruce, balsam, Virginia scrub pine, and pitch pine.

Shrubs and Plants.

Among the trees along the slopes are found mountain laurel (ivy), rhododendron, sand myrtle, dogwood, redbud, vacinium, dog hobble, flame azalea, trilliums, orchids, trailing arbutus, Virginia bluebells, sorrel, violets of many species, and over two hundred varieties of flowering shrubs and plants varying from semi-tropical to those of the Canadian region.

Ferns, Liverworts, and Mosses.

There is a great number of ferns, liverworts, and mosses throughout the entire section. In many places the ground and ledges are completely covered, especially at the higher altitudes, where large beds of sphagnum and mountain fern-moss form a carpet more than a foot deep.

Animal Life.

To the average person, animal life may appear comparatively scarce. Yet a naturalist may find an abundance of wild life in the various habitats. Among the lower levels, occur animals that are common in East Tennessee. A large variety of snails, spiders, centipeds, including scorpions, are typical. Of the insects most of the orders are represented by one or more species. Spring-tails (Collembola) are abundant on the moist ground

everywhere. Grasshoppers, crickets, katy-dids, and cockroaches are abundant on the forest margin and lower slopes. May-flies and stone-flies are found near the water, and the nymphs are abundant in the swift streams. A few dragon-flies may also be found. There is a large number of hemipterous insects found both in the water and on the flora. Of the beetles, ground and wood-boring species are more prominent. Scorpion-flies may be noted in the thick field strata along the trails. In the streams numerous caddice-fly nymphs may be found. Butterflies and hymenopterous insects are found wherever there are flowers at any level.

In many of the streams and brooks there can be found bass, perch, rainbow, and speckled trout. Many other species of fish, common in East Tennessee, may be found in the lower altitudes.

The most abundant of all amphibia are the salamanders. They abound in the streams and moist slopes, and may be collected in any locality. Toads are abundant, while frogs are found in the low altitudes.

Several species of lizards are found along the forest margin. There are also a few land and fresh water turtles.

A few varieties of snakes are found. The two most dreaded are the rattler and copperhead, these being the only two known to possess poisonous fangs. The black snake, blue-racer, fox snake, water snake, garter snake, king snake, and the small ring necked snake are present, but are not often encountered.

The summer-dwelling birds number less than one hundred species. Among the most common, dwelling near the settlements and along the mountain sides, are sparrows, bobwhites, doves, woodpeckers, flickers, goldfinches, towhees, cardinals, indigo buntings, yellow-breasted chats, wood thrushes, brown thrashers, wrens, robins, and various warblers. Those that choose the higher altitudes are the ruffed grouse, wild turkey, yellow-bellied sapsucker, Canada warbler, Wilson thrush, brown creeper, pheasant, golden eagle, northern raven, and the duck hawk. Chimney swifts, chickadees, and the Carolina juncos are most abundant.

Many of the mammals that once roamed the forest have become extinct. Others have become so scarce that weeks are re-

quired to locate them. Among the animals that are left in the Smokies are the Virginia oppossum, Virginia deer, wood hare, Carolina wood vole (mouse), woodchuck, eastern chipmunk, red squirrel, raccoon, Carolina weasel, Carolina skunk, American black bear, gray fox, red fox, wild cat, shrew, and bats.

Summary.

The Great Smoky Mountain section of North Carolina and Tennessee is noted for its ruggedness of area, its variation of altitude and temperature, its geological age, its humid atmosphere, its unparalleled variety of trees, flowering shrubs and plants, and its innumerable host of animal life. These have attracted scientists and nature-loving tourists from every part of the United States, and from many parts of the world.

The great demand for the preservation of this virgin forest, has inspired public spirited citizens to purchase the holdings of private lumber companies and soon this section will become "The Great Smoky Mountain National Park".

IV. Description of LeConte Creek

A close observation of the valley has been made and it has been zoned according to the vegetation, which is composed of virgin timber. Each zone was divided into plots, one thousand feet in length.

Chestnut Zone.

The first zone extends approximately one and one-half miles, and includes the first seven plots. It is largely composed of oaks, birches, buckeyes, poplars, and beeches, which attain a very large size. But the dominant tree is the chestnut; this is being destroyed by the chestnut blight and apparently is being replaced by oaks. Numerous shrubs and plants are present. A number of large trees have fallen and are in a decaying state.

The stream in this zone has an average of about 10 percent fall and is for the most part shallow, containing numerous large boulders, some of which are covered with moss and rock ferns. Several deep pools are formed where the water plunges over large rocks. Two or three small islands are formed at the bases of the coves; these contain trees and other vegetation.

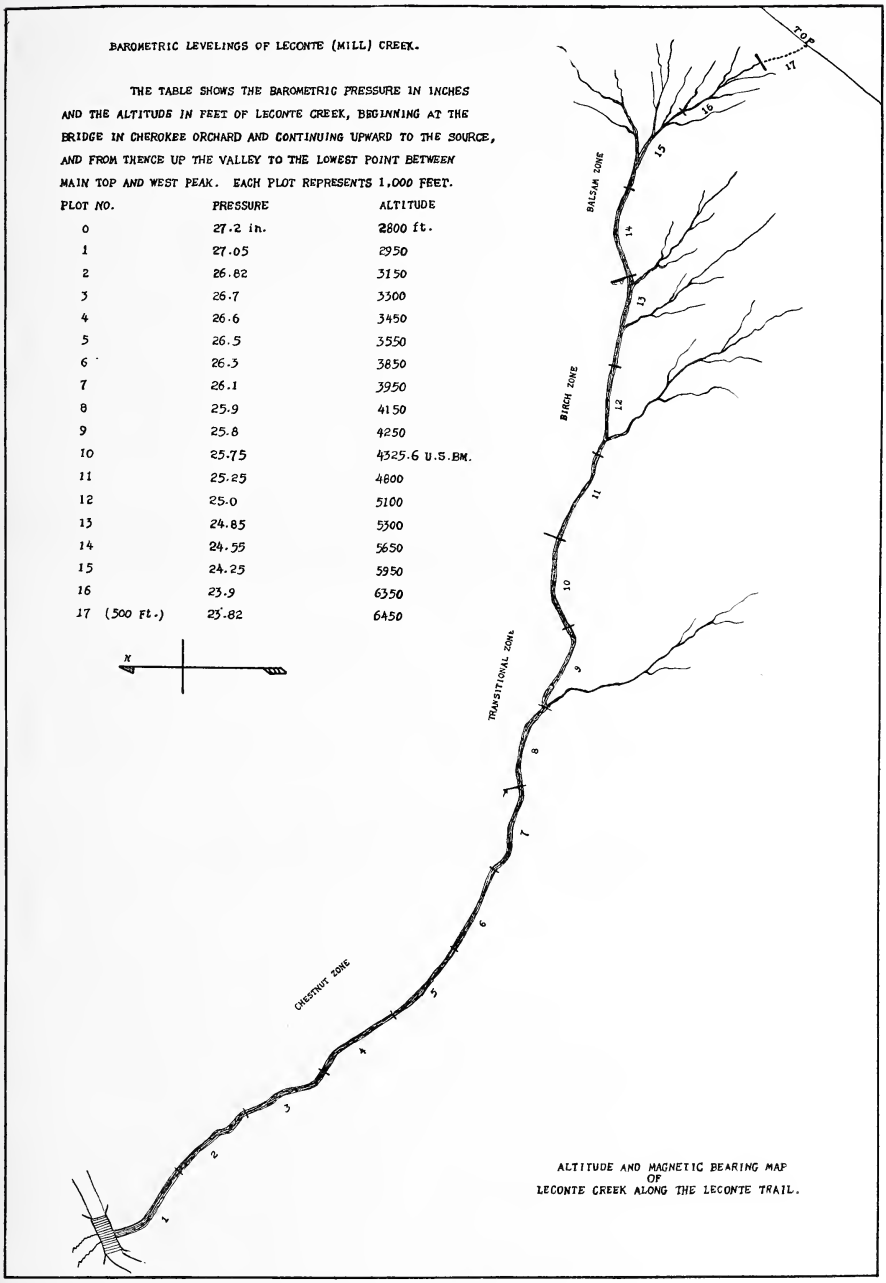

BAROMETRIC LEVELINGS OF LECONTE (MILL) CREEK.
THE TABLE SHOWS THE BAROMETRIC PRESSURE IN INCHES AND THE ALTITUDE IN FEET OF LECONTE CREEK, BEGINNING AT THE BRIDGE IN CHEROKEE ORCHARD AND CONTINUING UPWARD TO THE SOURCE, AND FROM THENCE UP THE VALLEY TO THE LOWEST POINT BETWEEN MAIN TOP AND WEST PEAK. EACH PLOT REPRESENTS 1,000 FEET.
PLOT NO. PRESSURE ALTITUDE
0 27.2 in. 2800 ft.
1 27.05 2950
2 26.82 3150
3 26.7 3300
4 26.6 3450
5 26.5 3550
6 26.3 3850
7 26.1 3950
8 25.9 4150
9 25.8 4250
10 25.75 4325.6 U.S.BM.
11 25.25 4800
12 25.0 5100
13 24.85 5300
14 24.55 5650
15 24.25 5950
16 23.9 6350
17 (500 Ft.) 23.82 6450
N
CHESTNUT ZONE
TRANSITIONAL ZONE
BIRCH ZONE
BALSAM ZONE
ALTITUDE AND MAGNETIC BEARING MAP OF LECONTE CREEK ALONG THE LECONTE TRAIL.

Figure 74.

than 450,000 acres of virgin forest. Mount LeConte rises 6,680 feet above sea one of the steepest vegetative slopes in America.
E. Thompson, Knoxville, Tennessee.

The trees are not as large as those in the previous zone, but are, however, much thicker and taller. The dominant tree is not outstanding and has not been determined.

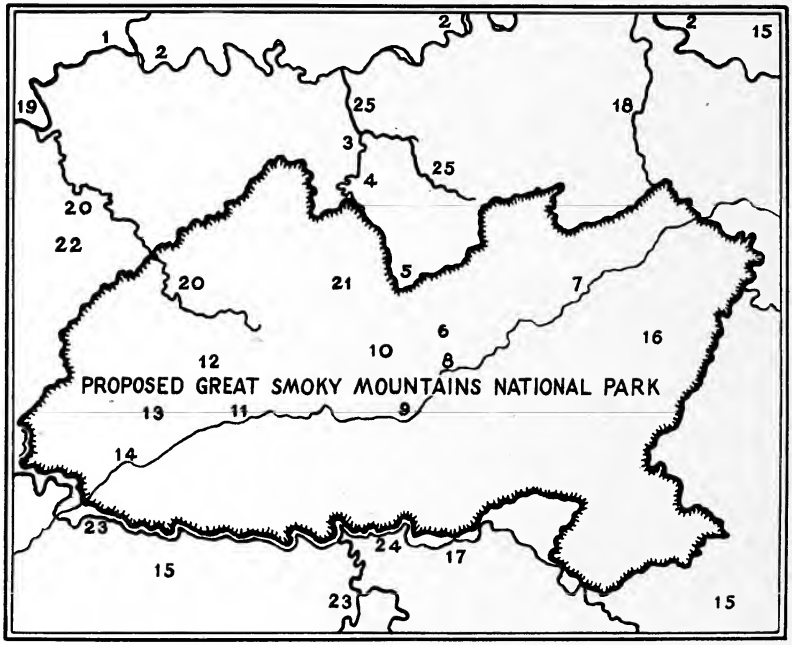
The stream has an average fall of 10 percent. It contains larger boulders, than the previous zone, and is intercepted by many falls and rapids. A small branch enters from the west about mid-way of the zone. The valley is not as wide in this zone, but the slopes are steeper. Rhododendron covers the entire west side of the valley to the water's edge. On the east, large cliffs are prominent, and large rocks prevail throughout the entire zone.

Fig. 73. The proposed Great Smoky Mountains National Park includes more level, and over a mile above its base, forming
Photograph and copyright by James

The slopes of the valley vary somewhat, but in general they are not very steep. An old deserted house and two log barns stand within a few hundred feet of the stream at the edge of the Cherokee Orchard which continues about one-half of the zone. The LeConte trail leads along the left side of the stream the entire length of the Chestnut Zone.

Transitional Zone.

This zone, which extends approximately 3000 feet and includes the next three plots, ends at Rainbow Fall. It consists of hemlock, buckeye, hard maple, red maple, black cherry, white ash, birch, oak, and many small shrubs, plants, mosses and ferns.



OUTLINE MAP OF SMOKY MOUNTAINS NATIONAL PARK

Fig. 75. This outline map of the Great Smoky Mountains National Park area is reproduced from the U. S. Geological Survey Topographic Map and keyed to indicate location of points of interest in and around the park, and more prominent land-marks. The Tennessee-North Carolina boundary line is shown extending across the park, and about equally dividing it between the two states. The total area of the park extends about sixty miles east and west, and about thirty miles north and south at the widest point. The key figures indicate: 1, Knoxville, Tennessee; 2, French Broad River; 3, Sevierville, Tennessee; 4, West Fork Little Pigeon River; 5, Gatlinburg; 6, Mount LeConte (6580 feet); 7, Mount Guyot (6636 feet); 8, Indian Gap; 9, Clingman's Dome (6680 feet); 10, Sugarland Mountain; 11, Thunderhead; 12, Rich Mountain; 13, Cade's Cove; 14, Gregory Bald; 15, Pisgah National Forest; 16, Balsam Mountain; 17, Bryson City, North Carolina; 18, Pigeon River; 19, Tennessee River; 20, Little River; 21, Norton Big Trees; 22, Maryville, Tennessee; 23, Little Tennessee River; 24, Tackasegee River; 25, Little Pigeon River.

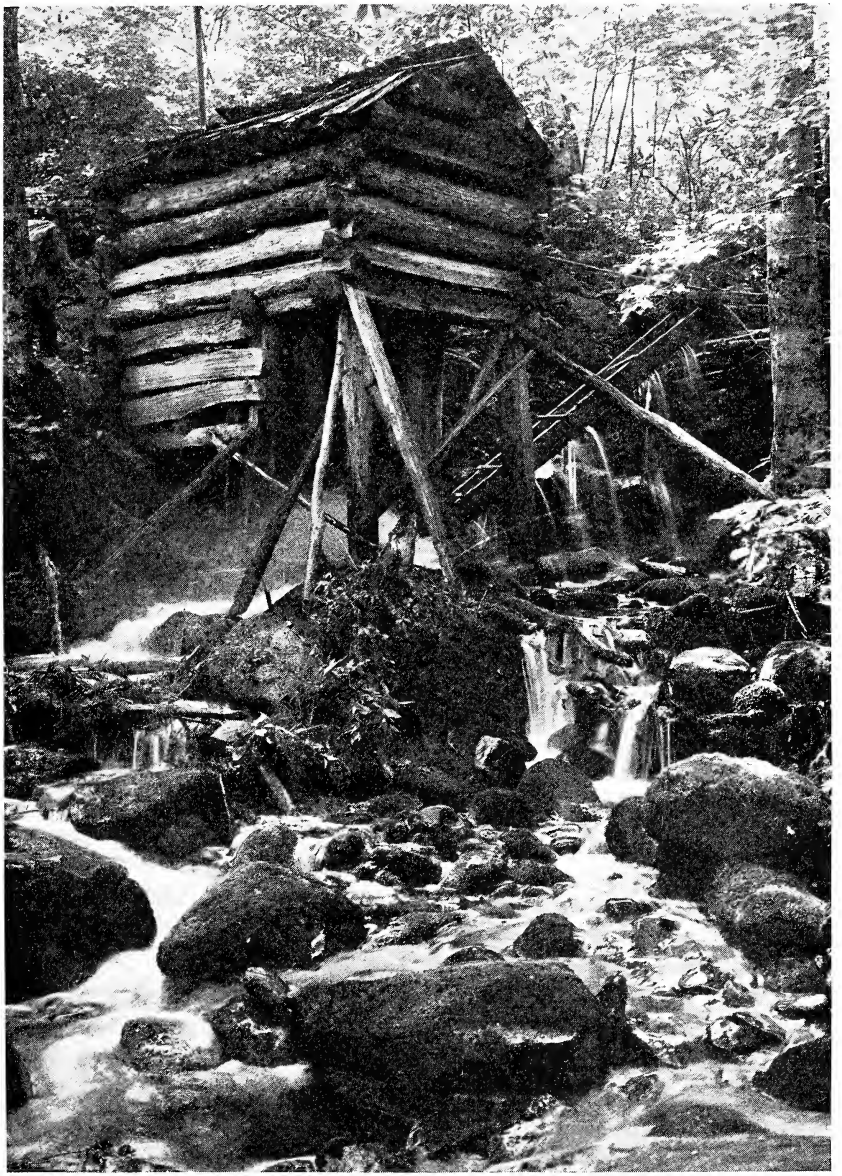


Fig. 76. The old grist-mill, in Cherokee Orchard, is an ideal relic of pioneer days. Numerous large boulders partially covered with moss are prevalent throughout the Chestnut Zone. Photograph and copyright by James E. Thompson.

Fig. 77. Water-falls and small rapids intercept the stream forming whirlpools and eddys where salamander larvae abound under decaying leaves near the water's edge. A scene in the Chestnut Zone. Photograph and copyright by James E. Thompson.

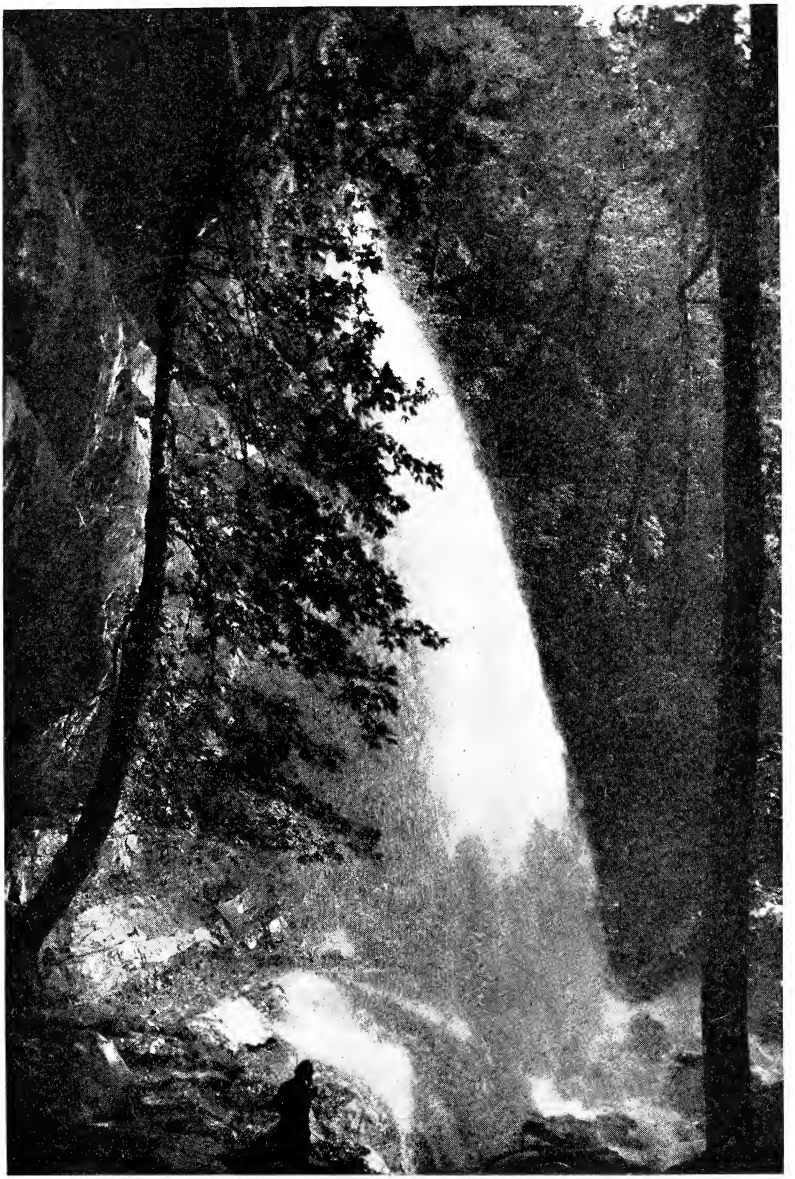


Fig. 78. Rainbow Falls marks the end of the Transitional Zone, and is the only natural barrier in the entire stream. The altitude at the top is 4,325.6 U. S. BM. The water makes a plunge of eighty-five feet. The photograph was taken after a heavy rainfall. Photograph and copyright by James E. Thompson.

Fig. 79. Giant ferns and birch trees cover the side of Gregory Bald. This scene is typical of the Birch Zone of Mt. LeConte. Photograph and copyright by James E. Thompson

The trail leads along the east side of the stream the entire length of the Transitional Zone.

Birch Zone.

This zone includes the next three plots, and is composed of birch, buckeye, balsam, spruce, white maple, viburnum, and rhododendron. The trees are larger and not as thick in the lower altitudes as they are higher up in the zone. In the openings there is a variety of flowering plants. Moss and ferns are prevalent.

At Rainbow Falls the stream is wide and as one ascends it becomes narrower and swifter, having a fall of 32 percent. The falls are larger and the rapids more frequent than in any other zone.

In general the valley becomes somewhat narrow, and the slopes very steep. The large boulders and cliffs are partially covered with moss and ferns. About a third of the way, a small stream flows from the west. Here the valley is somewhat wider. At the upper end of the zone there is a small western cove, from which flows another stream. Here a small delta has been formed upon which are a few large trees.

The trail crosses the creek twice in the Birch Zone.

Balsam Zone.

This zone includes the last three and one-half plots of our area. It is composed of balsam, spruce, red cherry and white ash, which are typical of Canadian forests. Balsam is by far the most abundant. The trees are so thick that the ground is continually shaded. White maple, viburnum, and huckle-berry shrubs are prevalent on the crest. After a short transitional section the ground is completely covered with fern-moss, sorrel, and ferns.

Here we find the stream steepest, having a fall of 34 percent. After a few hundred feet there are very few large boulders and high cliffs. The stream is fed by a large number of seeps a few hundred feet from the crest, which is directly between Main Top and West Peak.

After a few hundred feet the valley widens extensively and forms a long gentle slope.

Near the top the trail leaves the stream and leads directly east one-half mile to LeConte Lodge.

Summary.

According to the United States Biological Survey, Fourth Provisional Zone Map, the forest ranges from the Transition to the Canadian. The summit is covered with fir, typical of this zone. Sphagnum, fern-moss and ferns completely cover the ground. As one descends the mountain the deciduous forest appears, principally birch and buckeye. Replacing these at a lower level are the chestnuts and oaks.

The stream is classed hydropsyche, containing numerous falls, rapids, large boulders, a few deep pools and shoals.

The entire valley contains virgin forest, flowering shrubs, and plants. The slopes are steep, containing many cliffs practically covered with moss and ferns. Numerous boulders are exposed along the valley for the most part.

The best approach to Mt. LeConte is by way of Cherokee orchard where the last residence is left behind. For more than three miles a trail, too rough and steep for pack horses, follows LeConte Creek to a small lodge on the summit.

V. The Problem.

So little attention has been given to the fauna of this region from an ecological stand-point that any comprehensive attempt on my part would seem futile. Nevertheless, there is an unusual opportunity to study life, environment and heredity in its natural state undisturbed by the agencies of man.

Mt. LeConte is typical of the whole region and this section was selected for the present survey.

The problem chosen for this report deals only with the salamanders, and is two-fold: First, to determine the number of species found; and second, to determine the distribution of the different species.

VI. Technique and Methods.

During the winter months numerous trips were made to Mt. LeConte and winter conditions were studied. During this time

plans were formulated for the survey. On May 15, temporary headquarters were made above Rainbow Falls. Through the coöperation of J. Walter White and R. F. McClure the entire stream, beginning at the Cherokee Orchard and continuing upward to the point directly between Main Top and West Peak, was surveyed and plotted. A United States Engineering compass was used to secure the calls. An ordinary chain was used to measure the distance. At the end of each thousand feet the pressure and altitude were recorded. The data were made with an aneroid barometer checked at United States Bench Marks. A metal tag, with the plot number, was tacked to a tree at the end of each plot. So far as was possible all collections were made under uniform weather conditions. The time consumed at each plot was approximately equal. The animals were collected in their natural habitats without the use of trapping, baiting, or any method of congregating them.

A dip net was used for specimens found in the stream. Adult specimens were found near the stream by turning over stones, logs, and moss. The animals from each plot were collected and preserved in separate jars or vials in ten percent formaldehyde. Each container was labelled, giving the plot number and date.

The following table shows the distribution of salamanders collected along LeConte Creek. The figures at the top indicate the plot from which the salamanders were taken.

TABLE I.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Desmognathus quadra-maculatus.	0	0	2	3	3	3	6	9	13	23	8	4	3	5	3	0	0	85
Desmognathus phoca.	1	0	2	0	1	1	1	1	2	2	0	0	1	0	0	1	0	13
Desmognathus fuscus carolinensis	0	2	1	1	2	1	1	2	2	2	3	5	1	1	2	3	0	29
Plethodon jordani.	0	1	0	0	0	1	2	1	3	1	1	1	2	5	8	13	19	38
Cyrinophilus danielsi.	0	0	0	0	0	0	0	0	1	0	3	0	2	0	0	0	0	6
Eurycea bislineata wilderae.	0	1	1	4	2	5	1	2	3	2	0	1	1	0	0	1	0	24
Desmognathus larvae.	3	9	7	19	30	32	26	20	19	29	2	8	2	3	2	1	0	212
Total.	4	13	13	27	38	43	37	35	43	59	17	19	12	14	15	19	19	407

VII. Discussion.

The Salamanders collected from this locality belong to a single Family, the Plethodontidae.

Desmognathus quadra-maculata (Holbrook).

These specimens are semi-aquatic, living in or near the stream, and when disturbed, plunge into the water and are difficult to collect once they hide under large rocks.

The first specimens were collected in Plot No. 3, at an altitude of 3150 feet. There is a steady increase in number of specimens encountered, to the end of the Transitional Zone. Rainbow Falls marks the end of the Transitional Zone, and is the only natural barrier in the entire stream. The altitude at the top is 4325.6 U.S. B.M. Here the water makes a plunge of 85 feet, and while the falls itself is only a few feet wide, the cliff is more than 300 feet wide. As many as 52 specimens have been counted lying upon the moist rocks by the observer at one time. Only a few specimens were observed above the Falls, and not any were found above an altitude of 6000 feet.

In the summer of 1930, 33 specimens were collected in the Transitional Zone.

Desmognathus phoca (Matthes).

This species seemed to be very evenly distributed along LeConte Creek. They are found most frequently in the water, but may be encountered some distance from the stream under the thick moss or bark of decaying logs.

Desmognathus fuscus carolinensis (Dunn).

This species is more or less terrestrial, and occupies the slopes rather than the streams. Occasionally one may be taken from or near the stream. They, like Desmognathus phoca, seem to be very evenly distributed along LeConte Creek.

Plethodon jordani Blatchley.

This species is found only in the Great Smoky Mountains. It occupies the tops of many of the highest peaks. It is terrestrial, and may be found under decaying logs and moss. The first was collected at an altitude of 3000 feet, but they are more abund-

ant above 5000 feet. Only a few were collected, but large numbers were observed under the moss from decaying logs. It is interesting to note the color variation of the red cheeks.

Gyrinophilus danielsi (Blatchley).

This species is not very frequently encountered. One larva was taken from the Transitional Zone, and five adults from the Birch Zone. The adult is very sluggish, and the five specimens were taken at night near the stream, at an altitude of above 5000 feet.

Eurycea bislineata wilderae Dunn.

This species is the most attractive of the salamanders in the collection. It is very evenly distributed along the stream. They are terrestrial, living under rocks and decaying logs.

Larvae.

A large number of larvae was taken from the water. They abound in the shallow pools under fallen leaves, and are most abundant in the Chestnut Zone.

VIII. Summary.

This paper contains a brief description of the Great Smoky Mountain area, emphasizing its unparalleled variety of flora, and listing a large number of its fauna. A more detailed description of Mt. LeConte and LeConte Creek is given together with photographs illustrating the vegetation of various Zones.

The problem and procedure is clear. The results are based on observations and collections of more than four hundred specimens of salamanders.

1. Six species belonging to four genera, and a single Family, were found in the section studied.

2. The distribution of the salamanders collected are tabulated in Table I. Conclusions based on this Table are as follows:

a. *Desmognathus phoca, Desmognathus fuscus carolinensis,* and *Eurycea bislineata wilderae* appear somewhat evenly distributed throughout the area studied.

ind this a haven of rest after a long climb up the mountain side. Fig. 81. **Below:** Dense
a foot thick. Note the decaying logs where numbers of red-cheeked salamanders
may be collected.

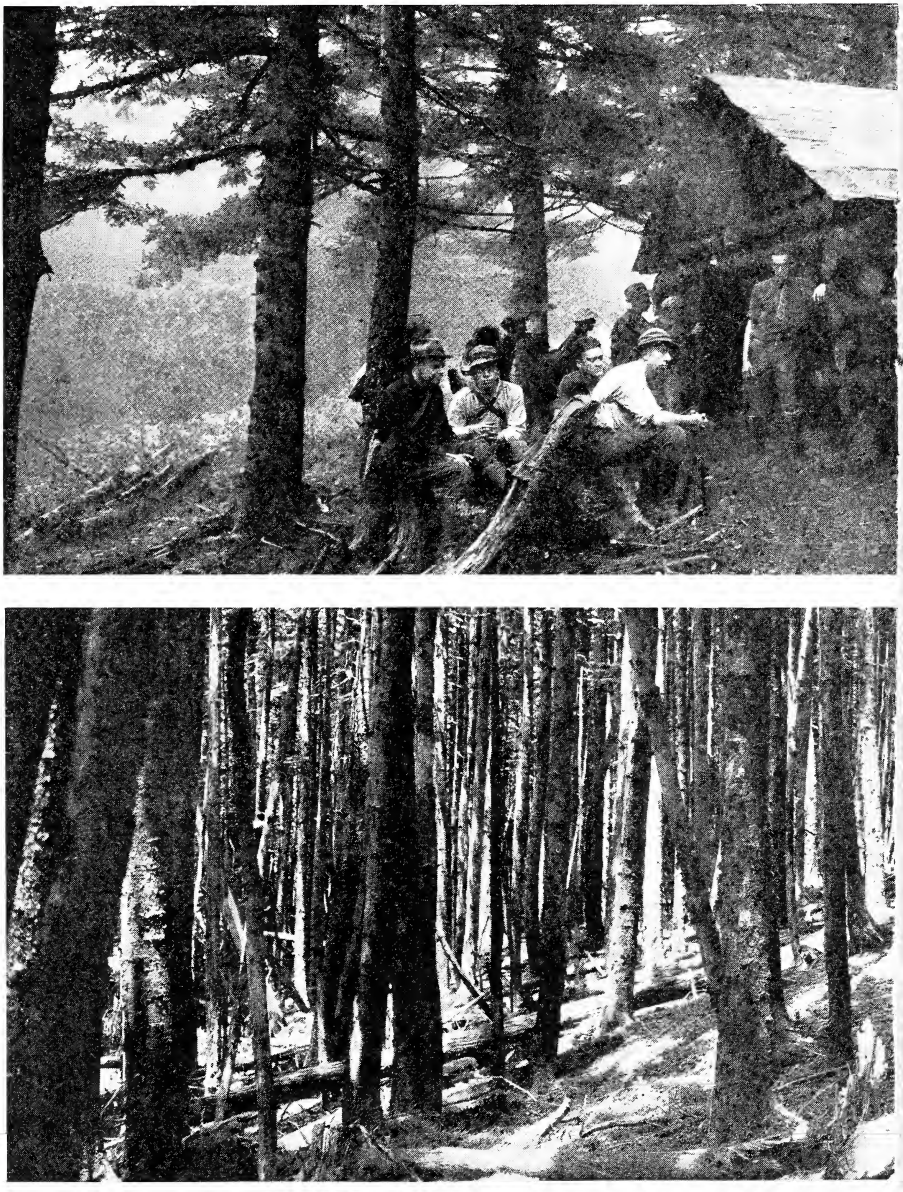


Fig. 80. **Above:** The LeConte Lodge is located on the summit of Mt. LeConte. Hikers
growth of balsam shadow the ground where fern-moss forms a carpet more tha
Plethodon jordani

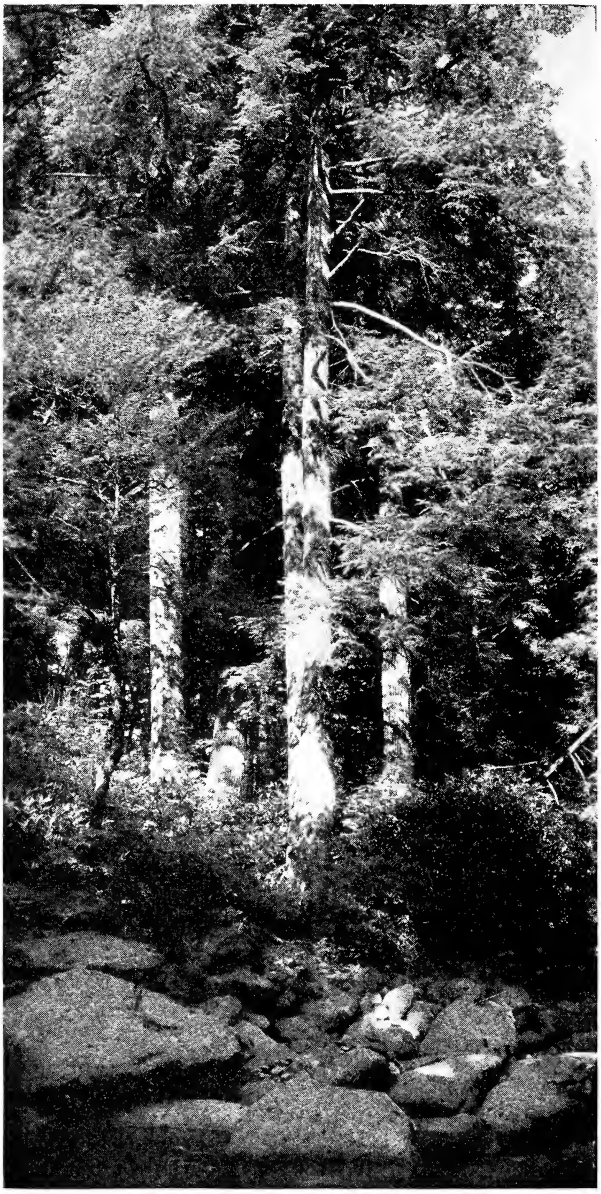


Fig. 82. Tall trees crowd the forest to the water's edge high in the Balsam Zone of the Great Smoky Mountains. Photograph and copyright by James E. Thompson.

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NOTES ON CERTAIN BIRDS OF PARADISE

By Lee S. Crandall

Curator of Birds, New York Zoological Park

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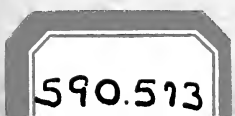

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NOTES ON CERTAIN BIRDS OF PARADISE*

By Lee S. Crandall

Curator of Birds, New York Zoological Park

The following notes represent a rather miscellaneous collection of personal observations on various birds of paradise living in the New York Zoological Park. No attempt has been made to present complete accounts of the species mentioned. Some of these birds were collected by the New York Zoological Society's expedition to New Guinea[1] in 1928–9, in which Mr. J. E. Ward and the writer participated. Others have been gathered from various sources, usually through dealers, so that, beyond the known range of the form in question, there is no means of determining exact localities.

Prince Rudolph's Blue Bird of Paradise

Paradisornis rudolfi Finsch

My notes on the curious, inverted display of the male of this species have already been printed.[2] Displays by female birds of paradise, while unusual, are not unknown and I have the following description of such a display by a female blue bird of paradise, made on March 19, 1923. The sex of this bird was later confirmed by post-mortem examination.

Hanging upside-down from top of cage, legs fully extended. Wings slightly spread, breast feathers expanded laterally, just projecting beyond wings, and turned slightly forward. Tail pressed forward, between legs, until nearly horizontal. Head not turned upward as high as cock's in display, and eyes not closed. Vibrated backward and forward from hips, like the cock, and also occasionally drew her body upward to horizontal position. Also vibrated rapidly up and down, bending leg joints. Very persistent and almost impossible to disturb, although not ordinarily a particularly tame bird.

In general, this display of the female is similar to that of the male, but there are several striking differences. I have never seen

* Submitted for publication, November 16, 1932. To press December 3, 1932.

[1] New York Zoological Society Bulletin, Vol. XXXII, No. 6.

[2] New York Zoological Society Bulletin, Vol. XXIV, No. 5, pp. 111–113, also "Paradise Quest" (1931) pp. 107–108.

a male move his tail into the horizontal position, or "vibrate up and down." During display, the male sings constantly, in a low, grating voice; the female was silent. I saw this female in action only once but she was observed on another occasion by a keeper. Neither of the females now in the collection has so far been seen to attempt display.

There is much confusion concerning the natural molting periods of the birds of paradise; no doubt differences in altitude, humidity and temperature account largely for conflicting statements. Blue birds of paradise taken at Deva-deva, Central Division, Papua, in October, 1928, were all in full plumage, with no indication of molt. These captive birds began dropping feathers in January, continuing the process of feather renewal normally. Once they have become established in New York, however, all birds of paradise that I have been able to observe begin the molt in spring or early summer. In some species, there appears to be a tendency to begin somewhat later in consecutive years, but there is not yet sufficient data on this point. I have the following dates for approximate beginning and completion of molt in an individual male blue bird of paradise:

Molt began June 16, 1930, completed October 14, 1930
" " July 7, 1931, " November 9, 1931
" " July 1, 1932, " November 8, 1932

These figures indicate a continuous molting period of approximately four months, which is confirmed by observations on two other males of the same species, during single years. The period of full courtship display coincides, naturally, with completion of the molt but display may take place even at the height of the molting period, when the bird is in very ragged condition. Presence or absence of the female appears to have little if any bearing on frequency of display.

Red Bird of Paradise

Uranornis rubra (Daudin)

I have never seen the display of this species. I have the molting period of an immature male now living in the collection: May 3, 1932 to August 10, 1932. This span of about three months corresponds to what seems to be normal here, for females and plumeless males of *Paradisaea*.

Emperor of Germany's Bird of Paradise

Paradisaea guilelmi Cabanis

Two adult males of this species, purchased in London, arrived here on November 18, 1931. One commenced molting about December 10, 1931 and finished about April 20, 1932. The other was first noticed dropping feathers on December 17, 1931 and was in full plumage about April 30, 1932. This period of roughly four months is normal for plumed males of *Paradisaea*, as observed here.

This bird has at least two types of call-note. One resembles the usual call of *Paradisaea* males, very loud and piercing, in volume somewhere between *apoda* and *minor*, and delivered with the mouth wide open. The other is quite different from anything I have heard before. The bird draws himself erect, expanding the strikingly large green patch on the throat and breast. He then emits a soft, clear, *poop, poop, poop!*, throwing his head upward with each note and keeping the bill almost closed.

No signs of attempted display were seen until October 16, 1932. On this occasion, the bird was moving along a perch, then hopping to another, his body in a stiffly horizontal position, head and neck extended, beak turned down. He was "bobbing" slowly up and down, from the hips. He then spread the wings in the horizontal plane, and vibrated them very rapidly. The flank plumes were slightly spread vertically, and raised somewhat above the line of the back. This continued at intervals for about ten minutes.

On October 25, the same bird was seen giving the loud call, then "bobbing" along his perches as described above. He then called again, four times, and leaped to his favorite perch. His body became rigid, in the horizontal position, the head and neck extended forward and slightly down. The flank plumes were held as described above. The wings were suddenly spread and flicked forward, so that the upper surfaces were toward the bird's head. This pose was held for about five seconds, when the wings were snapped back into normal position. After being held there for another five seconds, they were again thrown forward. The bird repeated this flicking movement seven times, at about the same intervals, then threw up his head, called loudly and began moving about his perches.

On the morning of October 27, at about nine o'clock, the full display was seen for the first time. The bird went through the

"bobbing" and "flicking" phases of his display several times. Suddenly he called loudly, and turned head first under his perch, which he clutched firmly. The body was drawn up quite close to the perch, in a position nearly horizontal, but with the anterior portion somewhat lower than the posterior. The wings were fully spread and turned well up. The tail, also, was widely spread and turned nearly vertical, so that the long wires extended far above. The head and neck were fully extended and turned upward. The plumes were erected at an angle of about 45°, those at each side forming a semicircle, overlapping anteriorly and posteriorly to make a complete circle around the inverted abdomen. Each plume now appeared as a separate entity, the widely-spaced barbs being seen to great advantage. Head, wings and tail remained outside the circle, which enclosed only the feet, as they grasped the perch. The body was then moved slowly from side to side, with a slight rotary motion, causing the plumes to wave gracefully but not disturbing the general formation. The display lasted for about five minutes, during which the head, wings and tail were held rigidly in position. The bird made no sound during the period, at the end of which he returned head first to normal position. After an interval of about ten minutes, devoted to calling loudly and leaping with animation from perch to perch, he repeated the entire performance, including "bobbing," "wing-flicking" and the inverted climax.

Count Raggi's Bird of Paradise

Paradisaea apoda raggiana Sclater

The courtship display of this species is too well known to be described here. I have, however, a few notes on the molting period. A single adult male is recorded as beginning to drop feathers on the following dates: June 1, 1918; May 21, 1921; May 16, 1922; May 1, 1923. No notes of finishing dates were kept. Adult birds of each sex, taken at Deva-deva in October, 1928, were in full plumage. Of these, an adult male began his molt, while at sea, on February 26, 1929; he was in full plumage on July 1, approximately four months later. In 1930, he began on May 8, and was complete on September 20. In 1931, the dates were May 3 and September 10; in 1932, May 12 and September 21. The only dates I have for a female of this species are from April 20 to July 18, which is the normal expectation.

Lord Rothschild's Gorgetted Bird of Paradise

Astrapia rothschildi Foerster

Two adult males and a supposed female of this species were received from London on November 18, 1931. As soon as they had been placed in flight cages, it was noticed that the wings of the male make a distinctly audible rustling sound when in motion.

One of the males began molting about January 1, 1932, and was finished about May 1. The second bird started about January 15, and had completed the change by May 30. On May 17, 1932, the first of these males was seen for the first time in a phase of display. He stood erect on the perch, his tail pushed forward beyond the perpendicular and slightly spread. The dark blue gorget or breast plate was widely spread and flattened, its fiery golden margin glowing conspicuously. The green feathers of the breast were also expanded laterally. The bird remained rigidly in this position for about ten seconds, making no sound. A few days later, the same phase was seen, except that on this occasion the bird rapidly opened and closed the lateral tail feathers.

This form of display was seen almost daily until August 26, 1932, when a more complicated development was observed for the first time. The bird turned backward under the perch, at right angles to it, the body nearly horizontal, but the anterior portion slightly lower than the posterior. The head and neck were turned upward at one extremity, the tail at the other, so that the bird formed an approximate semicircle. The gorget and the feathers of the abdomen were widely spread, as before, the gold margin of the former being very conspicuous. The ear coverts were spread upward around the head, joining the elevated ruff on the nape. The wings were pressed tightly against the body, and the feathers of the back were expanded so as to partly cover them. The tail was held upright and widely expanded at first, then the lateral feathers were rapidly opened and closed, the middle pair remaining stationary. The display was enacted four times, at intervals of from four to five minutes, each period lasting from ten to fifteen seconds.

At no time during display was any sound heard. This species is strangely quiet, and the only note it has been heard to utter here is an occasional thin, jay-like *kak, kak, kak, kak!* which seems to function as either call or alarm note.

Long-tailed Bird of Paradise

Epimachus meyeri meyeri Finsch

An immature male and a female, apparently adult, of this form, were collected at Deva-deva, Central Division, Papua, in October, 1928 and landed in New York on March 29, 1929. The male appeared very young and we took him to be a bird of the year but this could not be definitely established. While still in immature plumage, he frequently gave a loud, rattling sound, reminiscent of the beginning of the call of the giant kingfisher or laughing jackass (*Dacelo novaeguineae*). In calling, the body was extended horizontally, with the mouth open. Violent paroxysms shook the bird, as the sound was literally shaken out. The female uttered only a single, plaintive yelp, which was given by the male also, when hungry or separated from the female. The alarm note is a deep, guttural grunt, delivered by both sexes, with rapid jerking of wings and body. These notes were continued when the birds were fully adult.

Both birds were in molt when landed in New York, but no notes of dates were made. Both were noted as dropping feathers on March 15, 1930 and both were recorded as completely finished on June 15, 1930. The tail of the male now appeared to be slightly longer and his general color somewhat darker than that of the female. He was also, by now, distinctly larger than his mate but aside from these points, the sexes were similar.

On April 5, 1931, both birds again began the molt. The female was finished by July 10 but this time the male required a longer period. On May 15, it was noticed that black feathers were appearing in rump, wing coverts and thighs. By June 15, the lower back, upper tail coverts, nape and the inner secondary on each side were black. A gray patch had appeared in the center of the breast and the two middle tail feathers, now black, had reached a length of about four inches. On September 10, the change was recorded as complete, including the flank plumes and the long pectoral shields. The tips of the middle tail feathers had become damaged, so that no measurement could be made. The change from immature plumage to the magnificent dress of the adult male had required a period of approximately five months.

In 1932, the male began dropping feathers on May 10, and was in full plumage by October 3, so that the period was again about five months.

Two forms of display were noted in the immature male. The most common was seen for the first time on September 13, 1929. The bird gave his rattling call, then turned his body so that his breast was directed upward, his feet retaining their original position on the perch. The breast feathers were spread as widely as possible (which is not very much in the immature bird), lapping over the tightly closed wings. The tail was partly spread. This position was held stiffly for about ten seconds; the bird then moved rapidly about the cage, returned to the original spot and repeated the display. When not in molt, the bird went through this performance many times daily. Usually, the bill was kept closed; very rarely, it was widely opened, displaying the bright yellow lining of the mouth. Once only, I noted that the lateral tail feathers were vibrating rapidly.

On a single occasion, a quite different form of display was seen, while the bird was still in immature plumage. It has never been noted since. The bird was in an upright position, with the breast feathers spread. The tail was jerked wide open, then tightly shut, the alternation being very rapid. The wings, which were closed against the body, were moved up and down along its sides, the upward movements coinciding with the opening of the tail. The display was continued for a minute or more so that, fortunately, I had opportunity to observe it fully.

After the male had assumed adult plumage, he was first seen in display on October 14, 1931. It was the common inverted form, most used by the immature bird, but now become more complicated. Standing normally on the perch, the bird expanded the feathers of the breast, taking some time to arrange the short decorative flank plumes, which extended outward, forming a fringe around the sides. He then gave his rattling call and turned the breast upward, his feet retaining their original position. The breast feathers were now spread to their fullest extent, the bird's body appearing flattened. The short feathers of the upper breast turned upward about the head, circling the throat so closely that the iridescent black of face and throat became very conspicuous. The wings were closely folded and the tail was slightly spread, though not vibrating or moving. The beak was closed. The long pectoral shields were folded beneath the plumage, so that they were entirely invisible. (They take no part in this form of display.) As in the immature stage, this pose

was held rigidly for about ten seconds, when the bird returned to normal position.

Later on, a second form of display was used by the adult bird, quite different from anything that had been seen before. In this phase, the bird sits in a normal position, ostensibly preening the loosely extended breast feathers and pectoral shields. Suddenly, without calling, the body is drawn erect, with tail very slightly opened, wings tightly closed. The breast feathers, encircled by the decorative flank plumes, are widely spread. The pectoral shields are thrown straight upward, so that they extend far above the head, wrapping it closely. At the upper extremity, the shields are narrow and compressed; at their bases, they broaden gradually, to pick up the line of the spread breast feathers. The beak is widely opened, to show the bright yellow lining of the mouth. This position is usually held rigidly for about five seconds, when the bird resumes his alternate preening and displaying.

On rare occasions, usually very late in the evening, a further development of this display has been seen. Stiffly maintaining the upright position just described, and with the feet firmly grasping the perch, the bird rotates his body in a series of short jerks, pausing for several seconds at the end of each, until it is at right angles with the axis of the perch. He then jerks slowly in the opposite direction, until he has again come to a right angle with the perch but is facing the other way. This movement may be continued for from two to five minutes. Throughout, the bird is obviously exerting himself to the utmost to maintain his tense attitude. There is no movement of tail, wings or plumes, and no sound, once the position has been struck.

Lesser Superb Bird of Paradise

Lophorina superba minor Ramsay

I think I can add nothing to what is already known of the display of this bird. In addition to the rather harsh *ka-a, ka-a, ka-a,* which is given by the male in calling and displaying, both sexes use a series of rather sharp thin notes, rapidly repeated, when alarmed. This call is also used in the evening, at perching time, the sexes joining in chorus. At such times, it is noticeable that the voice of the female is distinctly higher and thinner than that of her mate.

Many species of this group cannot be kept in pairs in small quarters but male and female of this form agree well together. They frequently indulge in "tickling," the sexes alternating in working through the head and neck feathers of the companion. I have not noticed this habit in any other bird of paradise.

Most birds of this species collected at Deva-deva, in October, 1928, showed no signs of molt but I have notes of two males, one adult and one just coming into color, that were molting heavily at that time. A young male taken at this time was in the typical intermediate plumage resembling that of the female but interspersed with patches of black. About April 1, 1929, this bird began the molt and by September 1 was in full adult plumage, including full cape and breast-plate. Beyond the facts that full color was assumed in a single molt, after the intermediate stage, and that the time required was about five months, nothing of unusual interest was noted. A female beginning at the same time (April 1) was finished about July 1, establishing uniformity with the molting period of the females of all species noted.

On April 5, 1930, the male noted above was again in molt, beginning with the dropping of the cape feathers of the back, and the tips of the green breast-plate. Because of suspicion of some peculiarity, the bird was caught and examined on July 5. The body feathers had completed their growth and those of wing and tail were just finishing. Observation had shown that the iridescent feathers of the crown and the center of the breast-plate had not been dropped. On the nape, the space from which the cape was to grow, was completely bare. At each end of the breast-plate, was another bare space. The plate was represented only by the small central feathers, the whole being about one and one-half inches across. About August 1, the feathers of the crown and central breast-plate, began to drop, new ones beginning to grow immediately. The bare patches previously noted were still present. On August 15, it was seen that these spaces were filled with heavy blood quills. These grew very rapidly, so that by September 10, the entire molt was considered to be complete.

In 1931, the molt of this bird began about May 7 and was completed by October 5; in 1932, the dates were May 28 and October 24, the periods again being approximately five months for the third and fourth successive molts. The same delay in renewal of the ornamental plumage was noted, as in 1930.

In a fully colored male, taken at Deva-deva in October, 1928, and showing no sign of molt at that time, the cape and tips of the breast-plate were missing, and the spaces they should have occupied were bare. This bird died before new growth began but the instance seems to confirm the delayed renewal as normal for the species.

Lawes' Six-plumed Bird of Paradise

Parotia lawesi lawesi Ramsay

and

Greater Six-plumed Bird of Paradise

Parotia sefilata (Pennant)

I have been able to note no difference in the display forms of these two birds; I have already given a description of the dance of the former.[3]

The only sound I have heard made by males of *Parotia sefilata,* is a harsh squawk, usually a single note but sometimes repeated so rapidly that, except in quality, it somewhat resembles the full call of *Paradisaea. Parotia l. lawesi* uses the same note, though somewhat softer. The latter also makes a soft, trilling sound, *treet, treet, treet,* rapidly repeated and with a rising inflection, more commonly heard at perching time.

My only record of the molting period of *Parotia sefilata* is one for an adult male, the period running from May 5, 1930 to September 6, approximately four months. There are two for a male of *P. l. lawesi:* April 21, 1930 to August 18, and April 8, 1931 to August 1. Each is roughly four months. I have no data for females. Birds of each sex taken at Deva-deva in October, 1928, showed no indication of molt.

Stomach Casts.

On several occasions, pellets of matted food detritus, cast by the lesser superb bird of paradise, have been observed. This regurgitation has not been noted in other species, though it may occur. These pellets had no covering and did not appear to differ from those commonly ejected by other passerine birds.

[3] "Paradise Quest" p. 99.

Casts of another nature have been recovered in several species, as follows: *Paradisaea apoda raggiana,* June 24, 1929, and two more from the same bird within the next few weeks; *Parotia lawesi lawesi,* December 1, 1930, January 3, 1931 and April 6, 1932; *Lophorina superba minor,* January 2, 1931. All cases cited are of adult males. These casts were in the form of sacs, sometimes containing food detritus but usually empty. Their shape, size and heavily corrugated folds led to the supposition that they were formed by a shedding of the inner lining of the gizzard. Histological examination by Dr. Charles V. Noback, Veterinarian of the Zoological Park staff, confirmed this opinion.

In most cases, the casts were dry and shriveled when found. In two instances, they were recovered almost immediately after regurgitation. One of these, from *Paradisaea apoda raggiana* measured 30 x 16 x 7 mm; the other, from *Lophorina superba minor,* measured 19 x 15 x 9 mm. Both were quite empty.

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OBSERVATIONS ON THE LIFE HISTORY OF THE MARBLED SALAMANDER, *AMBYSTOMA OPACUM* GRAVENHORST

By G. K. Noble and M. K. Brady

From the Laboratory of Experimental Biology, American Museum of Natural History, and from the National Zoological Park.

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(Figs. 83–93 incl.)

Introduction

The Marbled Salamander, *Ambystoma opacum*, is one of the commonest species of *Ambystoma* in the eastern United States. It differs from all other species of the genus in its habit of usually laying its eggs on land. This fact, first discovered by the Reverend Charles Mann in 1855, has excited the attention of herpetologists for many years. Many observations have been reported on the life history of this form, those of Dunn (1917), Brimley (1920), Bishop (1924), and Lantz (1930 and 1930a) being especially noteworthy. In 1929, while collecting in the vicinity of Washington, D. C., we discovered that great numbers of brooding females could be obtained under leaf mold on dry pond bottoms or on pond banks which later would be flooded. The fact that we could obtain eggs in large numbers induced us to repeat the work of previous observers and to examine certain additional features of the life history. We have already published a note (Noble and Brady, 1930) on certain phases of this work and in this paper we intend to put on record a summary of our observations extending over a period from October 1929 to November 1931.

In the course of the work we received assistance from several sources. We are especially indebted to Mr. Sam Yeaton, Mr. G. P. Engelhardt, and Mr. J. A. Weber for the opportunity of publishing their field notes, which are recorded below. Miss Margaret Harland has given us technical aid in the preparation of the material and we are indebted to her for the microphotography.

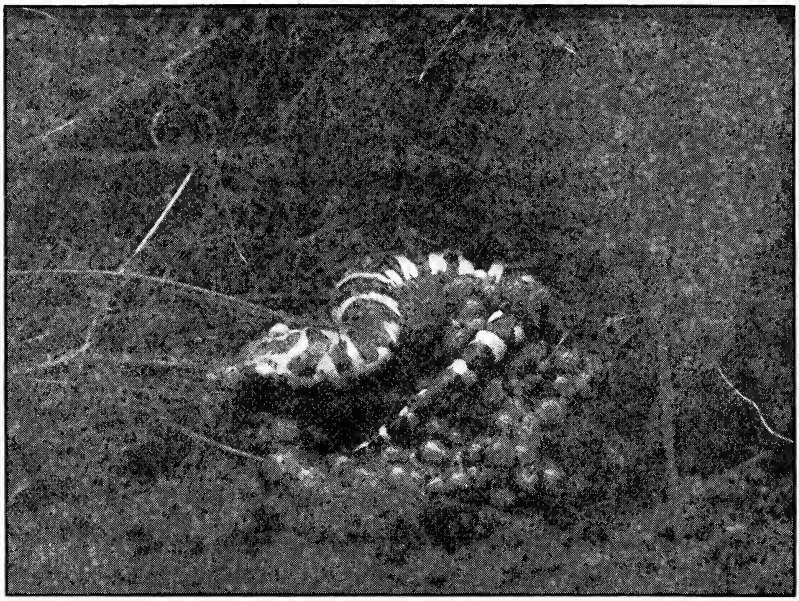

Fig 83. Marbled salamander brooding her eggs. The cover of moss has been removed but the female has not changed her position. The female usually lies adjacent to the egg mass while brooding and rarely does the tail cover the egg mass as shown here. Photographed at Miller's Place, Long Island, by S. C. Yeaton.

Breeding Time and Place

The eggs of *A. opacum* have been collected during all the fall months. The Reverend Mann (1855) found eggs at Gloucester, Virginia, in November and December. McAtee (1907) gives September and October as the months during which this species is found with eggs in Monroe County, Indiana. Brimley (1920) records eggs in October and November in the region near Raleigh, North Carolina. Dunn (1917) found fresh eggs at Mt. Vernon, Virginia, September 21, 1916. Deckert (1916) records eggs with developed embryos from Silver Lake, Westchester Co., New York, September 25, 1913. Bishop (1924) took two sets of eggs at Raleigh, North Carolina, on October 26, 1923. Eggs which we collected from October 3 to 6, 1929, in the Washington region had already undergone considerable development. On Long Island during 1931, egg-laying had occurred in damp locations by September 18. By September 20, most females discovered were with their eggs (Fig. 83). On the other hand, Mr. G. P. Engelhardt writes us that he has had a female under observation in the field at Hartsdale, New York, which laid eggs between October 2 and 4, 1931. It may be concluded that both in the New York and in the Washington areas egg-laying may occur in the field as early as September 20; in Westchester County it may occur as late as the first week in October. Females, which we brought from Long Island into the laboratory, laid eggs as late as September 28, 1931. Lantz's

specimens which were collected in the Washington area laid eggs in England on October 10. Mr. J. A. Weber has reported to us his discovery of six clutches of eggs with attendant females at Greensburg, Louisiana, October 25, 1930. From the form of the eggs he assumed that they had been laid recently.

Until the time we began our work with *A. opacum* it seemed that most eggs of the species had been discovered under logs or similar coverings by the edge of ponds, or more often under similar materials lying in hollows which later would be filled with rain water. Consequently we were interested to discover that the species lays its eggs far more frequently under dead leaves or grass in regions which later will be inundated. Several of these breeding sites may be considered in detail because the species will doubtless be found abundant elsewhere among similar surroundings.

In the Washington area the two localities studied during 1929 differed considerably in physiography. The breeding ground at Oakwood, Virginia, was in the dry bed of a temporary pond on one side of a railroad embankment. The region we studied covers about one-quarter of an acre and is of relatively recent origin. It is filled to varying degrees with rain water from December to June. The Rock Creek Park territory investigated was formed by the dry banks of a permanent pond, exposed by the autumnal drought. The terrain of both sites consisted of a layer of matted grass and leaf mold, covering a rather plastic clay. Much effort was spent at Oakwood in turning over logs. However, since but two nests were secured this way, in a spot where the form was known to be abundant, it was decided to investigate the mat of leaf mold which covered the lower areas of the pond floor. When this was rolled back a great ramification of tunnels was exposed. The mat of leaf mold had formed the roof of these tunnels. At various points along these runways, such as depressions or blind wings off the main corridors, the egg-clutches with attendant females were observed. The depressions or burrows containing the clutches were never very deep and the eggs were visible the moment the leaf-mold roofing was removed. Clutches were found occasionally around the entrances of holes, presumably made by crayfish, which opened up into the tunnels, and a few eggs were found within the holes. There was no evidence that the female had pushed or carried these eggs into these deeper tunnels, since the greater mass of every clutch was always found in the surface depression under the leaf mold. It was apparent, however, that the female had something to do with the shape of the immediate depression in which the eggs were deposited. In the majority of cases the area surrounding the eggs had the appearance of having been smoothed out and the edges of the depression quite often shelved out over the egg mass. Lantz says his female "slightly excavated the ground under a creeping plant" in the terrarium. It cannot be said with certainty that the depressions and tunnels found in the clay subsoil were originally made by the females. The soil was relatively resistant and could not be easily scooped out by a salamander. It seems more probable that most of the tunnels originally were made by some other agency but apparently they owed their smoothed-out and well-worn aspect to the activities of the brooding females. Unfortunately the ability of the females to excavate their nests in the hard clay could not be determined in the laboratory since our specimens had all laid and in the absence of any greater impulse were

content merely to tunnel in the moss and overlying debris of the terrarium. In some instances the nests were made in very faint depressions unconnected with any of the surface tunnels. Three such nests found at Oakwood had broad, well-smoothed edges and it is quite possible that they were excavated by the females. Several males and one spent female were found around the edges of the nesting area at Oakwood. None of these had excavated chambers such as those in which the eggs were found.

The selection of the nest site itself apparently involves the presence of a certain amount of moisture in the substratum and a cover of dead leaves or other material. At Oakwood the nests were not distributed evenly over the entire floor of the pond but were found clustered together in spots. These places usually were around the bases of alders, or along depressions made by drainage from the forest floor above the pond. Such places were more moist and had more leaf-mold covering than had other portions of the pond bottom. Clusters of from twelve to twenty nests would thus be found in certain favorable spots. In the Oakwood section one area 300 cm. long and 60 cm. wide, between the bases of two alders, yielded eighteen nests. Another area 150 cm. square yielded twenty nests. In some cases it was impossible to separate the clutches, two or three masses being confluent along the burrow floor. In the Rock Creek station a small area 109 cm. by 62.5 cm. contained seven nests, while a carefully examined area of 18 meters square on either side yielded but three nests. Here it may have been a question of cover. The leaf mold was thickest in the area in which the seven nests occurred. Further, this small area was situated on the steep slope of the pond side, three of the nests being found 109 cm. from the edge while the others were strung out between this point and the edge. There were no nests on the flat surface of the forest floor above. This seems to indicate that low depressions are not invariably selected, but that the character of the cover and degree of moisture are important factors in the selection of the breeding site. Invariably the nests were in an area later to be submerged by the early winter level of the pond.

Our method of hunting for the nests was as follows: On moving over the surface of the ground on hands and knees we would feel for a slight "give." This would indicate the presence of a burrow mouth or depression under the leaves. As such situations usually contained nests, our hunting on October 4 consisted of feeling for such spots. The method of feeling for nests was finally abandoned because we found that pushing in the nest roof tended to disturb the brooding female. We first developed a much better method while studying one of the ponds at Coram, Long Island, during 1930. Here the water vegetation had become matted down and dried during the summer drought. Standing in the deeper parts of the depression, we cut a strip of this matting three or four feet wide and rolled it back towards the higher ground. A great many nests were found scooped in shallow depressions in the dirt floor of the pond, and were fully exposed as the matting was rolled back.

Mr. Sam Yeaton has examined other localities on Long Island where other methods of hunting had to be employed. His field notes are also of interest in indicating the importance of humidity in regulating the nesting site selection. At Lake Grove, on September 18, 1931, he found:

"The bottom of the pond was sandy, very dry and barely covered with humus. Thirty adults were found, usually in small groups in the side of tunnels formed by mice or possibly by the salamanders themselves. Most of the salamanders were about three inches below the surface of the sand. No eggs were found here, although we found over twenty gravid females. Two specimens were discovered about six inches from the ground in the low branches of shrubs. A female with a nest of eggs was found the same night at Coram near a small back-water between Coram and Middle Island.

"On September 19, 1931, eighty-three adult *opacum* were caught at Jones Pond, Miller's Place. Only a dozen of the females were brooding eggs but the remainder were swollen with eggs. The brooding females had scooped out shallow depressions beneath the sheets of matted grass where the ground was still moist. The bottom of this pond was very flat and the nests were scattered all over the pond floor and not concentrated at certain levels as is the rule in the case of nests in dry ponds having steeper banks. In many cases the males and females were found together. Some of the depressions in which the eggs lay were natural irregularities of the pond floor but others apparently had been dug by the female. Some of the females without eggs had dug shallow depressions and apparently were preparing to lay eggs in them. On April 4, 1931, Mr. Jay A. Weber and I dredged this area without finding any *opacum* larvae. This would indicate that the adults had not laid here the previous fall in spite of their present abundance.

"On September 21, 1931, near Melville, Long Island, thirty-three adults were collected, mostly brooding females. Many females with eggs were on a moist bank in depressions made by the hoofs of cows. On September 18, we had visited the same locality and found no eggs. Males were found wandering in damp places near the border of the ponds while the females were restricted to suitable breeding grounds."

These data indicate that the female *opacum* may change her breeding site from season to season according to the degree of humidity present in any one locality. The largest number of brooding females collected by Mr. Yeaton during 1931 was obtained under sheets of grass or other vegetation in situations similar to those at Coram. In 1930 at this locality we also found females brooding their eggs under sheets of sphagnum. In 1931 Mr. Yeaton collected forty-two adults in this habitat. The females in one area showed a decided preference for sphagnum covering the roots of fallen trees. The nest level averaged 30 cm. above the dry swamp bottom but because of the pitch of the surrounding banks these roots would be inundated by the first heavy rains.

Mr. Yeaton made an especial effort to collect migrating *opacum* for it was obvious that some specimens could not have been in their breeding sites all summer. On September 19, 1931, near Miller's Place, Long Island, he found one gravid female beneath a stump on a gravelly hill-side about 180 m. from water and on the other side a road separating it from any marshy places. Another specimen was discovered on the same day about one and one-half miles from the nearest water. There was a dry pond about 60 m. from this place but it could not have held more than 30 cm. of water or have been more than 450 cm. square. No salamanders were found in this dry bottom and it is doubtful if the captured female would have laid her eggs there.

In 1932, after the present manuscript had been submitted for publication, Mr. Yeaton made another visit to Miller's Place with a view to observing a more extensive migration of *A. opacum* to the breeding areas. In this he was unsuccessful, but on September 9 he collected at Miller's Place no less than eighty-five males without finding a single female. There were no eggs or females in this area which he knew from previous experience would be later occupied by brooding females. Two days later the first females were captured in this area. It is therefore clear that the males of *A. opacum*, like the males of *A. maculatum*, precede the females to the breeding sites. This precedence of the males over the females appears to be the rule of many migratory salamanders as well as of frogs, of birds and of some mammals.

These data, although scanty, indicate that both sexes of *opacum* migrate to suitable breeding grounds about the middle of September, the males arriving before the females. The eggs are laid on land in moist situations. If the locality is very dry, egg laying does not occur. Possibly the adults move on toward more suitable situations. We have seen no evidence of a mass migration such as occurs in *Ambystoma maculatum*. Since courtship, as we shall show below, is not performed by great numbers of individuals at one time such mass movements would not be expected.

The courtship of *A. maculatum* occurs in the water. This species does not appear to be better fitted structurally for aquatic life than does *A. opacum*. We were interested in testing the reactions of the latter species to submergence, for it seemed possible that these reactions might throw some light on the breeding behavior of the species. We carried out our first experiments in the field.

At the Rock Creek station a brooding female was placed in water several centimeters deep and was observed to swim clumsily to the surface, endeavoring to keep her head out. She swam in various directions but upon reaching an object which provided a foothold she immediately climbed out of the water, instead of seeking to escape under the submerged leaves and debris as *Ambystoma maculatum* would have done. In the laboratory, the behavior of *A. opacum*, both male and female, when placed in water 10 cm. in depth, were in marked contrast to the behavior of *A. maculatum* and *A. tigrinum*, under the same circumstances. *Tigrinum* was found to swim readily about the tank, eagerly accepting food offered to it under water. *Maculatum* was equally at home in the water, although it was not capable of the same ease in swimming. *Opacum*, however, under these circumstances, showed signs of distress, swimming violently and clumsily about the tank, endeavoring to escape by climbing movements of the limbs. Three pairs of *opacum* were placed in a tank with a water depth of 2 cm. and provided with a stone shelter, the top of which was near the surface of the water. Under these conditions the animals were always able to keep their heads above the water and walked leisurely about seeking an escape, when they were not resting on the stone work. Next day the water depth was increased 3 cm. The animals immediately made a more violent effort to escape, striving to keep their heads above water. When the depth was increased to 15 cm. two of the animals drowned; the remaining four, by dint of stretching up from the rock work, were able to continue atmospheric respiration. When the depth was reduced to 2 cm. the specimens moved about in a leisurely manner. Specimens

kept for a month in water having a depth of 2 to 3.5 cm. never became completely acclimated to that element, refused food and consistently endeavored to escape. From this it would seem that *A. opacum* is certainly not at home in the water and will drown if denied the opportunity to indulge in atmospheric

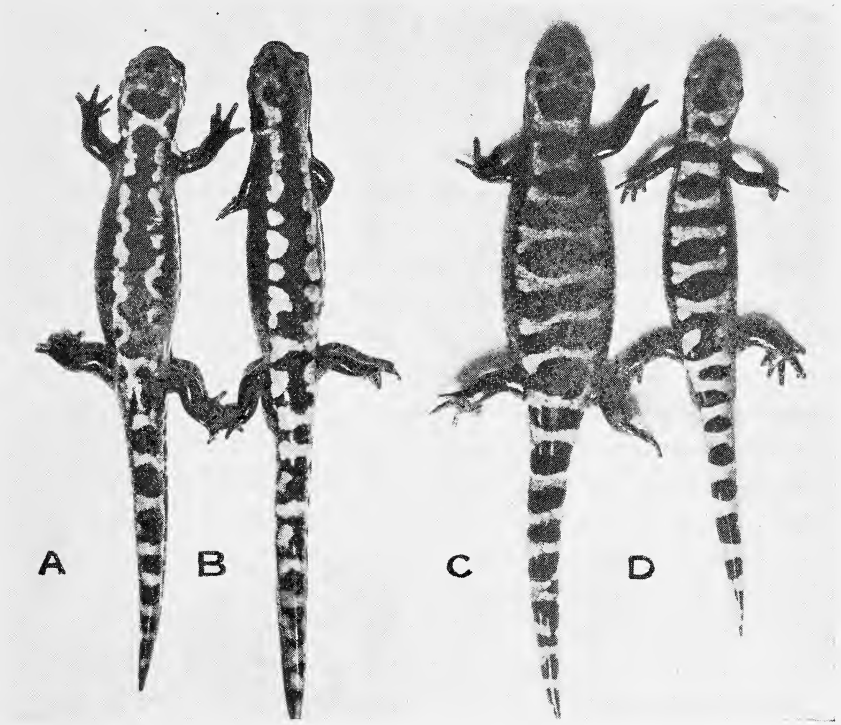

Fig. 84. Two pairs of *Ambystoma opacum* collected on Long Island showing extremes of variation in color pattern. Females (A and C) may be striped or cross-barred. Their color pattern does not distinguish them from the males (B and D).

respiration while in that element. It is certain that in nature the species never deposits its eggs in the water and that the female must desert her nest as soon as the pond basin begins to fill with water.

Sexual Differences in Coloration

Ambystoma opacum is unique among the species of the genus in exhibiting a consistent difference in color between the sexes during the breeding season. The white color pattern along the back is distinctly whiter in courting males than in females. Nevertheless, as indicated below, we have failed to find that this color difference plays any role in sex recognition or courtship.

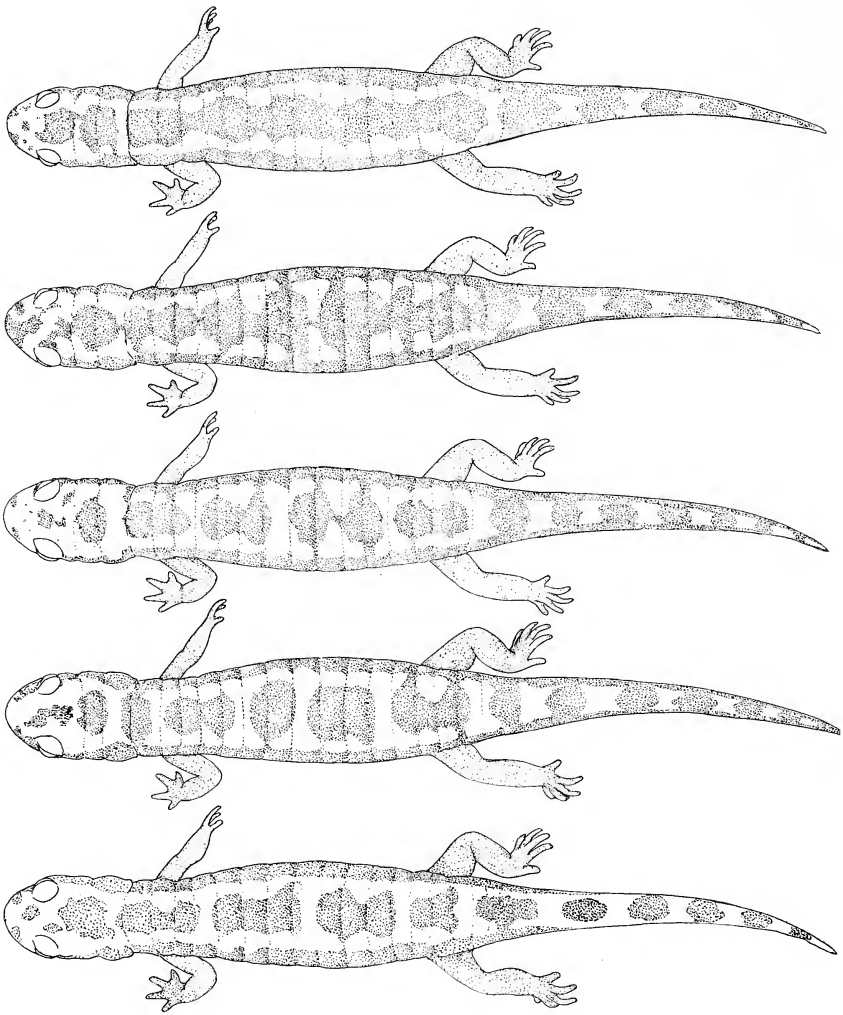

Fig. 85. A series of brooding *Ambystoma opacum* collected in the vicinity of Washington, D. C., illustrating the wide range of color pattern variation found in the adult female.

There is considerable variation in color pattern. Dunn (1917) found the females from one locality tended to exhibit more of a striped pattern than the males. The limited series of adults at Lantz's disposal were in agreement with Dunn's findings and Lantz (1930a, p. 64) has generalized as follows (translation):

"The original pattern, which may still be distinctly recognized in the female, is formed out of two stripes, which, beginning behind the nostril extend over the eyelids, parotids, neck and sides of the back to the tail. These longitudinal bands, especially on the neck and tail, are connected by a number of cross-bands, which in the female are ordinarily few; in the male, however, they can be so fully developed that nothing more remains of the original longitudinal pattern, in which the cross-bands on the sides of the body and tail either are not further joined or scarcely meet one another."

We have examined over five hundred breeding *A. opacum* and have failed to find any consistent differences in color pattern between the sexes. In figure 84, from among the three hundred and thirteen adult specimens collected on Long Island during the fall of 1931, we have selected individuals of both sexes with the striped and others with the cross-barred pattern predominant. Again, among the eighty-one adult females found guarding their eggs at Oakwood, Virginia, and Rock Creek Park, Washington, during October 1929, we have selected a series which shows nearly the complete range of color variation in the species (Fig. 85). The males collected in the same region fall within this range of variation. Both males and females may be either predominantly striped or cross-barred. We have found no consistent difference between the Long Island and the Washington specimens.

Courtship

Lantz (1930) was the first to describe the spermatophore of *A. opacum*. He found several attached to moss in a terrarium containing several adults. He writes, "As is well known, the marbled salamander breeds in the autumn, and the mating season appears to be quite short. In the two cases observed it was restricted to a few days in the first half of October. During this time unusual agitation prevailed in the terrarium after nightfall. The males were steadily pursuing the female, pushing her and rubbing their snouts against her body. They were also seen to chase each other in very much the same manner. Unfortunately nothing further could be observed, the animals' being so easily disturbed by light that even switching on a weak electric lamp made them soon retire into their hiding places. The actual procedure of fecundation remains, therefore, undisclosed."

Recently it has been emphasized that the evolution of courtship of the Caudata follows closely the phylogenetic scheme (Noble 1931). The courtship behavior remains essentially the same throughout a group of related species in spite of the radically different habitats such species may frequent. Plethodontids, whether aquatic or terrestrial, have the same type of courtship and the same has been shown to be true for certain natural groups of salamandrids. It seemed to us important to determine if *A. opacum*, a terrestrial species, had the same type of courtship found in the aquatic forms of *Ambystoma*.

Methods of Study

Our field observations on courting *A. opacum* were made from September 9 to 15, 1931, in the vicinity of Washington, D. C. These were supplemented by laboratory observations during the same period in Washington. From September 24 to 28, 1931, a series of Long Island specimens were observed under laboratory conditions in New York. Observations in the field were made by means of electric flashlights covered with red cloth. In the laboratory the entire illumination was provided by a series of photographer's red electric light bulbs of only 10 watt capacity.

Many of the salamanders were imprisoned on their courtship grounds by covering them with crystallizing dishes. Others were observed in courtship without such a cover. In the laboratories of the American Museum two or three pairs of adults were placed together in separate crystallizing dishes 20 cms. in diameter. Each dish was provided with several large pieces of damp slate, and was covered. The dishes were placed in shallow troughs of running water and the temperature regulated by the addition of ice. In the laboratories of the National Zoological Park the bottoms of the laboratory tanks were provided with soil from the breeding grounds. The soil was arranged to form either a flat surface or one cut by a series of interconnecting crevices and depressions, to simulate the conditions found in the dry bed of a pond. The soil was moistened to approximate natural conditions. Observations were made in Washington on segregated pairs and on groups of several pairs. Since many adults may be found together under the same log or pile of debris during the courting season, it is probable that group courtship is the rule in nature. However, the movements of individuals seem to be the same whether they are in pairs or in larger groups. Observations in the Washington area were made by Brady, those in the New York area by Noble. Our accounts were drawn up independently and found to agree except in certain details to be noted below. The discrepancies may be due to the fact that many of the Long Island salamanders had courted before reaching the laboratory. Brady, alone, observed the actual acceptance of the spermatophore by the female salamander, with her cloaca. Both of us observed spermatophores deposited by various males.

The Inception of Courtship

In the laboratories of the American Museum six to ten crystallizing dishes of adults were kept under observation at one time. During most of the period the salamanders either remained quiet or moved slowly over the damp stones. On several occasions the beginning of courtship was witnessed. One male would suddenly begin to dash rapidly about the dish butting his head against any individual he chanced to meet. This surprising activity would stir up the group and often another male would begin the same butting performance. A close examination of these active males revealed that they were usually endeavoring to push their snouts under individuals they chanced to meet. Their efforts were directed as forcefully towards other males as towards females. For example on September 24 at 8:45 P. M., one male was seen to butt his snout twelve times in rapid succession against the inguinal region of another individual which was proved by cloacal examination to be a male.

A female was never observed to begin a courtship and when butted by a courting male she exhibited less response than a male under the same circumstances. In attacking the tail of another salamander the courting male attempts to lift up the appendage with his snout but he usually strikes the tail in lowering his head after each lifting movement, thus giving it another rub. On several occasions a quiescent female was observed to arch her tail when this organ was butted by a male. This sometimes resulted in the male's working his way under the tail, or by turning he frequently crawled under the body. When two courting males met head on each tried to thrust his head under the chin of his opponent. The moment one male touched the chin of the opposite male with the top of his snout the opponent would jerk his head to the side and bring it with a vigorous thrust back under the chin of the first. The result was a head "fencing" conducted with such speed that the two heads appeared a blurr. To one familiar only with the slow movements of *A. opacum* outside of the breeding season, this show of agility was a startling performance. The behavior was witnessed three times on September 24, once on September 27, but has not been seen in the field.

Courting males may show a greater interest in other males than in females. On September 24 one male, after methodically thrusting his snout into the sides of a female for over a minute, turned toward a male and continued the butting movements with much greater vigor. Again on September 28 at 8:30 P. M. a courting male met another male and a female head on. The courting male rubbed the side of his head first against the male, and then against the female. He then turned and gave his full attentions to the male.

Lantz, as indicated above, found that courting males would pursue other males, and we have both confirmed this observation many times. This failure to discriminate between the sexes at the outset of courtship results in an increase in general excitement throughout the group. It has a mutually stimulating effect and brings more males into courtship at one time than would otherwise occur.

Courtship Postures

In addition to the butting and prying reactions there were several other types of behavior pattern which appeared many times both in the laboratory and in the field groups. If a butted individual attempts to escape, the courting male will frequently throw his hind legs and tail directly across the path of retreat (Fig. 86). The courting male with his body thus curled will usually continue to thrust his head into the side of the annoyed individual. The position is assumed not merely to trap the escaping salamander but to stimulate it further. With every head thrust the male will often jerk his pelvic region toward the snout of the pursued salamander, with the result that the latter receives almost simultaneously a push in the side and a slap across the snout. On September 28, one male was observed to butt a female nine times with his head while maintaining this position and jerking his pelvis toward her at each thrust.

In the field it appeared that the male was primarily interested in thrusting his head under the cloaca of the female. In the laboratory, however, males which had succeeded in assuming this position frequently worked forward under abdomen and chest, vigorously pushing up with the top of the head. If the

male had thrust his head under the fore part of a female he would frequently work back with the same lifting movements to the cloaca and beyond along the tail. Such movements often result in the female's being lifted from the ground and thrown to one side of the active male. Lateral rubbing movements of the

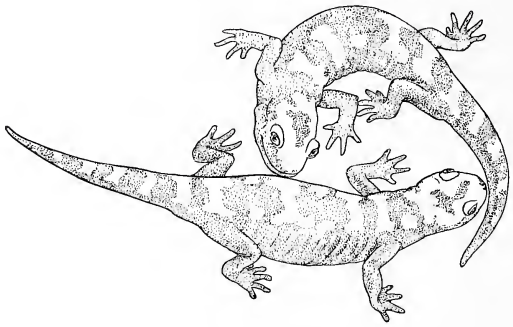

Fig. 86. Courtship of the marbled salamander. While butting the female in the side with his snout, the male blocks with his tail her escape.

male's head may occur when he has thrust it under another individual. The lifting thrust may be accompanied also by side movements of the head. During the less active moments of the courtship the male may rub his cheek across the cheek of another individual. Females have been observed to respond in the

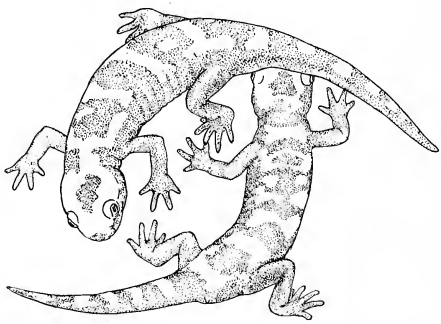

Fig. 87. "The waltz" in the courtship of the marbled salamander. The male (right) attempts to thrust his snout under the tail base of the female while the latter endeavors to bring her snout in contact with his cloaca. The result is a rapid circular movement of the pair.

same manner. The female exhibits her rising interest in the attentions of the male by ceasing her attempts to escape and often by turning her head toward the male. In the field and in the laboratories of the Zoological Park it was noticed that the female frequently turned her head in the direction of the male's cloaca and attempted to put her snout in contact with it. This resulted in

bringing her own cloaca in front of the male's head. The male moving forward to reach the female's cloaca would withdraw his own and the movement continued would result in a circling "waltz" (Fig. 87).

In the laboratory, pairs of males were often seen to circle around in a "waltz," each attempting to thrust his head under the tail or cloaca of the opposite one. In Washington it was observed that if the waltzing salamanders were both males the movement did not continue very long. Only twice was it found to exceed sixty seconds, while if the partners were of opposite sex it would frequently continue for several minutes. It seems probable that cloacal secretions of the female stimulate the male to continue the "waltz" for these extended periods.

Although a male usually attempts to crawl under a partner, he may scramble over. This is generally the case if he does not succeed in thrusting his head under one end of the other individual, in which event he sometimes scrambles over his partner to the opposite end. Although such movements are accompanied by more or less butting with the head, there is never a definite attempt to cover up the nostrils of his partner in the manner characteristic of plethodontids (Noble and Brady, 1930a). However, in the course of a scramble a male may bring his chin over the snout of a female. Sections of this chin skin show that no hedonic glands (cf. Noble, 1931, Fig. 49) are present. Hence the stimulus of this phase of the courtship is mechanical rather than chemical.

The Taking-up of the Spermatophore

We expected to see the spermatophore produced at the climax of the courtship. This was not always the case. For example, on September 27 at 7:45 P. M. the following was recorded:

"Male slowly approaches another male and undulates the base of his tail. He butts side of the male and then turns to a female, slowly rubbing the upper portion of her side, and works towards her tail. During this procedure the male's tail is undulating rapidly. When he reaches the female's tail, he raises his body on legs held stiff and straight and slowly extrudes a spermatophore. Then the male turns and butts the opposite side of the female. After a moment's rest the male turns to another male and butts him with far more vigor than he displayed with the female. A second female passing attracts his attention and he continues vigorous thrusting against her."

The undulation of the base of the tail invariably preceded the production of a spermatophore, although such tail movements also occurred at other times. The undulation sometimes ceased immediately after the spermatophore was deposited, but in other cases it was continued for a few seconds. In seventeen instances the undulation continued until a second spermatophore was produced. One male was recorded as producing three spermatophores one immediately after the other. In six of the eight occasions when spermatophores were taken up by the females of isolated pairs the acceptance occurred immediately following production. The female, moving directly after the male (Fig. 88), passed her chin and body over the spermatophore until the cloacal lips came in contact with it. In the other two cases, several seconds of nosing around transpired before the female snout came in contact with the spermatophore. Then she

moved her cloaca over it. In five of these acceptances the female was seen to undulate her pelvic region while her cloaca was directly over the spermatophore. In three other cases where the spermatophore was secured by the female, she was found to remain motionless over the spermatophore for several seconds. In

Fig. 88. The deposition of the spermatophore. In the final stage of the courtship of the marbled salamander the male deposits the spermatophore while the female is following directly after him. If the female fails to secure the spermatophore head with her cloacal lips she may nose about until she has found it.

one instance, the female, after covering the spermatophore a few seconds, moved a few centimeters away in the direction of the male. She then turned, and apparently smelling the floor, worked her way back to the spermatophore and resumed her position over it.

As previously stated, group courtship appears to be the rule in *A. opacum* because many pairs were found together. In several groups studied, both in the field and in the laboratory, some or all of the males involved produced spermatophores. The sufficiently stimulated female usually accepted the first spermatophore with which she came in contact. This was usually the one produced by the male whose cloaca she had been nosing. In twenty-eight recorded instances the female apparently became aware of the spermatophore by smelling it, since her snout was brought in contact with it before she moved over it. However, both sexes appear to nose the ground frequently while courting. In six clearly seen cases and apparently in many others, the female first reacted to the spermatophore when her cloaca came in contact with it. In either event the female remained with her cloaca over the spermatophore for several seconds, the longest recorded instance lasting nearly one minute. Usually, however, when a number of individuals were involved, the female would be forced from her position after a short interval. In such instances the female frequently sought contact with another spermatophore. One female thus covered five spermatophores. The taking up of the spermatophore followed most quickly when the female was following the male or moving with the male along the corridors of crevices. One typical record will serve to show how both methods of taking up the spermatophore may occur in the same group. The record was made at the lower pond in Dead Run Swamp, on the Virginia shore of the Potomac, opposite Plummer's Island.

Record of Courtship

"The female first moves away from the spermatophore which the male has produced, although she has been following him for some centimeters. She

later moves back to cover it and shows definite undulations of the base of tail, less intense than the tail wag of the male. A male is now following a female and is rubbing her with his chin. The male wags his tail while following female and rubbing her. The male stops female by throwing tail across her path. The male is now astride female and rubs her with chin. Female slides back and follows male with nose near cloaca. Pair separates. Two spermatophores found on floor. Pair in full waltz. Male crawls over female and rubs her cloaca. Female is now following male. He undulates his tail base and produces a spermatophore. The female misses it and noses about on the ground 5 centimeters from the spermatophore. She finds it and moves first head, then body, and finally cloaca over it. The female undulates her pelvic region. Male still active and turns to female on side of dish. The male thrusts his head under female's cloaca and raises her from floor. Female follows male but no spermatophore is produced. Male now follows female, his tail undulating. A spermatophore is produced but the female turns toward male and the pair waltz. Both undulate their tails. Male plainly seen to produce a spermatophore. The female in waltz position stops, moves away from spermatophore. She turns and moves over spermatophore and secures it while undulating tail base."

Many other records were made in the field, both with glass covered and with exposed salamanders. At Ritchie, Virginia, in a pond where many courtships were recorded, the temperature was 26°–26.5° C. At Dead Run Swamp, Virginia, the temperature ranged from 23.3°–25° C. These temperatures were higher than those maintained in the laboratory.

Many spermatophores were damaged by the adults' walking over them. It was difficult to be sure even under ideal laboratory conditions how much of the spermatophore was taken up by the female with her cloacal lips. Certainly in most cases only the head of the spermatophore was removed by the female. In

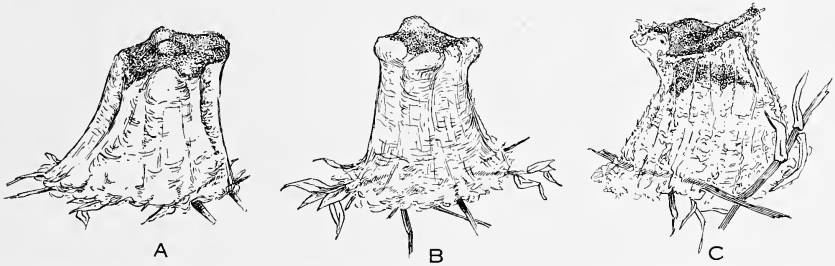

Fig. 89. Spermatophores of the marbled salamander, × 4. A. Freshly deposited spermatophore. B. Spermatophore from which most of the head has been rubbed off. C. Compound spermatophore.

Washington, in only five of the fifty or more cases of impregnation observed were the females seen to envelope the entire spermatophore with the cloaca and remove it. In at least twelve the female removed all or part of the head, leaving the stalk still adhering to its place of deposition. Spermatophores usually were deposited on a fairly loose surface of crumbling leaf mold, hence in most cases

the female dragged the stalk from its place of attachment before she succeeded in removing the head. In New York where wet slate was provided, headless spermatophores were frequently found firmly glued to the rock. In the melée of courtship many spermatophores are doubtless crushed and in nature many are presumably covered with dirt or bits of debris, rendering them difficult to see.

The Spermatophore

A typical spermatophore of *A. opacum* is shown in Figure 89. It measures 4 to 5.5 mm. in height and its stalk is approximately 2 mm. wide at the apex and 6 mm. wide at the base. It differs from the spermatophore of *Ambystoma maculatum* in being smaller and in having a quadrangular or pentangular summit. Each corner of the summit is formed by a low rounded prominence and the top of the structure is truncate and slightly concave. In the fresh spermatophore these summits are usually covered with a mass of sperm which are thus placed in a decidedly advantageous position for being engulfed by the cloaca of the female. Lantz (1930, Fig. a) has described a spermatophore which seems to have lost most of this sperm mass. A fresh spermatophore is less concave at its summit than the one he figured, and there is usually a thin cap of white spermatic fluid completely covering the truncate top. The central portion of this surface may be raised into a slight eminence. Sections reveal that this central prominence is formed chiefly of eosinophilic granular substance which agrees in character and staining properties with the secretion of the male's pelvic gland. The spermatozoa are spread over the top of the spermatophore. A remarkable feature is that the heads of the spermatozoa are often all directed the same way. Thus in the micro-photograph (Fig. 90) of the head of one of the spermatophores it may be noticed that the spermatozoa covering one of the four summits are directed outward. This orientation of the spermatozoa would appear to be advantageous to a rapid impregnation.

The base of the spermatophore appears glassy, but slightly frosted, to the unaided eye. Sections reveal that the basophilic mucous material of this base is divided up into short segments by thin partitions of eosinophilic material. Unlike the eosinophilic material on the spermatophore head, this is not granular but homogenous. Sections of the cloaca of the male *A. opacum* reveal that this eosinophilic scaffolding of the stalk is produced by a series of glands lying on either side of the pelvic gland in the roof of the cloaca. The secretion of these glands is homogenous, in sharp contrast to the secretion of the pelvic glands. Unlike the cloacal glands which line the walls of the cloaca, this secretion is not mucus. With thionin, methylene blue or haematoxylin the secretion of the cloacal glands is stained blue. The abdominal glands, which empty on the cloacal lips distal to the cloacal glands, produce an eosinophilic secretion which is finely granular and hence readily distinguished from both the pelvic gland and from the gland which produces the eosinophilic scaffolding of the stalk.

The abdominal gland may pour its secretion directly to the outside when the cloaca is turgid. It has been assumed that in aquatic salamanders which drive a current of water towards the female during courtship, the abdominal gland secretion is carried in this current and tends to stimulate her. It seemed

to us possible that it was the secretion of the abdominal gland which chiefly interested the female during the "waltz" phase of the courtship. The question arose as to whether or not the spermatophores on being produced become covered with a layer of abdominal gland secretion which would serve to make them, like the male cloaca, attractive to the female. We have shown above that the spermatophore is found by the female even when not in line with her body.

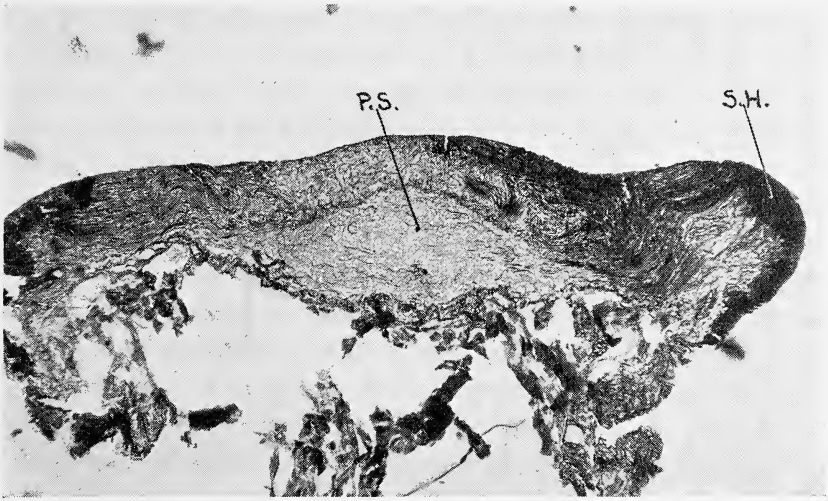

Fig. 90. Vertical section of the spermatophore head of the marbled salamander, × 61. P. S. Pelvic gland secretion. S. H. Mass of sperm heads.

Our sections of the spermatophore fail to reveal evidence of a covering layer of abdominal gland secretion. Moreover, in our sections of the cloaca of the male the secretion of the pelvic, scaffolding, and cloacal glands may be seen in the lumen of the cloaca, but no abdominal gland secretion is found there. If the abdominal gland plays any part in spermatophore formation it produces at most a very superficial covering.

Lastly, it may be pointed out that *A. opacum*, like other species of *Amby-stoma*, exhibits some variation in the form of the spermatophore. The groove which is found on one side of the typical spermatophore is frequently lacking. Again, double spermatophores (Fig. 89C) may be produced. Smith (1910) has described compound spermatophores in *A. maculatum*. We have not found a compound spermatophore formed of more than two spermatophores in *A. opacum*.

Method of Sex Recognition

From the above description it may be concluded that there is no recognition of sex at the beginning of courtship but that males endeavor to stimulate any salamander of their own species they chance to meet.

In *Ambystoma maculatum* the males engage in a Liebesspiel with other males and attempt to push under them. Wright and Allen (1909, p. 690) described the action of a male toward a female:

"It seemed to be the object of the male to bring the top of his head in contact with the venter of the female. The throat region of the female seemed to be preferred, although he often began in the cloacal region or even at the tip of the tail and rubbed the dorso-lateral part of the head along her whole ventral side." During the Liebesspiel of *A. maculatum* it has been noticed that the males respond in exactly the same way to other males (Noble 1927, p. 34). Wright and Allen found that the mere presence of females in jars with the males stimulated the latter to the production of spermatophores. We have noted in *A. opacum* that spermatophores are deposited more often after a male has been rubbing a female than at any other time. Spermatophores usually were not produced at the moment the male was nosing the female's cloaca, and it seems probable that secretions from the general integument as well as from the cloaca may excite the males. It may be concluded that in both *A. maculatum* and *A. opacum* the males become sexually active sooner than the females. They excite the colony to sexual activity by engaging in a series of rubbing movements which are exactly the same whether directed toward male or female. Eventually the odor of the female excites the male to the production of a spermatophore. The antics of the male induce the female to follow him and this may automatically lead to the picking up of the spermatophore. However, our work has also disclosed that the female shows a definite interest in the spermatophore and when her body is not in line with it she will move toward it for the purpose of covering it. At the height of the courtship the female appears to be interested in bringing her snout close to the cloaca of the male. The orifice of his cloaca is provided with a series of abdominal glands which are believed to produce a secretion stimulating to the female. It has been suggested above that the abdominal glands may coat the spermatophore with a secretion which makes it attractive to the female. We could find no histological evidence in support of this assumption. Hence it is possible that the other secretions which enter into the formation of the spermatophore are odorous and attractive to the courting female. In brief, our observations suggest that secretions of the integument and cloaca play an important role in sex recognition and stimulation. In this *A. opacum* agrees with the other species of *Ambystoma*.

Comparison with Other Salamanders

As indicated above, the courtship of *A. opacum* agrees essentially with that of *A. maculatum* even though the first proceeds on land and the second in the water. This is further evidence in support of the thesis (Noble 1931) that the courtship pattern is relatively stable in evolution. However, the only other species of *Ambystoma* whose courtship is known in detail, differs markedly from *A. opacum* both in the ability of the males to distinguish sex and in the courtship pattern. Until recently there has been some uncertainty as to the courtship of this species, *A. jeffersonianum*, because the original describer reported the males to embrace "exactly in the manner of the spotted newt" (Wright 1908), and

subsequent observations (Mohr 1931) showed that the male gripped with his forelimbs and usually not with his hind. The observations of Mohr have been confirmed and extended by Kumpf and Yeaton (1932) and one of us has been able to witness the performance several times. Kumpf and Yeaton recorded the courtship of two male and three female *A. jeffersonianum.* There is no doubt that, although these males gripped one another at times, they could distinguish the opposite sex far more rapidly than any courting specimens of *A. opacum* which we observed. The courtship pattern resembled that of *Triturus pyrrhogaster* or *T. torosus* far more closely than it did that of *A. maculatum* or of *A. opacum.* Mohr (1931) concludes "that there is no marked difference in the courtship behavior of *A. maculatum* and *A. jeffersonianum.*" The evidence he has so far presented in favor of this is brief. He states that a single male "was seen to be vigorously undulating his tail and whole posterior part of his body. Several times he clutched convulsively at the ground with his hind legs. A female approached, nosing the cloacal region of the male, which almost immediately deposited a spermatophore. The male crawled very slowly away, undulating his tail feebly. The female followed and came to rest with the cloaca immediately above the spermatophore and remained motionless for perhaps fifteen seconds, then pushed vigorously after the male into deeper water."

A second male in the laboratory "swam over a female, grasping her with the forelegs, then slid slowly backward and forward rubbing his cloacal region over the dorsal pelvic region of the female."

At the present time we have no evidence that the male of *A. jeffersonianum* attempts to pry under and lift up the female during courtship, nor is there evidence of a Liebesspiel engaged in by males alone before the females have become stimulated. There are various rubbing movements, but apparently these are not specific for *Ambystoma.* On the other hand the forelimb amplexus is a new phase in *Ambystoma* courtship, a phase which is further developed in another group of salamanders. It has been suggested (Noble 1931) that the courtship of *Ambystoma* is sufficiently generalized to form the ground plan out of which the courtships of the higher groups of urodeles may be evolved. The observations of Mohr and of Kumpf and Yeaton lend support to this view. Their work has also shown that there has been an extraordinary evolution of the pattern of courtship within the genus *Ambystoma.* Further, one species has developed a courtship pattern which is essentially the same as that of certain primitive salamandrids. Since two species of *Ambystoma* have a simpler type of courtship in the sense that sex discrimination is made less rapidly it would follow that the courtship pattern of *A. jeffersonianum* has evolved out of that of these two species. *Triturus torosus* and *T. pyrrhogaster* are not close relatives of *A. jeffersonianum.* Hence the courtship pattern of *A. jeffersonianum* would appear to represent a case of parallel evolution. Many cases of the development of the same structural modification in unrelated groups have been described (Noble 1931). The evidence at hand appears to indicate that the courtship of *A. jeffersonianum* represents a parallelism rather than a case of true genetic affinity.

It may be noted, however, that *A. jeffersonianum* agrees with *A. opacum* in the smaller number of spermatophores produced. This is correlated with the fact that in neither species do the males congregate in great numbers and engage

in a Liebesspiel of several hundred individuals. Our field observations indicate that such large assemblages are characteristic of *A. maculatum*. Because of the irregularities of the terrain these mass formations could not be carried on with any success in *A. opacum*. Possibly the smaller number of courting *A. jeffersonianum* is correlated with the rarity of the species in any one locality. However, Mohr (1930) has recorded 200 specimens of this species in one locality. He states (p. 53): "Everywhere, within three or four feet of the shore Jefferson's salamanders were rising to the top, taking a bubble of air after the fashion of the spotted salamander. Close to shore the salamanders seemed to be congregating." This description agrees closely with our observations of the Liebesspiel of *A. maculatum*. Mohr remarks that the spermatophores of *A. jeffersonianum* are less conspicuous than those of *A. maculatum*. Possibly this is the reason they are not found in large numbers.

In both *A. opacum* and *A. jeffersonianum* there is a smaller mass of spermatozoa in each spermatophore than occurs in *A. maculatum*. This would appear to be correlated with the fact that both species produce on the average fewer eggs than does *A. maculatum*. The spermatophore of *Triturus viridescens* has a very small head of sperm and this species, like *A. opacum*, may lay only half as many eggs as *A. maculatum*. However, to judge from Smith's summary (1911), the difference between the average egg number in the species of *Ambystoma* is not as great as the difference in sperm head sizes. Until a study is made of the number of spermatozoa in the sperm heads of these spermatophores, it will be impossible to state how close is the correlation between egg number and spermatozoa number in the various species of *Ambystoma*.

The Spermatozoön

Lantz (1930) appears to have been the first to describe the spermatozoön of *A. opacum*. He states (p. 323):

"At high magnification the sperm looked a tangled mass of spermatozoa intermingled with numerous other much longer and slightly thinner filaments. The spermatozoa are about 75 μ long, thread-like, extremely thin and bear a narrow pointed head piece about 6 μ long. At the time the observation took place they were all perfectly inert, and curved into semicircular shape."

We have examined sections of spermatophores fixed in Zenker's fluid (bichromate of potassium and corrosive sublimate) and have also examined smear preparations of spermatophore heads fixed in Bouin's and in Zenker's solution. We have also examined teased preparations of the fresh spermatophore head. The latter proved much less satisfactory than the fixed material. Delafield's haematoxylin and eosin were used for stains.

The spermatozoa of *A. opacum* are very different from the structures Lantz (1930) has described and figured. They closely resemble the spermatozoa of *Ambystoma mexicanum* as figured by Retzius (1906). The tail is provided with an undulatory membrane extending the entire length except for the tip, which is provided with a lash or end piece. Opposite the membrane a flat keel (Fig. 91) extends for approximately one-sixth of the length of the tail. A similar but apparently shorter keel occurs in *A. mexicanum* and readily distinguishes the

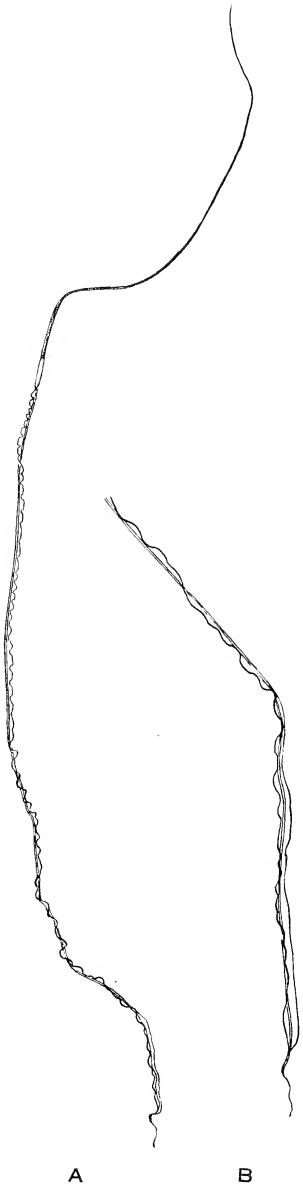

Fig. 91. Spermatozoön of *Ambystoma opacum*. A. The whole spermatozoön viewed laterally. B. The caudal portion, under higher magnification showing the forward extension of the keel.

spermatozoön from that of the plethodontids so far as is known (Noble and Weber 1929).

The spermatozoa of *A. opacum* differ from those of *A. mexicanum* as figured by Retzius (1906) in their shorter lash on the tail, the longer head without a barb, and in the less protruding centriole of the middle piece. Under oil immersion the head of the spermatozoön is found to taper to a very fine point. In some preparations the delicate point, or acrosome, may be bent over, but we have failed to find a distinct barb present. This is the more surprising in that the barb is found on the acrosome of many other species of salamanders (Wilson 1925). In our stained preparations the middle piece has a very distinctive appearance. Its anterior fifth or at least the margins of this region take a deep blue stain in striking contrast to the remainder of the middle piece, which stains a bright pink. The spermatozoa vary somewhat in length. Well-fixed spermatozoa are more than six times as long as the structures Lantz described. We have failed to find the "numerous other much longer and slightly thinner filaments" unless these be represented by the sperm heads which, to judge from Lantz's figure, he apparently did not see. Spermatozoa in our smear preparations vary from 480 μ to 530 μ in total length. The parts of a typical spermatozoön measure as follows: head 150 μ, middle piece 10.2 μ, tail exclusive of lash 320 μ, lash or end piece 7.5 μ.

The Egg

There is a general agreement among the various writers as to the number of eggs laid by *A. opacum*. Mann (1855) reported 108 eggs; McAtee (1907) 50 to more than 150; Dunn (1917) over 100; Bishop (1924) two sets of 102 and 73 eggs; Lantz (1930) 94 the first year, 103 the next, for his laboratory specimen. Fifteen clutches taken at Oakwood, all of which we are reasonably certain are single sets, give the following figures: 75, 81, 101, 122, 125, 132, 139, 143, 147, 167, 173, 191, 193, 226, 232, resulting in an average of approximately 150 for the typical sets. We found one set at Oakwood which contained 340 eggs. Since this nest was guarded by but one female and was somewhat off from the main nesting area, it may have been a single set. This number is so large, however, that we do not include it in our average. In a great number of cases in the principal nesting area, as has been stated above, it was not possible to tell where one set began and another ended. In addition to the close proximity of the nesting depressions, as a factor in bringing this situation about, the females apparently move along the tunnels during oviposition, which results in the stringing out of many clutches. A number of eggs apparently had rolled away from the main portion of the sets, for eggs would be found scattered singly or in little groups at various points along the principal nesting tunnels.

Measurements of the eggs with their capsules in the field ranged from 2 to 5 mm. according to the degree of moisture to which they had been exposed. It was subsequently determined in the laboratory that the egg was capable of desiccation to a point where it measured approximately 1.5 mm. without injurious effect. Two batches of 50 eggs each, in this condition when found in the field, weighed 7.2 gms. and 6.68 gms. After twelve hours immersal in water they had gained 5.2 gms. and 6.84 gms. respectively. In another twelve hours

they had gained 2.2 and 1.48 gms., making their final weight 14.6 and 15 gms. respectively. After this there was no further increase in weight. One Oakwood clutch of 125 eggs was divided into five equal portions which weighed, separately: 3.2, 2.75, 4.5, 3.4, 3.92 grams. After twenty-four hours in water their respective weights were 7.2, 6.5, 7.38, 6.5, 6.75 grams. A clutch of 154 eggs from Rock Creek Park weighed 21 grams as taken from the nest. In twenty-four hours immersion it increased 17.75 grams in weight. Another twenty-four hours in the water increased its weight 1.5 grams. From this it will be seen that the eggs, in their normal condition as found in the nest, are capable of absorbing approximately their own weight in water, during the first twenty-four hours immersion. After that period the rate of absorption drops to a negligible point.

Although the eggs are normally deposited separately, we encountered several instances in which a cluster of several eggs were stuck together, adhering to each other by their sticky outer coverings. We also recorded several instances of two eggs' being connected by a well-developed pedestal. In two instances two eggs were enclosed in a common envelop.

The egg of *A. opacum* has been described as being enclosed by two envelops, an outer and an inner, separated by a jelly-like layer (Bishop 1924). Lantz (1930, p. 323) states:

"The egg is spherical, 4 to 5 mm. in diameter and possesses two membranous envelops, separated by a coat of jelly. A much less viscous medium surrounds the vitelline sphere, which measures 2.5 mm. in diameter."

The egg of *A. opacum* preserved in formol appears to have four capsules: a clear wrinkled outer capsule, a grayer and thicker capsule immediately within this, a clearer capsule of the same or slightly greater thickness coming next in order, and finally a thin but highly refractive capsule forming the innermost of the series. Between the inner capsule and the egg with its closely adherent vitelline membrane is a large water space. The vitelline membrane, often difficult to see in living eggs, is clearly visible in these eggs when a cleavage furrow is viewed from the side. A typical egg measures 2.8 mm. in diameter. The greatest diameter of the water space is 4 mm. The diameter of the surrounding envelops, reading from within out, is as follows: 4.1, 4.5, 4.8 and 5 mm.

In the fresh eggs these same capsules may be recognized readily even in those four months old and ready to hatch. The outer capsule is thin and soft. Dirt and other debris adhere to it. Within this is the thicker and resistant second capsule. When this is cut through, the embryo, enclosed in the highly refractive inner capsule and the one surrounding that, slips readily through the puncture. It is then seen that the capsule third from the outside is very soft and gelatinous as Bishop and Lantz state. We prefer to call this a capsule rather than a jelly layer since it has the structure of a capsule in eggs preserved in formol. In living eggs it differs from a capsule in that it forms an amorphous mass when pulled free from the other capsules. In fresh eggs ready to hatch the water space surrounding the vitelline membrane is eliminated by the pressure of the large embryo. In brief, we recognize the same structures Lantz described in the egg of *opacum* but we call his "coat of jelly" an egg capsule and we recognize an additional outer capsule formed of soft adhesive material.

The Brooding Habit

Much has been said of the attitude of the female *A. opacum* toward her eggs. It is generally agreed that an adult is usually associated with the egg mass and the guardian upon examination has been found to be a female. In 1929, we collected eighty-one females guarding their eggs. Only one male was taken in the nesting area. It was found near a female with three freshly laid eggs in a very indistinctly formed depression under a brush pile. This case may indicate that, in nature, oviposition closely follows impregnation. Lantz (1930) found that oviposition did not occur until two weeks after fecundation in his laboratory specimens. We have seen spermatophores produced the same night that eggs were laid in the laboratory (September 28). Only one female was found outside the principal nesting area at Oakwood during 1929. This was a spent animal and was not associated with any eggs although it is possible that her nest had been overlooked. In some instances it was not possible to identify the respective broods of adjacent females, the clutches being so confluent that we were unable to separate them. In several instances nests were found unattended, in both the Oakwood and Rock Creek sites, and at another point nearer Oakwood. It is quite possible that the disturbed females in these cases made off before discovery. As will be pointed out below, the female will usually desert the eggs upon being disturbed.

Mann (1855) describes the female as being found "curled up" on top of the eggs. Dunn (1917) reports the mother as "lying on top of them." Lantz (1930) writes the "female sits on the eggs." In our experience the female was usually found on the periphery of the egg mass, the tail either turned toward and encircling some of the eggs or turned away from them. The clutch itself was invariably too large and too well spread out to permit the female to come into contact with more than a small portion of it at a time. When completely exposed the female usually pushes her snout into the egg mass, a reaction apparently due to negative heliotropism. Often, when a convenient means of escape is at hand, the female departs with celerity.

In the plethodontid salamanders the female will return to her eggs, apparently being attracted by them. Wilder (1917) found that a female *Desmognathus fuscus* will brood the eggs of another female. We have performed some experiments both in the field and in the laboratory to determine how close is the bond between the female *A. opacum* and her eggs. In the field brooding females were marked for identification by ligatures attached to the limbs. Then these females were transferred into one another's nests. In one instance, one of the females remained in the strange nest into which she was placed the day before, while the rightful owner of the nest disappeared from the strange nest into which she had been placed. Marked specimens were removed to distances of from twenty-five centimeters to one meter from their nests. The nests were carefully covered but the next day no female was found to have returned to her nest. In the case of two adjacent nests found unattended the first day, a female was found to have appeared and come into contact with one of the groups of eggs the next day.

In the laboratory a crystallizing dish was filled with clay sub-soil from the

nesting area. Inter-connecting depressions, six in all, corresponding to those in which the nests were found, were made in the clay. A clutch of eggs was placed in one of these depressions. The whole was then covered with a layer of moss and leaf mold, to correspond to the conditions in the nesting area. The female found with this clutch was then placed in the dish. Although she stayed in the depressions during a period of twenty-seven days, she moved from one to another without evincing any preference for the one containing her eggs, but showed a disposition to remain for some time in any one depression.

Four nests were placed in soil and débris in a large tank. The nests were then covered with a layer of moss. The four females to whom these nests belonged, having been marked for identification, were placed in the tank. During a period of two weeks they remained in depressions other than those containing the nests. It was again noted that the animals, once located, showed little disposition to move.

Ten nests were placed in crystallizing dishes. The clutches were placed in the centers of the dishes, surrounded by layers of moss and débris. During a period of thirty days no marked tendency to remain with the egg mass was observed in the female. Depressions in the moss seemed to be as satisfactory as the egg mass for the female. The coiled attitude, observed in females associated with their eggs, may also be assumed by the animals when occupying positions removed from the eggs.

From these experiments it would seem that the eggs lack any great attraction for the female *A. opacum* and that definite orientation toward the eggs, such as is exemplified by *Desmognathus* (Noble and Evans 1932), is lacking in this ambystomid. In the laboratory while these experiments were being carried on we had a brooding *Desmognathus fuscus* and a *Plethodon cinereus* which would invariably return to their eggs. Under the conditions imposed in the laboratory there was no doubt that the female *A. opacum* was not attracted by her eggs as strongly as the terrestrial plethodontids mentioned were attracted by theirs.

It seemed to us possible that the disturbance caused by transporting the salamanders might have prevented the normal appearance of a brooding instinct in the laboratory. Therefore, we decided to secure further data on the duration of the brooding period under natural conditions. In the Washington area during 1931 we secured the following data:

In Rock Creek Park on October 12 most nests in the upper part of pond, where it was damp, were found to be deserted. In the lower pond area, where it was drier, some females were found with eggs. Four nests with females were located under a large log pile. One could view these without disturbing them by moving the top log. The temperature on this day was 10° C. There was only a trace of water in the pond but the ground was damp. On October 14, with the temperature at 17.5° C., a slight drizzle falling and making the ground wet, only two of the females were present. We shall call these No. 1 and No. 4; the missing two, No. 2 and No. 3. On October 15, with the temperature at 17.8° C., the rain falling and the ground very wet, all females were guarding their nests except No. 2. On October 16, with the temperature 11.5° C., the rain falling and the ground under the logs wet, females No. 3 and 4 were present but the others were not seen. On October 17, with the temperature at 10° C. and the

ground saturated, all females had left their nests. On October 21, although the ground was dry and the temperature up to 11.2° C., the nests were still deserted. Hatching was in full sway on November 21 when the ground was again very wet. It had been raining hard during the week. On November 22, only eight unhatched eggs were left in nest No. 1, only fifteen in nest No. 2 and forty-three in No. 3.

We made less extensive observations in other localities. For example at a pond on the Glover estate, Georgetown, D. C., on October 4, the temperature was 24° C., and the ground was very dry. Out of fifteen nests seen in one locality and seven in another, only two lacked an attending female. These observations agree with those made during 1929. During early October when the ground is dry the nests are usually attended by the maternal parent.

In Dead Run Swamp on October 11, the temperature was 16° C. and the ground was damp because of extensive rains during the previous week. Most of the nests found were deserted and contained swollen eggs. Only three females were found with eggs near one pond and only one nest with brooding parent near the other pond. Three nests were selected for further observation. No. 1 contained 150 eggs, No. 2 had 225 and No. 3 held 170 eggs. Larvæ could be seen within the egg capsules and a trace of a balancer was observed in specimens examined. This locality was not visited again until October 18. Then the temperature averaged 10° C. No females could be found near their nests. All eggs were found to be greatly swollen. The larvæ examined had absorbed their balancers and some had hatched. In set No. 1 about seven eggs had hatched, in set No. 2 about three. Only nest No. 3, which was on drier ground, had no hatched eggs.

It was very interesting to find that certain salamanders had been feeding on the eggs. Two *Desmognathus fuscus* and no less than five *Eurycea bislineata* were caught very near the eggs. The *Desmognathus* stomachs contained *opacum* eggs and larvæ. Three capsules were taken from the first *Desmognathus* and four capsules and partly digested *opacum* larvæ from the second. Several predacious beetles also were seen with the eggs. This observation indicates that if the female leaves her charge before hatching, the eggs may be devoured by *Desmognathus* and apparently by other enemies.

This conclusion was confirmed by later observation. On November 1, further examination of these nests in Dead Run Swamp was made, when the ground was dry and the temperature was 7.2° C. All three sets of eggs were reduced. Nest No. 1 contained one hundred eggs, No. 2 held only ninety, and No. 3 contained one hundred and twenty eggs. Again Amphibia were captured with *A. opacum* eggs in their stomachs. One *Eurycea bislineata*, two *Desmognathus fuscus* and one *Rana clamitans* were found to have eaten the *opacum* eggs. Many beetles were found in the nests. It does not follow that these amphibian enemies had been attracted to the eggs by smell alone. In the laboratory we have seen a *Desmognathus* snap at an *opacum* larva moving within its egg capsules. On November 15, the egg number was reduced to seventy-five in nest No. 1, fifty-eight in No. 2 and ninety-three in No. 3. Some insects, but no Amphibia, were found in the nests. On November 1 and November 15 a search was made for hatched larvæ in the nests, but none was found.

Unfortunately no opportunity permitted our following the fate of eggs in other localities. These Washington observations indicate:

1.—The female parent leaves her brood about the end of the first month, and apparently after heavy rains.
2.—Before deserting her eggs, the female may move about. Our observations show that she does not guard her eggs continuously.
3.—In the field, as in the laboratory, many eggs hatch on land when the ground is saturated. Probably crevices or crayfish burrows may hold sufficient moisture to permit the survival of these larvæ, which are structurally fitted for life only in water.
4.—When the female leaves, the eggs may be eaten by salamanders, insects or other enemies.
5.—These enemies as well as droughts, considered in another section, play an important role in keeping the species in check.

Lantz (1930) reports that his female *A. opacum* in the laboratory remained with the eggs steadily at first and intermittently later on. We found females in the field brooding their eggs in the daytime and at night. Our field observations indicate that the female may return to the eggs once she has left them. We secured evidence, however, that the females do not forage for food, at least not during the early part of their brooding. We examined the contents of the stomachs of twenty-six brooding females taken in the Washington region in October 1929. Of these nine were empty, and fourteen contained nothing but bits of shed skin and vegetable débris, which, no doubt, had become entangled in the skin at the time of swallowing. The other three contained, besides the cast skin and vegetable matter, (1) an ant and another small hymenopteran, (2) a coleopterous larva, (3) an egg, apparently in early cleavage stages. It seems reasonable to believe that the last item was accidently swallowed and that *A. opacum* brooding females do not feed on their eggs as does the male *Cryptobranchus*.

Lantz (1930, p. 324) remarks in regard to *A. opacum:* "In the natural habitat of this species the eggs are laid in the vicinity of ponds, and the female has been observed to move them to higher grounds when the ponds rose." Our observations in the field lend no support to this assumption. In the Oakwood nesting area we placed a female and her eggs in a mud basin, in a tiny spring pool at the lowest point of the pond bottom. This basin was so arranged that the water partly covered the clutch, but some of the eggs were in contact with the surface. The female was placed on top of the eggs. The next morning she had deserted the nest in the improvised basin. In the Rock Creek station, however, a nest was found partially submerged, the egg capsules being just in contact with the water's surface. The female in this case was sitting on top of the eggs. As we have stated above we have not found this to be the normal position. This nesting site, customarily dry at this time of year, had been flooded by heavy rains which had occurred during the previous week. The instance would indicate that the female does not leave the eggs until full submergence occurs unless she is disturbed. However, as reported above, we have seen other cases of the female's leaving before this time. In most of the nests

we observed there were no lower and upper levels available to which the female could move the eggs and this, coupled with the fact that there would be obvious difficulties in the way of a salamander's moving a batch of one hundred or more separate eggs, makes it seem hardly possible that such behavior ever occurs. The female may play some part in keeping the eggs moist, however. The bladders of all brooding females were found to be greatly distended with fluid and it is quite possible that this factor would be of service in moistening the eggs, as has been suggested in the case of *Aneides lugubris* (Storer 1925). However, the brooding female may have other duties; we never found her nest attacked by the Amphibia or by insects while she was present. Her presence, therefore, may be of some advantage to the eggs.

Development

It is usually assumed from the work of Dunn (1917) and others that the eggs of *A. opacum* can withstand long periods of desiccation and that they do not hatch until covered by the rising waters of the ponds near which they are laid. Lantz (1930, p. 324) has reported some observations which are at variance with this view. He states:

"Considerable latitude exists with regard to the time of hatching and the larvæ will remain alive inside the egg for a very long time if for some reason hatching is delayed. In one egg kept on land the embryo lived 207 days; another which had been immersed in water the day after it had been laid, remained alive four days longer than the previous."

In order to secure more data on the relation of water to growth and to hatching in *A. opacum* we have repeated the experiments of Dunn and of Lantz on large series of eggs. We selected a number of clutches and divided each clutch into three approximately equal parts. One group (a) was placed in water 4 to 5 cm. in depth. A second series (b) was placed on saturated sand while a third series (c) was arranged on dry packed sand in chambers. Covered crystallizing dishes of the same diameter were used for containers in each case. The results of these experiments may be briefly listed:

Experiment 1a.

Forty-two eggs swollen with moisture in the field, placed in water on November 4. In ten days' time 92.5 per cent had hatched, as follows:

November	5	6	7	8	9	10	12	13
Number hatched	7	10	1	3	4	1	6	5

The balancers were large in the larvæ first hatched and reduced in the last. There was little change in the limbs. The first larvæ hatched were 16 mm. in total length, the last 17 mm.

Experiment 2a.

Twenty-five eggs, less swollen than those of Exp. 1a, were placed in water on November 4. In fifteen days 76 per cent had hatched.

November	4	5	6	7	8	10	11	14	19
Number hatched	2	1	7	1	3	1	1	2	1

The balancers were developed in all the larvæ at hatching, but there was

a decided difference in the limbs. In the first hatched the digits of the fore limb were not differentiated and the rear limb rudiments were not visible. In the last hatched three digits were present on the fore limb and the hind limb rudiment was present.

Experiment 3a.

Fifty-six eggs, found in a desiccated state in the nest, were placed in water on November 5. In forty-one days 88.4 per cent of the eggs had hatched:

November–December	5	6	9	13	17	18	23	1	4	6	7	8	9	11
Number hatched	1	1	2	1	1	2	3	11	1	5	7	4	6	1

The first hatched was only 13 mm. in length. It had large balancers and rudimentary fore limbs. The last hatched had the balancers practically gone and three digits visible on the fore limb.

Experiment 4a.

Sixty-three eggs, swollen with moisture from their damp nests, were placed in water on December 4 and within seven days all had hatched.

December	5	6	7	8	9	10	11
Number hatched	7	2	11	7	9	14	13

The first hatched was 20 mm. in length, the last hatched was only 18 long, and had the fore limb digits in a less differentiated stage than the earlier hatched one of larger size. The balancer of the last was well reduced, giving evidence of its greater age. These two larvæ are represented in figures 92 C and D.

Experiment 5a.

Forty-eight eggs, found desiccated in the nest, were placed in water on December 4. In twenty days 75 per cent had hatched:

December	7	8	9	10	11	12	13	19	20	24
Number hatched	1	1	13	7	5	3	3	1	1	1

The first hatched was only 13 mm. long with the fore limbs in the limb bud stage. The lips were barely formed and the balancers were large. The yolk sac was still prominent. The last hatched measured 18.5 mm. in total length. Three digits were present on the fore limb, a rudiment of the hind limb had appeared and the balancers were reduced.

Experiment 6a.

Twenty-eight much desiccated eggs were placed in water on December 4. In thirty-two days all had hatched:

December–January	5	7	8	10	11	12	16	21	22	24	27	28	30	31	5
Number hatched	3	1	1	2	7	1	1	1	3	2	1	2	1	1	1

The hatching of these submerged eggs extended over a period of a month. The enormous difference between the first and last hatched is shown in figures 92 A and B. The first hatched measured 10.5 mm. in total length, the last 18.5 mm. In the first, the lips, the eyes and the gills are rudimentary; the fore limb is represented by a bud. A large yolk sac and a not completely developed balancer are present. In the last hatched the balancer has been absorbed and the other larval structures are well developed.

Experiment 7a.

Thirty-four eggs were immersed in water on December 4. These had been partly dried in the field and were small. Over a period of seventy-six days, only 75.38 per cent of the eggs hatched.

December–January–February	10	11	16	22	2	6	7	8	1	4	24
Number hatched	1	2	3	9	4	3	1	1	1	1	1

The first hatched were only 13 mm. in total length and, like the first hatched in the previous experiment, had rudimentary gills and fore limbs. The last hatched was 19.5 mm. long and had four digits on the fore limb, the hind limb rudiment present, and the gills elongate.

In these experiments eggs frequently failed to hatch. Bishop (1924) found small nematodes emerging from the egg capsules of *A. opacum* simultaneously with the larvæ. He points out that while these parasites seemed to have no effect on the hatched larvæ, they may have accounted for the death of some eggs that failed to hatch. No nematodes were noted in our experiments. A dead egg very soon molds, and mold did not grow on most of the eggs until all the larvæ reported above had hatched. This indicates that the death of the larvæ was due to failure to hatch.

Several conclusions may be drawn from these results:

(1) The development of the encapsulated larvæ is correlated with the degree of moisture to which the eggs are exposed during the time they are in the nest. Swollen eggs usually contain well developed larvæ; desiccated eggs hatch out larvæ in a more embryonic condition.

(2) The time required for hatching, after immersion in water, is variable, ranging from seven to seventy-six days for these seven clutches. Again, the eggs which had been swollen with moisture require the least time in which to hatch.

(3) The percentage of eggs which normally hatch from each clutch is variable, ranging in these cases from 75 to 100 per cent and averaging about 86.75 per cent. In the case of those eggs which failed to hatch, there was always a normal development for a certain period.

(4) The larvæ may emerge from the egg in any one of a wide range of developmental stages.

Dunn (1917) reports balancers and fore limbs on his newly hatched larvæ. Bishop's (1924) specimens all lost their balancers before hatching. Lantz (1930) reports balancers present on his larvæ at hatching, also digits on the fore limb and a rudiment of the hind limb visible. He says, however, that if hatching is retarded the larvæ may emerge from the egg without the balancers and with a rudimentary fourth finger. The total lengths given for hatching specimens [15 mm. (⅝ inch), Deckert, 1916; 19 mm., Brimley, 1920; 15–19.5 mm., Lantz, 1930] do not fully cover the range exhibited by our series. Our specimens at hatching range from very early larval stages in which the eyes were not yet functional, the lips barely formed, the gills still without rami, and the fore limb in a rudimentary bud stage, to advanced stages in which the balancers had entirely disappeared, the four digits of the fore limb had become differentiated,

the rear limb bud had appeared and the larva had assumed a mature larval habitus. The escaping larvæ ranged from 10.5 to more than 20 mm. in length.

In the experiments comprising series "b," as stated above, the eggs were placed on saturated sand, in moist chambers. The sand was banked at an angle and a small amount of water was kept at the bottom of the slope to in-

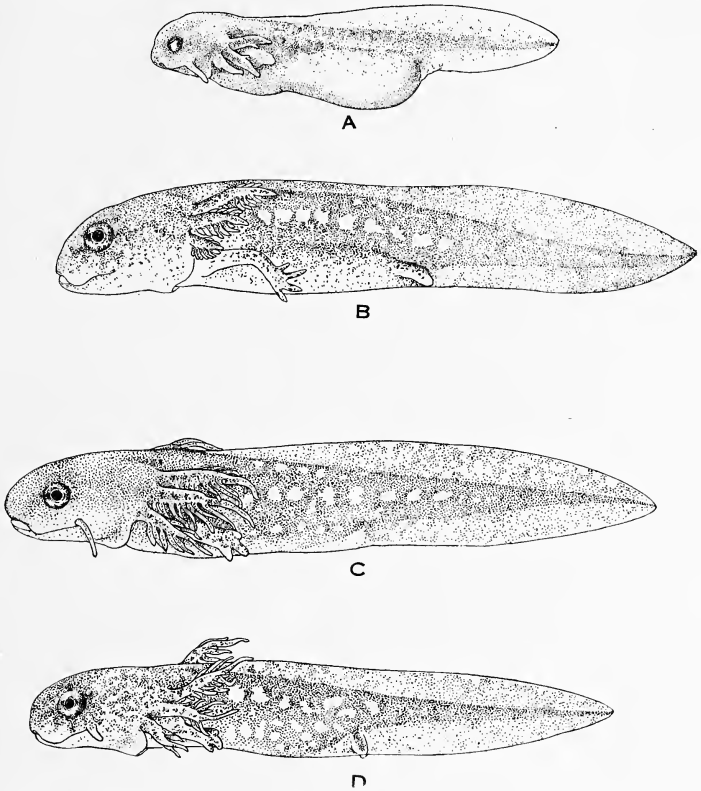

Fig. 92. Larvæ of *Ambystoma opacum* at the time of hatching, × 4.2. Balancers, rudimentary gills and limb buds may be present, or the balancer may be absorbed and the gills and anterior limbs well developed at this time. A and B are larvæ from the same egg mass, the larva shown in B having hatched January 5, 1930, a month later than the larva shown in A. C and D are larvæ also from a single egg mass, the second (D) having hatched six days after the first. Although the reduced balancers indicate that the last hatched larva is in a more mature stage of development, the larva is not as large as the one hatched nearly a week earlier.

sure complete saturation. The eggs, however, were not in contact with the water. In five of the seven dishes some of the eggs hatched, after remaining for some time on this saturated medium. Some of the larvæ made their way into the shallow water at the bottom of the dish. If they were unable to reach the water, as was usually the case, they seldom survived more than a few hours. We briefly summarize the experiments in this "b" series below.

Experiment 1b.

Forty eggs were placed on saturated sand on November 4. The first hatched forty-one days later, the last after fifty-four days, as indicated below.

December	14	17	24	25	26	27
Number hatched	1	2	1	3	1	1

Only 22.5 per cent of the eggs hatched. Some of the remainder lived in good condition until January 28 without hatching. One larva removed from the capsules on January 7 had lost the balancers and was developing the hind limb buds.

Experiment 2b.

Twenty-five eggs were placed on saturated sand on November 4. Only 28 per cent hatched, the first after fifty-two days, the last after one hundred days. Their hatching schedule was as follows:

December	25	28	29	Feb. 2	10	17
Number hatched	1	1	1	1	1	1

Two unhatched eggs were still alive on March 4. The last hatched, unlike the first hatched, had lost the balancers, differentiated four digits on the fore limb and had hind limb buds.

Experiment 3b.

Fifty-five eggs were placed on saturated sand on November 4. Only 10.9 per cent hatched, and these from thirty-three to fifty-four days after the beginning of the experiment.

January	6	12	18	19	23	27
Number hatched	1	1	1	1	1	1

All the larvæ which hatched had lost the balancers and acquired all four digits.

Experiment 4b.

Fifty-nine eggs were placed on saturated sand on December 4. Only 20 per cent hatched and these from twenty-one to thirty-six days later.

December–January	24	26	27	28	30	1	8
Number hatched	1	3	1	4	1	1	1

The first hatched had balancers, three digits on each fore limb, and lacked the rear limbs. The last hatched had lost the balancers, had acquired four digits on each fore limb and had developed hind limb buds.

Experiment 5b.

Forty-eight eggs were placed on saturated sand on December 4. Only 12.33 per cent of the eggs hatched and these from thirty-seven to sixty-nine days later. The hatching record follows:

January–February	9	21	23	27	29	10
Number hatched	1	1	1	1	1	1

One egg lived until March but failed to hatch. All the larvæ in this experiment had lost the balancers before hatching. The fore limbs had four digits.

Experiment 6b.

Twenty-seven eggs were placed on saturated sand on December 4. None of these eggs hatched but one lived until January 12. One removed from the capsules on January 6 had lost the balancers and had differentiated all digits on the fore limb.

Experiment 7b.

Thirty-seven eggs were placed on saturated sand on December 4. None of these hatched but apparently they all lived until February 13. One larva removed from the capsules on January 6 had lost the balancers and developed hind limb buds.

Although all workers who previously had considered the eggs of this species have held that complete immersal in water was requisite for hatching, the results of this experiment show that this is not necessarily the case. Contact with a sufficiently damp medium was enough to hatch more than 13 per cent (13.39) of nearly 300 eggs exposed to it. This percentage would have been higher if we had selected only eggs swollen with moisture in their nests for the experiment (See series "a").

The series "c" experiments demonstrate the ability of the eggs of *Ambystoma opacum* to withstand a great amount of desiccation. It will also be seen, from the results, that intra-capsular development was not always retarded by the dry medium on which the eggs were kept.

Experiment 1c.

Nov. 4: Forty eggs placed on dry, packed sand.
Jan. 4: Sixteen eggs still good. One removed from capsule had balancers and rear limb buds.
Mar. 4: One egg left. On removal from capsule embryo was found still to have balancers, a rudimentary fourth finger and hind limb buds.

Experiment 2c.

Nov. 4: Twenty-five eggs placed on dry packed sand.
Jan. 7: All good. One removed from capsule had balancers and a rudiment of the fourth finger.
Mar. 4: One egg left. On removal from capsule larva was found to have lost the balancers and to possess a developed fourth finger and buds of the hind limbs.

Experiment 3c.

Nov. 4: Fifty-five eggs placed on dry, packed sand.
Jan. 4: Eighteen left. One removed from capsule had traces of balancers, fourth finger and hind limbs rudimentary.
Mar. 4: Two left. The larvæ removed had the barest rudiments of balancers. The fourth fingers were rudimentary and the hind limbs still in bud stage.

Experiment 4c.

Dec. 4: Fifty-nine eggs placed on dry, packed sand.
Jan. 6: Nine in good shape. One removed from capsule lacked the balancers; had a fourth finger and rear limb buds.
Mar. 4: Desiccation had proceeded too far at this time.

Experiment 5c.

Dec. 4: Forty-seven eggs placed on dry, packed sand.

Jan. 6: Eleven in good condition. Balancers lacking on specimens taken from capsules at this point, four digits on fore limbs, rear limb buds appearing.

Mar. 4: Four remaining eggs recently dead.

Experiment 6c.

Dec. 4: Twenty-six eggs placed on dry, packed sand.

Jan. 6: Sixteen appear viable. One removed from capsule lacked balancers and showed hind limb buds.

Mar. 4: Four alive. Much desiccated. Balancers gone but fourth fingers and rear limbs still comparatively rudimentary.

Experiment 7c.

Dec. 4: Thirty-four eggs placed on dry, packed sand.

Jan. 6: Thirteen good. Example removed from capsule has no balancers but still had yolk sac; fourth finger rudimentary; no hind limb buds.

Mar. 4: Two good. Traces of balancers in one, none in other. Both embryos showed rudimentary fourth fingers and hind limbs.

To summarize, of one hundred and twenty eggs over a month old at the beginning of the experiment, practically 40 per cent were capable of standing a month's rigorous desiccation. Slightly more than 3 per cent survived two more months. More than one-third of one hundred and sixty-six eggs at least two months old survived a month's desiccation. A little more than 3 per cent lasted another two months under the same conditions. We may assume from these results that the eggs are capable of withstanding the several periods of drought which take place in the field. Conditions there would hardly approximate the degree of aridity to which the eggs in this experiment were exposed. Under more normal conditions a much greater percentage of the eggs will last over similar periods of time.

The longest period on record for eggs remaining within the nest is fifty-two days, recorded by Brimley (1920). Bishop (1924) kept the eggs more than a month. Lantz (1930) reports one egg kept on land in the laboratory, in which the enclosed larva lived for two hundred and seven days. We have kept eggs of *opacum* in good condition for over a year in our ice box at temperatures of 7° to 10° C. Lantz (1930, p. 324) comments on his long-term eggs: "If, however, hatching is retarded too long, the larvæ weaken gradually and become incapable of normal development, even if they finally succeed in freeing themselves from their envelopes." In the case of eggs kept seven months in the ice-box at 7° to 9° C., a fair percentage hatched out and developed normally when placed in water, the larvæ being fed *Daphnia* and *Enchytræus*. Our eggs over a year old did not hatch, but the enclosed larvæ were alive.

In view of these findings we have endeavored to determine if *opacum* normally ever winters over in the field. In the Washington area the fall of 1930 and the winter of 1931, were unusually dry. Evidence that some of the eggs survived this drought was obtained during March 1931, when several batches

of viable eggs were found in the still dry breeding ponds. In the Dead Run Swamp area, on the Virginia shore of the Potomac opposite Plummer's Island, two batches containing seven and thirteen eggs were found on March 5. Two days later a batch of fourteen eggs was found in the same locality. All of these eggs contained living larvæ. Most of them hatched immediately upon being placed in water. Some of the eggs in each batch—one in the first, three in the second and three in the third—failed to hatch after remaining immersed in water for several days, although the larvæ were alive when removed from the capsules. Batches of twelve and fourteen eggs were found in Rock Creek Park breeding sites on March 12 and one batch of fourteen was found near Priest's Bridge, Md., March 14. Most of these were viable but, as with the other sets, a few in each batch failed to hatch after immersion, although containing living larvæ. Half of the eggs in the last batch were placed on wet blotting paper, the other half being submerged in 2 cm. of water. Except for the few which failed to hatch, both groups of eggs hatched within the same period of time, one hour. All of the larvæ from these wintering-over eggs were in an advanced stage of development, possessing well developed branchiæ and rear limb buds and having the digits of the fore limbs well developed. They were all in a much weakened condition and extremely thin. They readily responded to efforts to feed them with entomostracans but failed to thrive on a diet of enchytræids. The failure of some of the larvæ to escape the egg capsules is paralleled by our experience in the laboratory and shows that the encapsulated larva may reach such a condition, if hatching be delayed, that the hatching mechanism may become unable to function. The number of eggs in these delayed batches (average twelve) is much below that which we have shown to be average for normal clutches at or near the time of laying. Hatching due to chance wetting caused by rains and thawing, or destruction by enemies, or both factors, probably account for this reduction in number. Although no empty egg capsules were found with these eggs, decay over the long period of time or extreme desiccation may have accounted for their disappearance. Observations made during the fall of 1931 in the Washington area indicate that amphibian and insect enemies destroy a high percentage of the eggs. These observations are discussed above.

In the present paper we are not describing either the early development of the egg or the later larvæ secured from the ponds. Such descriptions to be of value should point out the resemblance and differences between these stages in the life cycle of *opacum* and similar stages in other species of *Ambystoma*. At the time of writing we do not have adequate comparative material at hand. Mr. J. A. Weber has secured metamorphosing *opacum* at Miller's Place, July 4, 1929, and we have many records for *opacum* larvæ from Long Island ponds during the spring months.

The purpose of this paper has been to report in detail our observations on some of the more distinctive features in the life history of *A. opacum*. The most unusual feature of this life history is the habit of laying on land eggs which are destined to produce aquatic larvæ. It may be of interest to inquire further into the probable significance of this habit in the economy of the species.

Dunn (1917) has suggested that this terrestrial stage in the life cycle may represent an adaptation to the Atlantic coastal plain, with its conditions of

flood and drought. It does not seem to us that the distribution of the species lends support to this view. The species occurs throughout most of the Piedmont plateau and is found in the New England upland and in various areas in the interior lowlands. Its requirement of a semipermanent pond, which must contain water during at least the winter and spring months, is better fulfilled by the irregular topography and extensive drainage systems of such a region as the Piedmont plateau. In the coastal plain, with its relatively much more porous top soil and its greater rate of evaporation, these ideal conditions are less likely to be found. One of us has recently collected *opacum* in some numbers at Biloxi, Mississippi. The species was found thirty miles from the coast in hardwood swamps. According to Allen (1932) this species does not occur at all on the sandy coastal plains skirting the gulf coast at Biloxi. Here *Ambystoma talpoideum* breeds in small pools. This species which flourishes in a sandy coastal plain has not given up the water breeding habits of *A. maculatum*.

Those who have had field experience with species of *Ambystoma* have often found that different species occurring in the same area breed either in different though perhaps adjacent ponds, or if in the same pond, at different periods. Smith (1911) pointed out that, in the vicinity of Ann Arbor, *A. maculatum* and *A. tigrinum* breed in different ponds, "each species occurring to the exclusion of the other." He noted only a single exception to this rule. We have found the rule to hold for the Syosset area of Long Island. Piersol (1929) shows that *A. jeffersonianum* breeds before *A. maculatum*, in the pools around Toronto. The larvæ of the *A. jeffersonianum* are well developed by the time those of *A. maculatum* hatch, and feed largely upon them. This condition is balanced by the factor of pathologic polyspermy in a large proportion of the eggs of *A. jeffersonianum* induced by the low temperature of the water in which they are laid. The irregular development which follows destroys many of the eggs of *A. jeffersonianum*. Since this species is known to be an earlier breeder than *A. maculatum* throughout the common range of the two species, the temperature factor would appear to keep the more voracious *A. jeffersonianum* in check. Throughout much of its range *A. opacum* occurs in the same area with *A. maculatum*. The latter species produces more eggs than the former. Wherever the forms occur together as near Coram, Long Island, and in the Washington stations, they may breed in the same ponds. It may well be that after the perils of the several preceding months, the well-developed larvæ of *A. opacum* are so greatly reduced in numbers that *A. maculatum* is able to continue successfully. Such factors as active enemies in the more southern portion of the range, extreme cold with resultant ice in the northern parts of the range, together with periods of too prolonged drought throughout the range, must reduce greatly the number of *opacum* larvæ which live to transform. Since both species are so exceedingly abundant in the same area one would look for some such balance, as the larval habits appear to be the same. The adults of the species range over a large area but the number of available breeding sites within the area is comparatively small and would result in much concentration were the spawning dates to occur simultaneously. Therefore, we look upon the fall breeding and terrestrial egg-laying habits of *opacum* as an adaptation to avoid competition with other species of *Ambystoma*.

Mechanism of Hatching

Previous to the publication of our preliminary note (Noble and Brady 1931) on the hatching mechanism in *A. opacum* it was generally assumed that the larvæ escaped from the egg capsules by mechanical means. Bishop (1924) states "the embryo breaks out" of the capsules. Brimley (1920) mentions the larvæ as "trying to hatch out" before the eggs were placed in water. Lantz (1930) assumes that the egg capsules are weakened by the water. He states:

"With regard to the mechanism of hatching itself, it seems probable that a large part is played by sudden swelling of the eggs through rapid absorption of water up to the bursting point of the membranes. Eggs immersed in water in the earliest stages will develop normally, but the larvæ seem incapable of hatching or they do so very late, when obvious disintegration of the membranes has taken place."

Since larvæ may hatch either head or tail first it appeared highly probable that the capsules had given way at their weakest point to the pressure exerted by the half-coiled embryo within. However, in the experiments reported above we found that in many clutches of eggs immersed in water some of the eggs will fail to hatch even though they contain living embryos. It seemed strange that in eggs developing side by side all should not hatch at approximately the same time if the only factor concerned was that of water absorption with an accompanying disintegrating effect upon the capsules. Further, as stated above, we observed many instances of eggs hatching on damp sand. These observations forced us to reject the conclusion reached by Lantz that:

"The conditions required for normal hatching seem to be for the eggs to remain on land in moderately humid surroundings until mature, and then to be suddenly immersed in water."

The eggs obviously could hatch under other conditions, and moreover many eggs did not hatch when placed in the conditions which Lantz indicated. This caused us to search for another mechanism of hatching. One of us had previously shown that in *Alytes*, the Midwife Toad, the eggs could also be induced to hatch on land. In this species the larvæ were freed from the egg capsules apparently by the digestive action of a series of unicellular glands scattered over the snout (Noble 1926). These hatching glands had been previously described in an aquatic frog, but were unknown in any urodele until Wintrebert (1928) reported them in *Ambystoma mexicanum*. Sections of the larval *A. opacum* just before hatching reveal large numbers of these unicellular glands present over the snout and extend along the sides and top of the head. None are present on the tail.

The hatching glands are large epidermal cells which stain intensely with plasma dyes (Fig. 93). In Mallory's anilin blue connective tissue stain, following fixation in Zenker's solution, the hatching glands stain yellow while the remainder of the epidermis takes a bluish stain. The hatching glands are not to be confused with the only other large cells in the epidermis, namely the Leydig cells. In haematoxylin-eosin preparations the latter stain feebly and show a reticular cytoplasm while the hatching glands stain intensely and have a finely granular cytoplasm. The hatching gland cells are widely scattered over the

head in *A. opacum* and only rarely do two of them lie side by side. In *A. opacum* each cell has its base in the germinative or basal layer of the epidermis while its distal end reaches the surface. The secretion within the cell crowds the nucleus proximally. A cuticle is absent in the hatching gland cells. In larvæ fixed at the moment of hatching some of the glands may be seen discharging

Fig. 93. Vertical section of the integument of the head of a larval *Ambystoma opacum* immediately before hatching, × 500. The unicellular hatching glands (H. G.) reach the surface and lack the cuticle which forms a conspicuous margin to the superficial epidermal cells. The function of the hatching glands is to digest an opening through the egg capsules which will permit the escape of the larva.

their secretion on the surface. In larvæ treated with pilocarpine the majority of the hatching gland cells have collapsed. A few days after hatching these gland cells have entirely disappeared.

We have studied sections of the heads of several other species of Caudata at the time of hatching. We have found unicellular glands similar in structure to those of *A. opacum* in *Hemidactylium scutatum*, *Plethodon cinereus*, *Desmognathus fuscus* and *Amphiuma means*, species which hatch out on land, and also in *Ambystoma maculatum* and *Necturus maculosus* which hatch in the water. Hatching glands are known not to occur in frogs which hatch fully formed from the egg capsules aided by a cornified egg tooth. It is highly probable that they occur in all other Amphibia.

That these unicellular glands really function as hatching organs has been shown by Wintrebert (1928) in the case of axolotl. In view of the fact that the environmental conditions are so different in the case of *A. opacum* we have endeavored to determine by experiment their function in this form. In one series of experiments we cut the larvæ free from their capsules before hatching.

After anæsthetizing them in a 1 to 4000 solution of chloretone we dipped them for a few minutes in a 1 per cent solution of pilocarpine hydrochloride. A series of eggs was then placed in watch glasses on slightly dampened Scottissue and each brought in contact with the head of one of the larvæ. Within a few minutes all the eggs thus manipulated had hatched, but none of the controls which had not been brought in contact with anæsthetized larvæ.

In order to exclude the possibility that the larvæ inside of the capsules had influenced their own hatching we performed a second series of experiments. The larvæ were removed from the capsules before hatching and their heads and tails cut off. When the tails or bodies were immersed in a 1 per cent solution of pilocarpine and brought in contact with the empty egg capsules lying on damp Scottissue no modification of the capsules was noted even after three hours of contact. When the heads were similarly treated and their dorsal surfaces brought in contact with the capsules a hole was digested either completely or partly through the capsules in the same period of time. The result was the same whether the treated head was brought in contact with the inner or the outer capsule. When the isolated heads were merely immersed in water and then brought in contact with the egg capsule no disintegration occurred during the three hour period. No change occurred in capsules immersed in water or in 1 per cent pilocarpine, alone, during this period.

We have studied the hatching of *A. opacum* both in water and in dilute solutions of pilocarpine. The embryo, or larva, at this time moves about violently within the capsules pressing the top of its head against the enclosing walls at many points. If the top of the head remains in one position for a short time the capsules will begin to soften and the outer surface becomes distended at this point. Fine white fibers appear in the capsules in this region, these being most numerous directly opposite the point of contact. If the embryo should move its position the area remains distended and probing with a needle reveals that this portion of the capsules has softened and lost most of its elasticity. If the tail should be thrust in one of these pockets it may break through to the outside before the head, which has begun its digestive action on another part of the capsule, has emerged at the new point. We have observed cases where tail and head hatched out at the same moment and the larva remained for several minutes threaded through the capsules. In a few cases the embryo moved so frequently that a large part of the inner capsule became opaque before hatching. In all these cases, however, it seems clear from the experiments reported above that the head alone initiates the hatching process.

Since the enclosed embryo is usually very active at the time of hatching, it must exert a certain amount of pressure upon the egg capsules. Eggs brought in contact with filter paper moistened with 1 per cent pilocarpine hatch in a shorter time than is required for egg capsules to become perforated, when they are moistened with the same solution and brought in contact with an isolated head. This apparently is due to the fact that the embryo is exerting more pressure against the capsules than the isolated head is able to do. We have placed a large series of eggs on Scottissue moistened with 1 per cent pilocarpine. One set of controls was placed on Scottissue moistened with a similar amount of salt solution. Another set was placed on Scottissue moistened with the same

amount of water. Only the first set hatched. Many of these began to hatch within a few minutes and all the larvae had escaped within two hours. An isolated head we had previously found would not invariably digest its way through the capsules within two hours after being placed upon them. Some digestive action would have been begun during this period but often it would not be completed.

We have attempted to arrest the hatching process by treating hatching eggs with dilute solutions of atropine sulphate. Embryos which had begun to digest through the capsules after a brief immersion in a 1 per cent solution of pilocarpine were immersed in a 1 per cent solution of atropine. Hatching continued without a marked delay. When eggs were placed on Scottissue moistened with atropine solutions of 5 per cent to 1 per cent no hatching occurred over a period of several hours.

The egg capsules of any species of Amphibian are very rarely found in nature after the escape of the larvæ. It has been shown above that hatching is accomplished by the digestive action of the integument covering the dorsal surface of the head of the embryo. The only structure found in this tissue and not in the integument of the tail and body are the unicellular glands described above. Therefore, we have concluded that they digest the egg capsules at the time of hatching. It might be assumed that the digestive action is continued after hatching and this leads to the disappearance of the egg capsules of *A. opacum* and other Amphibia. We have tested this hypothesis by placing a series of seven recently hatched larvæ in a watch glass with their egg capsules and a solution of 1 per cent pilocarpine. After a week the egg capsules showed no marked disintegration. A second series of egg capsules from which larvæ had hatched was placed in water and a third series of similar egg capsules in a 1 per cent solution of pilocarpine. This experiment was begun on December 13 and on the following January 29 very little disintegration had occurred. The inner capsules were removed from the outer and found to be still intact. These experiments show that the influence of the hatching gland is extremely local. They also show that in contrast to the views of Lantz, water *per se* has little disintegrating effect upon the egg capsules. It would appear that other agencies, possibly bacteria, cause the rapid disappearance of the egg capsules in nature.

Conclusions

1.—*Ambystoma opacum* lays its eggs under leaf mold, sphagnum, dry water weed or other cover in situations which will be flooded by the winter rains.

2.—Egg-laying may occur as early as September 18 on Long Island or as late as October 4 in Westchester County, New York.

3.—The female may dig a shallow depression for a nest or may utilize crayfish burrows or other natural cavities.

4.—The egg-laying site varies from year to year. The degree of moisture in the soil has an influence on the selection of a nesting site.

5.—The breeding female is not at home in the water and will drown if confined in this medium.

6.—There is considerable variation in color in the adults. The breeding males are whiter above than the females but there is no sexual difference in color pattern.

7.—The adults migrate to suitable breeding sites about the middle of September. The males become sexually active earlier than the females and excite a group to sexual activity by engaging in a series of rubbing movements which are exactly the same whether directed toward male or female.

8.—It is probable that the odor of the female excites the male to the production of a spermatophore.

9.—The behavior of the male induces the female to follow him and this brings the female into the right position for picking up the spermatophore. The female, however, may find and cover any spermatophore after she has been excited.

10.—The spermatophore of *A. opacum* has a distinctive form, its head being roughly quadrangular. The spermatozoa are frequently directed outward. They are held together by pelvic gland secretion. The stalk of the spermatophore is formed by the mucous secretion of the cloacal glands and a supporting framework of eosinophilic secretion produced by glands lying on either side of the pelvic gland.

11.—The spermatozoön agrees essentially with that of *A. mexicanum* except that it has a shorter lash to the tail, a longer head, and no barb.

12.—The female lays from 75 to 232 eggs, with 150 for an average. The egg has four capsules. It is capable of great desiccation without destruction. Eggs found in normal nests in nature will absorb approximately their own weight of water within twenty-four hours, when immersed in that medium.

13.—After laying, the female usually remains with the eggs for a period of at least several weeks. She may or may not return to them once she has left them. She does not forage for food during the early part of the brooding period. Eggs brought into the laboratory do no appear to be attractive to the female.

14.—In the field the female deserts the eggs after approximately a month of brooding. Unguarded eggs may be eaten by salamanders, insects, or other enemies.

15.—Eggs will hatch on land as well as in water. Moisture facilitates development. Desiccated eggs do not hatch as quickly as swollen eggs when im-

mersed in water, and the larvæ that escape are more embryonic than those from swollen eggs.

16.—Unhatched larvæ may winter over on land if the winter is unusually dry. Eggs containing such larvæ were collected in the field March 14. Others kept on ice over a year contained living larvæ.

17.—The terrestrial stage in the life cycle of *A. opacum* is an adaptation permitting the species to compete successfully in the same region with other species of *Ambystoma*.

18.—Hatching is accomplished by the digestive action of a series of unicellular glands scattered over the head of the embryo. They occur in other species of salamanders which lay eggs on land as well as in species laying them in water.

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