

No. 4 — *New and Little Known Batoid Fishes from the Western Atlantic*

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¹ Contribution No. 1204 from the Woods Hole Oceanographic Institution.

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INTRODUCTION

During the last five or six years, we have received for study a number of interesting batoids trawled by the U.S. Fish and Wildlife Service vessels "Oregon," "Combat," "Silver Bay," "Pelican," and "George M. Bowers." Most of these were taken in the Gulf of Mexico, the Caribbean and along the coast of South America to as far south as Lat. $01^{\circ}49'N$, off the mouth of the Amazon, but a few were trawled along our eastern coast, to the southward of Cape Hatteras. The catches were made chiefly in depths between 100 and 500 fathoms, with a few shoaler. Eight new species are here described, together with notes on other species. We are indebted to Harvey R. Bullis, Jr., of the U.S. Fish and Wildlife Service, for placing these specimens at our disposal.

Included also is an account of the first western Atlantic record of the pelagic ray *Dasyatis violacea*, captured by the U.S. Fish and Wildlife exploratory vessel "Delaware." For this specimen we thank Ernest D. McRae, Jr., Field Party Chief on the "Delaware" and Frank J. Mather III of the Woods Hole Oceanographic Institution. Drawings are by Jessie H. Sawyer except as otherwise noted.

SYSTEMATIC DESCRIPTIONS
ORDER BATOIDEI
Suborder TORPEDINOIDEA
FAMILY TORPEDINIDAE
TORPEDO NOBILIANA Bonaparte 1835

This species has long been known from both sides of the Atlantic. In the western side it occurs regularly from southern Nova Scotia to northern North Carolina and it has also been reported, on what appeared to be somewhat doubtful evidence, from the Florida Keys, Cuba, and the Gulf of Mexico.¹ We can now report that it is widespread in southern waters, although perhaps in smaller numbers than to the northward, for the present collection includes the following: a female of 330 mm in total length trawled about 85 miles northwest of Trinidad, Lat. 11°36'N, Long. 62°52'W, in 215-230 fathoms, "Oregon" station 2780; another female of 290 mm taken nearby in 290 fathoms, "Oregon" station 2777; also 2 from off the Mississippi Delta, a male of 215 mm in 10 fathoms, and a female of 613 mm in 250 fathoms, "Oregon" stations 1567 and 2285; a female of 450 mm from off the northwest coast of Florida (Cape San Blas) in 11-12 fathoms, "Silver Bay" station 32; a female of 211 mm from off Cape Romain, South Carolina, in 125 fathoms, "Combat" station 284; and 2 females, 300-336 mm from off Cape Fear, North Carolina, in 200 fathoms, "Combat" stations 290 and 356.

This electric ray is the only member of its genus thus far known from the western North Atlantic. Among its relatives in the eastern North Atlantic the typical plain dark chocolate or purplish brown coloration of its upper surface (occasionally with a few obscure darker spots) and the smooth margins of its spiracles distinguish it from *marmorata* Risso 1810 which is prominently spotted above and has long papillae around the margins of the spiracles; and it is marked off from *torpedo* by invariably lacking spiracular papillae, in a much wider caudal fin (21.5-26.0 per cent of total length on 8 specimens of *nobiliana*, 13.3-15.6 per cent on 3 specimens of *torpedo*) and a shorter distance from the origin of the first dorsal to the origin of the caudal fin (17.2-20.7 per cent for *nobiliana*, 22.4-23.7 per cent for *torpedo*).

¹ For discussion of its occurrence in southern waters up until that time, see Bigelow and Schroeder, 1953, p. 105.

Previously recorded from near shore out to about 60 fathoms, its known depth range is now considerably extended, to 290 fathoms, and its range southward to the offing of Trinidad.

Genus **DIPLOBATIS** Bigelow and Schroeder 1948

The outstanding feature of this genus is that each nostril is subdivided into two separate apertures by a cross bridge of stiff tissue. We state also, in our original diagnosis, that the teeth are entirely concealed when the mouth is retracted and closed. However, this statement must now be modified, for on a number of our specimens of *Diplobatis pictus*, listed below, from one to several rows of teeth in the upper jaw are exposed when the mouth is tightly closed, although on others none are exposed.

DIPLOBATIS PICTUS Palmer 1950

Plate I

Study material. Twenty-four specimens, males and females, 77-164 mm in total length, trawled off the coasts of Brazil, French Guiana and British Guiana, between Lat. 02°29'N, Long. 48°58'W, and Lat. 09°31'N, Long. 60°36'W, in 9-50 fathoms, "Oregon" stations 2001, 2037, 2058, 2213, 2215, 2236, 2263, 2267.

D. pictus differs from its close relative *D. guamachensis* Martin 1957 in its relatively narrower and shorter disc, in narrower expanse of pelvics, in location of the folds along sides of tail, and in coloration. Thus in 21 of our specimens of *pictus* the width of disc ranges from 38.8 to 50.0 per cent, the length of disc from 38.8 to 48.0 per cent, and the breadth of pelvics from 28.7 to 36.6 per cent (the smaller specimens having the narrower pelvics) of total length, whereas these proportions for the few *guamachensis* thus far examined are 53.0-58.1, 50.3-54.5, and 36.7-40.0 per cent, respectively.¹ The lateral tail folds originate between the rear end of the first dorsal base and the origin of second dorsal on *pictus* whereas they originate immediately behind the origin of the first dorsal in *guamachensis*. None of the color varieties of *pictus* thus far seen show the narrow elongate markings that are present on the holotype of *guamachensis*.

The color varies considerably in this species, if we are correct in assigning all our specimens to *pictus*, falling into two major

¹ Personal communication from Felipe Martin S., based on 4 specimens, 3 females and 1 male, 56.5-70.9 mm in total length.

patterns which can be termed the freckled form and the non-freckled form.

Fifteen non-freckled specimens, 77-156 mm long, were taken at 3 stations at the extremes of the above given latitudes, in depths of 9-26 fathoms while 9 freckled ones, 87-133 mm long, were taken at 5 stations between Lat. $05^{\circ}51'$ and $08^{\circ}09'$ in 19-28 fathoms (1 specimen in 50 fathoms).

The upper surface of the freckled form is pale brown, densely sprinkled in advance of the first dorsal with irregular dark brown spots ranging in size from smaller than the spiracle to about 1-2 times as large; also with a larger dark blotch or spot aside each dorsal and one or more on the dorsals and caudal but lacks the prominent blotch in advance of the first dorsal that is present on the type specimen; other markings agree with those of the type. There is also a series of white spots, as large as or a little smaller than the spiracle and surrounded by small dark brown markings arranged in 5 pairs in nearly straight lines from a little posterior to the spiracles to opposite the middle part of the pelvics, with a single spot (usually smaller than the others) in the midline opposite the second pair and another on one or both sides between the second and third pairs and about in line with axils of pectorals. On some specimens one or more of the white spots are missing. One specimen also has about 20 dark brown spots, about as large as the spiracle, scattered across the disc in front of the orbits, replacing several of the blotches present in that area on other specimens.

The non-freckled form ranges from plain light brown with a few vague darker blotches here and there, to others in which the blotches are prominent, especially those aside and on the dorsals, the dark bar in front of the first dorsal present on the type of *pictus* being clear on some, vague on others. On only one specimen are white spots present (faintly) arranged as on the freckled form.

The under surface of both color varieties is plain whitish.

The fins vary in shape in both color phases. Thus the tips of the two dorsals and the upper caudal lobe all are rounded on some specimens while on others the second dorsal is pointed, as are both dorsals on a few, although not quite as sharply so as is pictured for the type specimen (Palmer 1950, fig. 1 reproduced by Bigelow and Schroeder 1953, fig. 25 α). The upper caudal lobe is somewhat pointed on a few specimens. Dr. Giles Mead who kindly examined for us the type in the British Museum

found that the two dorsals are indeed as pointed as illustrated, the caudal a little less so and, on two larger specimens, these fins are not quite as pointed as those of the type.

In both color varieties the width of the disc is the same as the vertical length in some cases but in others it is either a little greater, or a trifle less. The widest divergence found in the one direction was a width of 50 per cent compared with a length of 44.7 per cent of total length of the specimen, and in the other a width of 42.8 per cent compared with a length of 45.1 per cent, among specimens greater than 100 mm long. On one abnormal male, 111 mm long, the width of disc is only 38.7 per cent of total length, a condition similar to that found by Palmer and Wheeler (1958, p. 450) for abnormal specimens of *Torpedo nobiliana*.

The longest diameter of orbit is greater than the interorbital width on most of the small and medium-sized specimens but less on the largest. Thus the orbit ranges from 0.8 to 1.7 (average 1.2) times the interorbital on 14 specimens 100-140 mm long and 0.7-0.8 (average 0.76) times on 5 specimens 150-164 mm long, the latter all females and of the non-freckled variety.

The teeth of both sexes, small to large, are in a triangular patch in both jaws, arranged in quincunx, in about 14-16 rows counting inward from center of jaw, the outermost row with 1 or 2 teeth and each succeeding row with an added tooth or two, making a series of 16-20 teeth in the innermost row, the anterior few rows of teeth usually without cusps, except on mature males, the succeeding teeth with a small triangular cusp which becomes increasingly long, narrow, and canine-like on the most posterior teeth, all the cusps pointing inward.

The claspers of mature or nearly mature specimens of 120-126 mm are short and stubby and scarcely reach, or extend but little, beyond the tips of the pelvics.

Proportional dimensions in per cent of total length of a female 122 mm in total length from Lat. 07°12'N, Long. 56°47'W (freckled variety) and of a female of 155 mm from Lat. 02°29'N, Long. 48°58'W (non-freckled variety) are as follows:—

Disc. — Extreme breadth 46.8; 46.1; vertical length 44.3; 45.4.

Snout length. — In front of orbits 10.7; 12.2; in front of mouth 13.2; 13.6.

Orbits. — Horizontal diameter 5.3; 4.1; distance between 4.1; 5.5.

Spiracles. — Length 3.6; 3.2; distance between 6.2; 6.5.

Mouth. — Breadth 6.2; 4.2.

Exposed nostrils. — Distance between inner ends 6.6; 5.5.

Gill openings. — Length, 1st 2.9; 2.5; 3rd 2.9; 2.5; 5th 2.5; 1.9.

First dorsal fin. — Vertical height 7.0; 7.1; length of base 6.3; 6.5.

Second dorsal fin. — Vertical height 7.8; 7.1; length of base 6.3; 5.8.

Caudal fin. — Upper margin 15.7; 16.1; lower margin 12.5; 12.9.

Pelvics. — Origin to tip 26.4; 27.7.

Distance. — From tip of snout to center of cloaca 52.8; 52.8; to 1st dorsal 66.0; 66.7; from center of cloaca to tip of tail 47.2; 47.2; from 2nd dorsal to origin of caudal 4.1; 3.2.

Interspace. — 1st and 2nd dorsals 3.3; 2.9.

Known from off the mouth of the Amazon to British Guiana in 9-50 fathoms.

Suborder RAJOIDEA

Since the publication of *Fishes of the Western North Atlantic, Part 2* (Bigelow and Schroeder 1953), in which the suborder Rajoidea included three families, the Rajidae, Arhynchobatidae and Anacanthobatidae, a fourth has been added, the Pseudorajidae Bigelow and Schroeder 1954. A revised key to families follows.

Key to Families

- 1 Two dorsal fins Rajidae p. 168
- Only one dorsal fin, or none 2
- 2 One dorsal fin Arhynchobatidae, New Zealand.
- No dorsal fin 3
- 3 Upper surface with prickles, or prickles and thorns; pelvic fins wing-like, not divided into lobes Pseudorajidae¹ p. 209
- Upper surface smooth; pelvic fins divided into two distinct lobes, the anterior lobe limb-like Anacanthobatiade p. 216

¹ The characters on which the family Gurgesiellidae De Buen 1959 are based appear to fall within the Pseudorajidae.

Family RAJIDAE

RAJA BULLISI sp. nov.

Figure 1

Study material. An immature male, 400 mm in total length, holotype, U. S. Nat. Mus. No. 196442, from about 30 miles SW of Dry Tortugas, Florida, Lat. 24°18'N, Long. 83°18'W, in 200 fathoms, "Silver Bay" station 1199. Also a male of 296 mm, paratype, M. C. Z. No. 40673, from the same station; and 16 specimens, males and females, 168-371 mm long, from nearby, "Oregon" stations 1324, 1326, 1328, 1329, in 200-300 fathoms.

Comparison with previously known species. The dark pores present on the under surface of *bullisi* are so small and inconspicuous that this species is not likely to be confused with other western Atlantic skates on which these pores are more obvious (p. 173). However, while it falls in line with these species with its sharp snout, its persistent nuchal thorn sets it apart from *floridana*, *laevis* and *oregoni* all of which lack this thorn. Absence of thorns between the scapular region and axils of pectorals distinguishes it from *garricki* which has a continuous row of thorns along the disc; its single row of thorns on its tail separates it from *olseni* which has several rows except on young specimens and these lack a nuchal thorn; and it differs from half grown and larger *flavirostris* in its longer tail (45.7-50.3 per cent of total length contrasted with 41.8-42.5 per cent in the half grown *flavirostris* with which we have compared it), also in its single row of tail thorns, *flavirostris* having lateral thorns as well.

Bullisi resembles several species of *Raja* known from Japanese waters (p. 176) in its sharp snout, nuchal thorn, and dark pores on the lower surface. But its narrower tail sets it apart from *R. gigas* and *R. macracauda* which have a robust tail, its plain or nearly plain colored upper surface (except the young) from *pulcra* which is mottled with dark brown and has an ocellus on each pectoral, and its single uniform row of tail thorns both from *kenojei* which has a staggered row, and from *acutispina*, *hollandi* and *macrophthalma* which have 3 or more rows of tail thorns. The presence of two widely spaced thorns along the anterior margin of each orbit distinguishes young and half grown *bullisi* from *tengu* at similar stages of growth on which the anterior orbital thorns are close together.

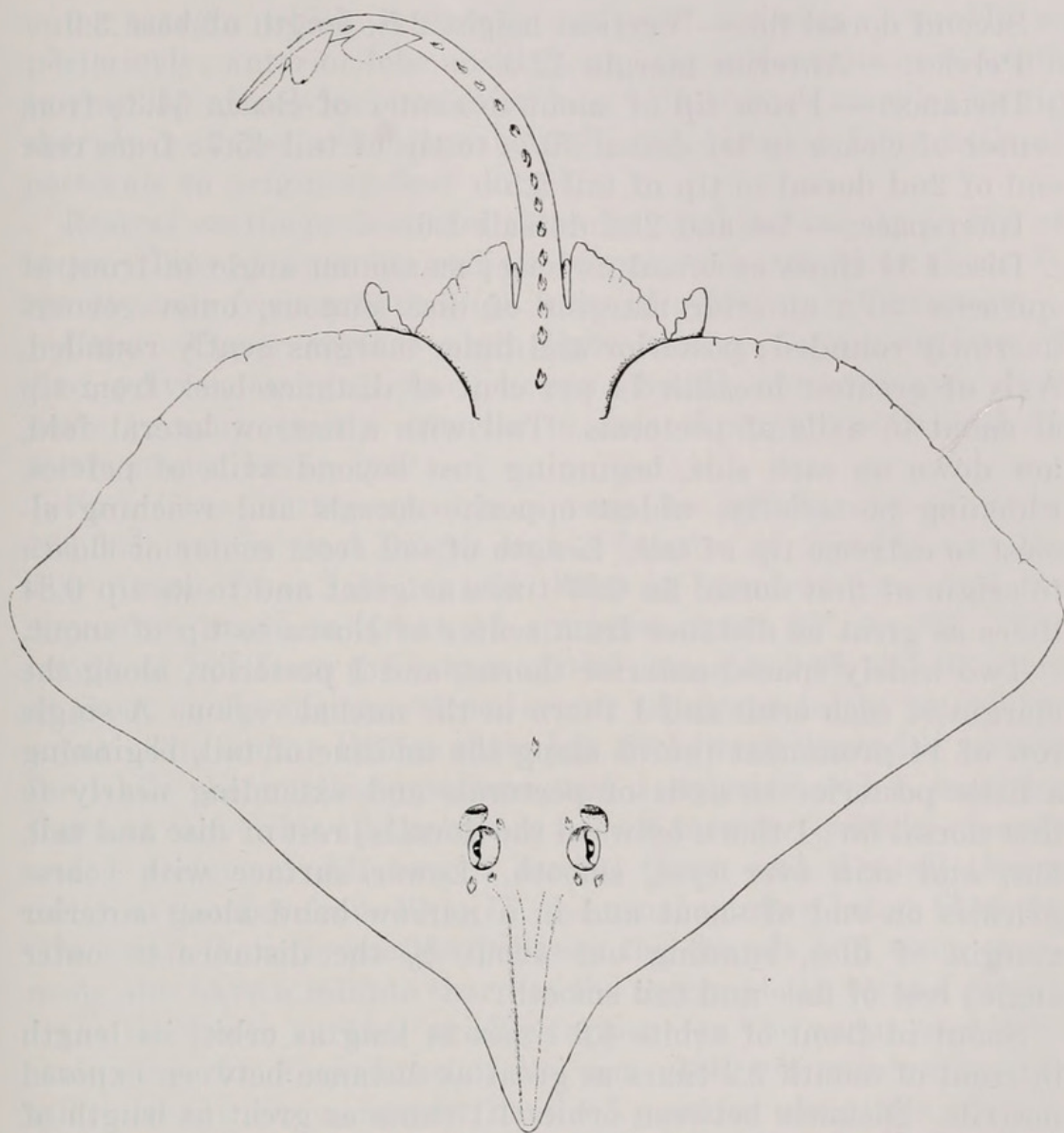


Figure 1. *Raja bullisi*, dorsal view of type, immature male 400 mm long.

Description of holotype. Proportional dimensions in per cent of total length:

Disc. — Extreme breadth 80.0; vertical length 59.5.

Snout length. — In front of orbits 19.0; in front of mouth 20.2.

Orbits. — Horizontal diameter 4.1; distance between 4.5.

Spiracles. — Length 2.7; distance between 7.5.

Mouth. — Breadth 8.8.

Exposed nostrils. — Distance between inner ends 9.2.

Gill openings. — Length, 1st 1.8; 3rd 1.8; 5th 1.3; distance between inner ends, 1st 16.2; 5th 9.1.

First dorsal fin. — Vertical height 3.0; length of base 4.0.

Second dorsal fin. — Vertical height 2.5; length of base 3.9.

Pelvics. — Anterior margin 12.0.

Distance. — From tip of snout to center of cloaca 54.3; from center of cloaca to 1st dorsal 30.7; to tip of tail 45.7; from rear end of 2nd dorsal to tip of tail 5.5.

Interspace. — 1st and 2nd dorsals 1.6.

Disc 1.34 times as broad as long; maximum angle in front of spiracles 90° ; anterior margins of disc sinuous, outer corners narrowly rounded; posterior and inner margins gently rounded. Axis of greatest breadth 74 per cent of distance back from tip of snout to axils of pectorals. Tail with a narrow lateral fold, low down on each side, beginning just beyond axils of pelvics, widening posteriorly, widest opposite dorsals and reaching almost to extreme tip of tail. Length of tail from center of cloaca to origin of first dorsal fin 0.57 times as great and to its tip 0.84 times as great as distance from center of cloaca to tip of snout.

Two widely spaced anterior thorns, and 1 posterior, along the margin of each orbit and 1 thorn in the nuchal region. A single row of 14 prominent thorns along the midline of tail, beginning a little posterior to axils of pectorals and extending nearly to first dorsal fin; 1 thorn between the dorsals; rest of disc and tail, fins, and skin over eyes, smooth. Lower surface with coarse prickles on end of snout and in a narrow band along anterior margin of disc, running out about $\frac{3}{5}$ the distance to outer angle; rest of disc and tail smooth.

Snout in front of orbits 4.6 times as long as orbit, its length in front of mouth 2.2 times as great as distance between exposed nostrils. Distance between orbits 1.1 times as great as length of orbit. Orbit 1.5 times as long as spiracle. Nasal curtain with a fine fringe; the outer flap of one nostril with a smooth margin; the other with a few minute knobs. Upper and lower jaws moderately arched. Teeth $\frac{33}{32}$, arranged in quincunx, ovate with a nearly flat crown and a low triangular cusp along the posterior margin.

Distance between first gill openings 1.8 as great as between exposed nostrils; between fifth openings 1.0 times; first to fourth openings about $\frac{2}{5}$ as long as orbit, fifth opening a little shorter than the others. First and second dorsals similar in size and shape, with convex upper margin; the space between the dorsals is about $\frac{3}{8}$ as great as the length of either dorsal base. Second dorsal confluent with caudal fin the base of which is nearly $1\frac{1}{2}$ times as long as dorsal base. Pelvics with concave

outer margin which is deeply scalloped anteriorly, weakly so posteriorly; anterior lobe about $\frac{4}{5}$ as long as from its own origin to rear tip of pelvics; posterior lobe with convex margin, its tip sharply rounded, reaching about $\frac{3}{8}$ the distance from axils of pectorals to origin of first dorsal.

Rostral cartilage firm and narrow, reaching nearly to tip of snout. Tips of anterior radials of pectorals reaching about $\frac{2}{5}$ the distance from axis through front of orbits to end of snout.

Color. Upper surface plain light brown. Lower surface of disc, pelvics, and tail, dark brown. Small, inconspicuous dark pores present, chiefly anterior to axis through mouth and directly under lower jaw.

Variations. Other specimens vary as follows. On 7 males 168-335 mm in total length and 3 females of 268-341 mm the disc ranges from 1.35 to 1.46 times as broad as long and the maximum angle in front of spiracles from 85° to 92° . The length of tail from the center of the cloaca is 0.88 to 1.01 times as great as the distance from center of cloaca to the tip of the snout. The ocular thorns show but little variation with growth for while the smallest specimen has 1 anterior and 1 posterior thorn at each orbit all the others have 2 anterior (widely spaced) and 1 posterior. All have 1 nuchal thorn and the tail thorns range in number from 12 to 15, the usual number being 13 or 14. One small thorn is present between the dorsals and some specimens also have a minute thorn at the origin of the second dorsal.

On the lower surface prickles appear on the snout at a very early stage for a specimen of 183 mm (186 mm with embryonic tail) already has a narrow band of prickles along the edge of the disc extending from the tip of the snout half way to a point opposite the mouth.

The snout in front of the orbits ranges from 3.7 to 4.5 times as long as the orbit, its length in front of mouth 2.1 to 2.4 times (1.9 on the 183 mm specimen) as great as the distance between the exposed nostrils. The width of the interorbital space varies from a little less to a little more than the length of the orbit. There are 31 to 36 teeth in the upper jaw and either the same in the lower jaw or 1 or 2 less on a given specimen.

The dorsal bases are about equal in length; the space between is 0.23 to 0.45 as great as the length of either dorsal base and on all the specimens the caudal fin is confluent with the dorsal fin, its base being from 1.3 to 1.8 times as long.

The color above of a newly hatched specimen, 168 mm long, or 157 mm minus its embryonic tail, is light brown marked with irregular dark brown spots, ranging in size from about one-fourth to as large as the orbit, on the disc and extending onto the tail where the markings coalesce to form 9 or 10 irregular crossbars to as far as the second dorsal fin. The dorsals are dark brown except for the posterior part which is pale; caudal dark, and the outer angles of disc are edged with dark brown. The lower surface is whitish, the posterior part of tail slightly dusky. The next largest specimen, 186 mm long, is similarly colored but the markings are less prominent. Specimens up to about 300 mm still have vague dark spots on the disc but larger ones are plain brown above, dark below.

Known from the vicinity of Dry Tortugas, Florida, in depths ranging from 200 to 300 fathoms.

Named after Harvey R. Bullis, Jr., in recognition of his kindness in making available to us for study the batoid fishes collected during the recent exploratory cruises of the U. S. Fish and Wildlife Service vessels in the Gulf of Mexico, Caribbean and southward along the South American coast.

RAJA CLARKII Bigelow and Schroeder 1958

Our description of this species is based on three specimens 580-747 mm long, two males and a female, trawled in the northern part of the Gulf of Mexico, in 260 fathoms, "Oregon" station 1277. The diagnostic features setting it off from all other known members of the Rajidae include the presence of 1 to 3 pairs of prominent white roundish or barlike markings on the upper surface of disc in combination with a broad snout and a band of formidable and very sharp thorns extending along the lower surface from the tip of the snout almost to the extreme outer margin of the pectorals.

Two more specimens have been taken, both females, one of 255 mm in total length from Lat. 12°50'N, Long. 82°12' W, in 275 fathoms, "Oregon" station 1924, and the other, of 364 mm from Lat. 13°22'N, Long. 82°04'W, in 300 fathoms, "Oregon" station 1929, both from off the coast of Nicaragua.

Neither of these small specimens have the white roundish or barlike markings that characterize the several larger specimens mentioned above, but otherwise their color agrees closely in that the upper surface is pale brown with numerous darker punctulations scattered over the disc, over the pelvics, and on the tail,

and in that the white lower surface has a wide irregular grayish band along the posterior and inner margins of the disc and along the rear margin of the pelvics. Also, the pattern of thorns is essentially the same, there being 38 thorns in the median row from the nuchal region to the first dorsal on each of the two smaller skates, of which 25 and 26, respectively, are posterior to the axils of the pectorals, compared with 34-40 on the three larger specimens of which 23-28 are posterior.

The proportional dimensions of all five known specimens are in close agreement excepting that the vertical length and the width of the disc of the 364 mm skate are 50.8 and 58.5 per cent, respectively, of the total length, compared with 54.4-55.0 and 65.0-68.7 on the three larger ones. Also, the two dorsals are virtually confluent on the two smaller ones whereas on the three larger there is 1 thorn directly on the midline within an interspace equal to about $\frac{1}{7}$ the base of first dorsal. This condition of either no interspace between the dorsals, or a very small one, has been found on certain other species of rajids.

The tooth count on the 364 mm specimen is $\frac{62}{63}$ and on the one of 255 mm 62 in the upper jaw, the lower jaw being imperfect, while on the three previously described, it is (580 mm) $\frac{61}{59}$, (665 mm) $\frac{63}{61}$, and (747 mm) $\frac{60}{60}$.

RAJA FLORIDANA sp. nov.

Figures 2, 3

Study material. An immature male, 772 mm in total length and 593 mm in disc width, the holotype, U. S. Nat. Mus. No. 196441, and a male and two females, 383-448 mm long, disc width 294-363 mm, paratypes M. C. Z. Nos. 40723, 40724, 40725, all from the offing of Jacksonville, Florida, Lat. 29°43'N, Long. 80°10'W, in 195 fathoms, "Silver Bay" station 1605. Also 26 specimens, males and females 158-428 mm long from between the offings of Cape Lookout, North Carolina and Dry Tortugas, Florida, Lats. 34°21' to 24°17'N, in depths of 170-225 fathoms, taken at 12 "Combat" and 2 "Oregon" stations. In addition, one of 165 mm trawled¹ by the "Albatross III" off South Carolina, Lat. 32°59'N, Long. 77°10'W, in 200 fathoms.

Comparison with previously known species. Western Atlantic skates with a sharp snout and with conspicuous dark pores on

¹ May 28, 1949.

the under surface include *laevis*, *oregoni*, *garricki*, *olseni*, *platana*, and *flavirostris*. Among these, *floridana* most closely resembles *laevis*, Mitchill 1817, the common barn-door skate of the northeastern American coast but it differs from *laevis* in a proportionately longer snout, wider disc, shorter tail and smaller dorsal fins. Thus on 7 small to medium-sized males and females of *floridana* 314-772 mm in total length, the distance from the tip of snout to the mouth is 19.5-24.9 per cent, the width of disc 73.3-81.2 per cent, the length of tail from center of cloaca 44.0-47.4 per cent and the distance from origin of first dorsal fin

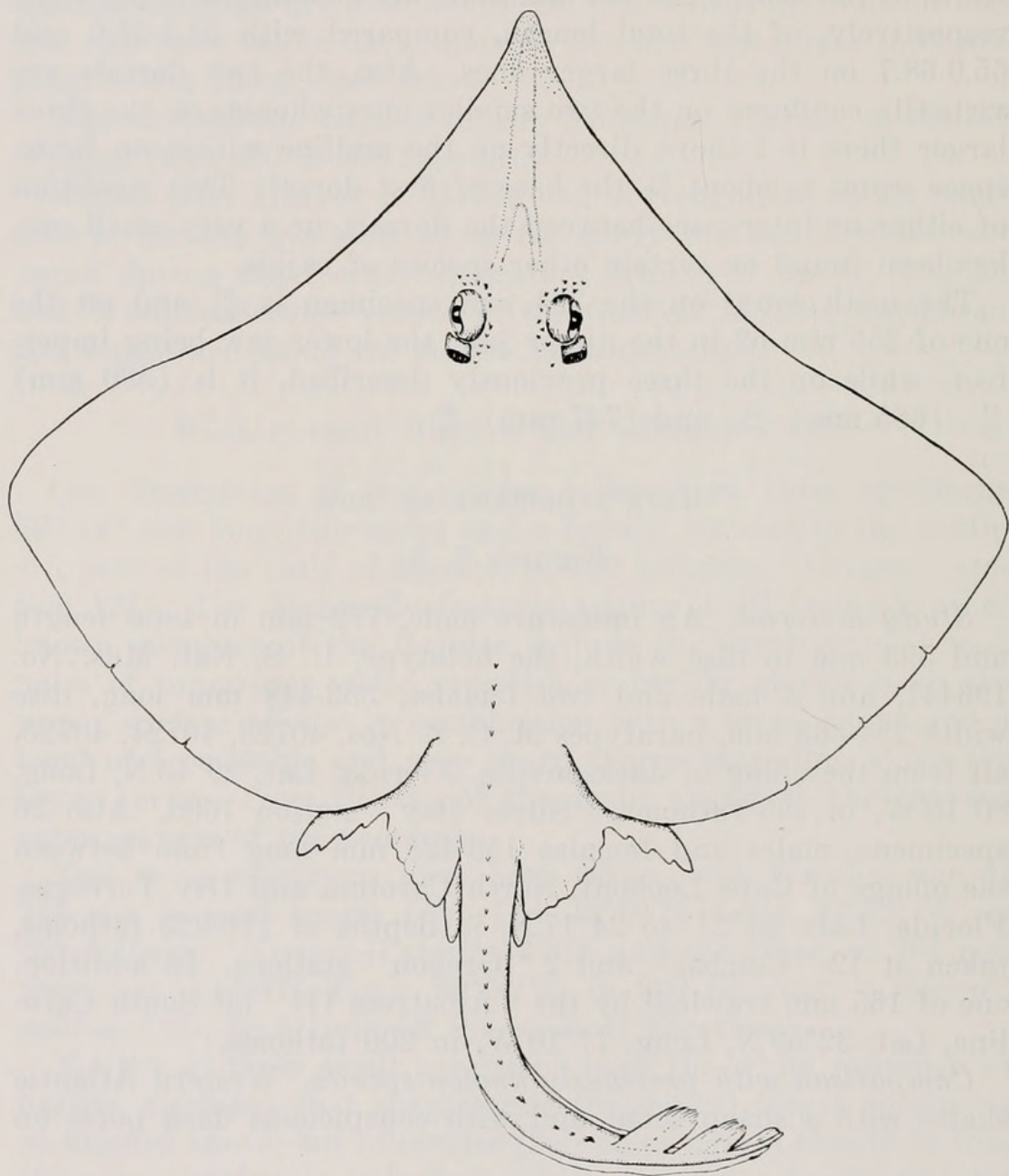


Figure 2. *Raja floridana*, dorsal view of type, immature male 772 mm long.

to the rear end of base of the second dorsal 8.4-12.1 per cent of the total length. These proportions on 2 males and a female *laevis*, 506-542 mm long, are 17.0-18.0 per cent, 68.0-71.0 per cent, 49.7-51.7 per cent and 14.5-14.8 per cent, respectively. We have not yet seen a mature *floridana* but our largest, the 772 mm male, lacks the row of thorns on either side of the midrow on the tail, that is present on *laevis* upwards of about 500 mm in total length, or with a disc width of about 350 mm. On 7 very young *floridana*, 158-240 mm in total length, the distance from snout to mouth is 18.0-21.1 per cent and length of tail 46.2-50.5 per cent of total length and there are only 8 to 10 thorns along the midline of the tail whereas on 5 *laevis* 177-195 mm long these percentages are 14.1-17.8 and 54.2-58.7, respectively, and the tail thorns range from 13 to 18 (see Figs. 3 and 4 for comparison of young of both species). *Floridana* is plain brown or grayish brown on the upper surface (except very small ones, p. 180) while *laevis* is marked with scattered dark brown spots except for some of the newly hatched which may lack spots.

The single row of rather inconspicuous thorns on the tail sets *floridana* apart from *oregoni* Bigelow and Schroeder 1958 which is armed with three rows of formidable tail thorns; absence of thorns along the midline of the disc distinguishes it from *garrieki* Bigelow and Schroeder 1958 which has an uninterrupted row of large thorns from the nape to the first dorsal fin; its single row of tail thorns also identifies it from *olseni* as well as its unfringed nostril flap and the absence of conspicuous whitish mucous pores on upper surface of disc (*olseni* has a more or less interrupted row of tail thorns each side of the midrow, a fringed nostril flap and conspicuous whitish mucous pores on the upper surface of disc, arranged in various designs). The more or less haphazard arrangement of the dark mucous pores on the under side of its disc, and their paucity over the posterior half, distinguishes *floridana* from *platana* Günther 1880 which is profusely covered with prominent, symmetrically arranged, black pores over the lower surface of its disc¹; and the absence of thorns on its disc, together with a single row on the tail, marks it off from *flavirostris* Philippi 1892 which has a persistent and prominent nuchal thorn and (except in the very young) an irregular row of spines on each side of the median series on the tail.

¹ Based on original description and illustration of a specimen 25 inches long (Günther 1880, p. 11, pl. 3) and a specimen 22 inches long in The Museum of Comparative Zoology taken off Rio de Janeiro by the Thayer Expedition in 1872.

Several species of *Raja*, with a sharp snout and with dark pores on the lower surface, bearing a close resemblance to *floridana*, are known from Japanese waters and are described, or discussed, by Ishiyama (1958). Through the kindness of Dr. Ishiyama, the Museum of Comparative Zoology collection includes representatives of all of these. They comprise *Raja macracauda* Ishiyama 1955, *R. gigas* Ishiyama 1958, *R. macropthalma* Ishiyama 1958, *R. acutispina* Ishiyama 1958, *R. hollandi* Jordan and Richardson 1909, *R. tengu* Jordan and Fowler 1903, *R. pulcra* Lui 1932 and *R. kenojei* Müller and Henle 1841.

In spite of the fact that we have this material for comparison, as well as the recently published accounts by Ishiyama, we find it difficult to present reliable characters that might distinguish

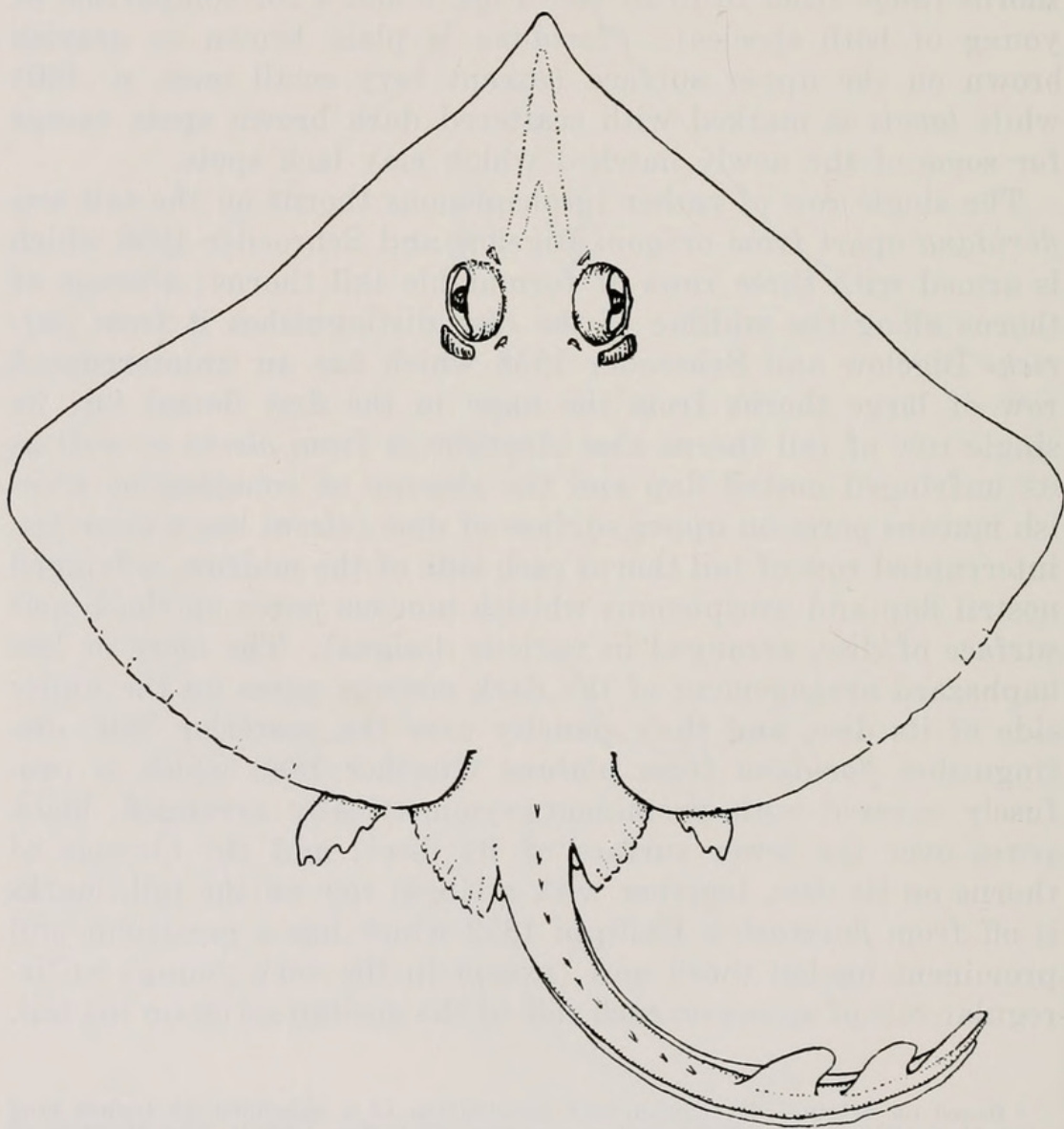


Figure 3. *Raja floridana*, juvenile male 158 mm long.

floridana from the above inasmuch as our only relatively large specimen (the holotype) is immature and all the others are juveniles. However, the lack of a nuchal thorn on all our specimens of *floridana* seems to assume importance, for all of the above Japanese species have one or more nuchals except possibly mature *gigas*, on which this thorn may be obscure or "worn out" (Ishiyama 1958, p. 386).

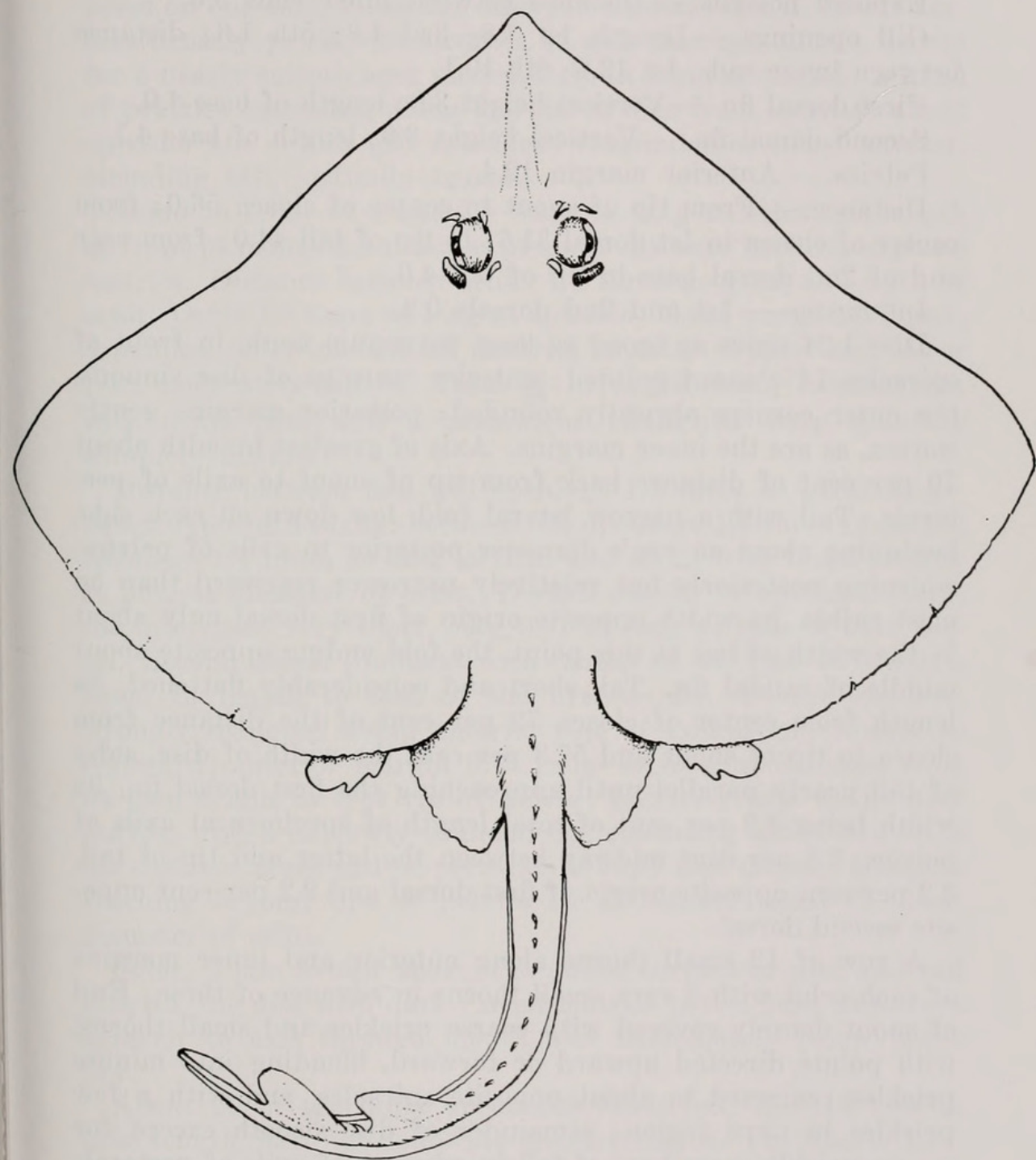


Figure 4. *Raja laevis*, juvenile female 225 mm long.

Description of holotype. Proportional dimensions in per cent of total length:

Disc. — Extreme breadth 76.8; vertical length 62.0.

Snout length. — In front of orbits 22.2; in front of mouth 24.9.

Orbits. — Horizontal diameter 4.0; distance between 4.5.

Spiracles. — Length 2.6; distance between 6.4.

Mouth. — Breadth 8.3.

Exposed nostrils. — Distance between inner ends 9.6.

Gill openings. — Length 1st 1.8; 3rd 1.8; 5th 1.3; distance between inner ends, 1st 13.6; 5th 10.1.

First dorsal fin. — Vertical height 3.0; length of base 4.0.

Second dorsal fin. — Vertical height 3.0; length of base 4.1.

Pelvics. — Anterior margin 12.4.

Distance. — From tip of snout to center of cloaca 56.0; from center of cloaca to 1st dorsal 31.6; to tip of tail 44.0; from rear end of 2nd dorsal base to tip of tail 4.0.

Interspace. — 1st and 2nd dorsals 0.3.

Disc 1.24 times as broad as long, maximum angle in front of spiracles 74° ; snout pointed; anterior margins of disc sinuous, the outer corners abruptly rounded; posterior margins gently convex, as are the inner margins. Axis of greatest breadth about 70 per cent of distance back from tip of snout to axils of pectorals. Tail with a narrow lateral fold, low down on each side, beginning about an eye's diameter posterior to axils of pelvics, widening posteriorly but relatively narrower rearward than on most rajids, its width opposite origin of first dorsal only about $\frac{1}{7}$ the width of tail at this point, the fold ending opposite about middle of caudal fin. Tail short and considerably flattened, its length from center of cloaca 79 per cent of the distance from cloaca to tip of snout and 57.3 per cent the width of disc, sides of tail nearly parallel until approaching the first dorsal fin, its width being 3.9 per cent of total length of specimen at axils of pelvics, 3.8 per cent midway between the latter and tip of tail, 3.2 per cent opposite origin of first dorsal and 2.2 per cent opposite second dorsal.

A row of 12 small thorns along anterior and inner margins of each orbit with 3 very small thorns in advance of these. End of snout densely covered with coarse prickles and small thorns, with points directed upward or forward, blending into minute prickles rearward to about opposite spiracles, and with a few prickles in nape region; remainder of disc smooth except for sparse prickles near base of tail in advance of axils of pectorals

and continuing more numerous all along upper surface of tail, to about opposite second dorsal fin. A midrow of 25 small thorns of assorted sizes, with a few rather large ones, beginning about an eye's diameter in advance of axils of pectorals and continuing to first dorsal fin. No side thorns on tail; no thorn between dorsals. Pelvics smooth; a few minute prickles on dorsals; caudal fin and skin over eyes smooth. A short row of 9 mucous pores on one side, 11 on the other, in nuchal region. Lower surface densely prickly in advance of axis through mouth, except for a nearly smooth area immediately in front of mouth; a band of prickles extending along margin of disc from snout to about opposite 4th or 5th gill openings; remainder of lower surface, including tail, virtually smooth.

Snout in front of orbits 5.5 times as long as orbit; its length in front of mouth 2.5 times as great as distance between exposed nostrils. Distance between orbits 1.1 times as great as length of orbit. Orbit 1.5 times as long as spiracle. Nasal curtain fringed; expanded outer margin of nostrils smooth. Upper and lower jaws moderately arched. Teeth $\frac{35}{35}$, arranged chiefly in quincunx, with ovate base and a prominent triangular cusp pointing obliquely inward.

Distance between first gill openings 1.4 times as great as between exposed nostrils; between 5th openings 1.1 times; first gill openings 1.4 times as long as fifth and about 0.45 times as long as longest diameter of orbit. Dorsals similar in size and shape, the interspace very short, only 0.07 as long as base of first dorsal. Second dorsal confluent with caudal fin the base of which is equal in length to that of the first dorsal. Pelvics concave, strongly scalloped along anterior side of excavation, weakly so rearward; anterior margin 0.75 times as long as distance from its own origin to rear tip of pelvic; posterior lobe moderately convex, with a narrowly rounded tip, extending about two-fifths the distance from axil of pectorals toward first dorsal. Claspers reaching beyond tips of pelvics by a distance equal to about diameter of orbit.

Color. Plain brown above, the under surface of disc and tail grayish, the disc with dark-ringed mucous pores, most numerous anterior to axis through mouth and immediately below lower jaw.

About 20 of the other specimens examined, 158-448 mm in total length, have the following characteristics. The disc is 1.32-1.43 times as broad as long and the maximum angle in front of

spiracles 85° - 94° . On sizes ranging from 158-273 mm the tail, from center of cloaca, is 86-100 per cent as long as the distance from cloaca to the tip of the snout, while on those of 305-448 mm its length is 80-90 per cent. There is only 1 anterior and 1 posterior orbital thorn on lengths up to nearly 300 mm, 2 anterior and 1 posterior at 300-400 mm, beyond which size they increase in number, one of 448 mm having 8 or 9 along the margin of each orbit. The number of thorns on the midline of the tail, on 18 specimens, ranges from 8 to 14, in most cases 8 or 9, with as many as 13 on a male as small as 330 mm and as few as 9 on a male of 428 mm. But while a 432 mm female has only 3 tail thorns (there is evidence that some thorns were shed) a 448 mm male has 21. In the interdorsal space 6 specimens lack thorns, 11 have 1 thorn and 3 have 2 thorns. Otherwise, all the specimens, other than the much larger holotype (772 mm), are smooth.

The length of the snout in front of the orbits is 3.8-4.4 times as great as diameter of orbit, its length in front of mouth 2.0-2.2 times as great as the distance between the nostrils while the interorbital space is 0.9-1.2 times as great as the length of orbit. There are from 27 to 38 series of teeth in each jaw, with a low triangular cusp, even on the smallest specimens of both sexes. The space between the dorsals, though short, is relatively greater than that on the holotype being 0.23-0.60 times as long as the base of the first dorsal and the base of the caudal fin is 1.0-1.5 times as long as the dorsal base.

The smallest specimens are light brown above with vague dark brown irregular spots about half as large to as large as the orbit and the tail has 5 dark bars about equally spaced. Lower surface whitish with a narrow dusky margin on outer angles of disc. Our larger specimens lack the spots and below are usually plain grayish white, some of them partly brownish.

Known from the offings of Cape Lookout, North Carolina to Dry Tortugas, Florida, in 170-225 fathoms.

RAJA LENTIGINOSA Bigelow and Schroeder 1951

This skate has heretofore been recorded from the northern part of the Gulf of Mexico in the offings of Pensacola and Cape San Blas, Florida, and in the southern part on Campeche Bank in various depths ranging from 29 to 305 fathoms (Bigelow and Schroeder 1953, p. 228). Our present collection extends its known range to the Atlantic coast of Central America where it

was taken off Honduras at 7 "Oregon" stations (1868, 1869, 1870, 1871, 1879, 1883, 1891) and off Nicaragua at 2 stations (1902, 1903), the most southerly at Lat. $11^{\circ}27'N$, Long. $83^{\circ}11'W$.

It apparently is widespread in the Gulf of Mexico for additional records, besides 2 more from off Cape San Blas ("Oregon" stations 945, 953), include 2 stations (550, 1514) in the northwest part and 1 (1054) in the southwest at Lat. $19^{\circ}37'N$, Long. $92^{\circ}40'W$. In all, the above series consists of 20 specimens, males and females, 80-435 mm in total length, from depths of 67-250 fathoms.

There appears to be no significant difference in color, or otherwise, between the specimens taken in the northern part of their range and those taken in the southern part. The smallest mature male, with clasper hooks exposed, is 345 mm in total length.

RAJA OLSENI Bigelow and Schroeder 1951

Earlier descriptions of this species (Bigelow and Schroeder 1951, p. 386; 1953, p. 251) were based on 8 specimens, 280-310 mm in total length, trawled in 64-76 fathoms, from the northern and northwestern part of the Gulf of Mexico. Our present series consists of 7 more, 151-568 mm long, taken in 53-130 fathoms, from the same general locality, "Oregon" stations 602, 847, 1419, 1514 and 2827; also "Silver Bay" station 316.

Raja olseni resembles *R. laevis* Mitchill 1817 in general appearance but differs in having an interspace between the dorsal fins nearly or quite as long as the base of the first dorsal (only 0.1-0.3 that long in *laevis*), a much greater distance between the rear end of the second dorsal base and tip of tail (7.1-9.0 per cent of total length on *olseni*, 2.8-3.8 per cent on *laevis*), in its fringe on the expanded outer margin of nostril (smooth on *laevis*); also the lateral folds along the tail extend only to the anterior third of the caudal fin, whereas on *laevis* they extend almost or quite to the extreme tip of the tail. The original specimens, also, of *olseni* when first described were jet black below, leading to our earlier statement (1951: 386) that "its mucous pores are not marked with black as they are in *laevis*." However, the paratype, in the Museum of Comparative Zoology, has faded by now to a brownish-cream, the pores being darker, while some of the recent "Oregon" specimens are pale below with the pores conspicuously black around and anterior to the mouth. Consequently, the pigmentation, or the reverse, of the mucous

pores on the lower surface is not reliably diagnostic between *olseni* and *lacvis*.

The proportions of the disc vary within a narrow range, the extreme width being 67.5-74.8 per cent and the vertical length 54.0-60.3 per cent of the total length of the specimens, and the width is 1.21-1.28 times the length save on the smallest one (151 mm) on which it is 1.37 times. The maximum anterior angle in front of spiracles is 110° on a 151 mm female, 88° - 97° on females of 241-568 mm and on males of 235-343 mm but only 78° on a male of 506 mm. The axis of greatest breadth ranges from 62 to 72 per cent of the distance back from the snout toward axils of pectorals, on 9 specimens. The length of the tail from the center of cloaca to the origin of the first dorsal fin is 0.51-0.62 times as great and to its tip 0.91-1.06 times as great as the distance from the center of cloaca to the tip of snout on specimens of 235-568 mm; these lengths on the smallest (151 mm) being 0.71 and 1.2, respectively.

Excluding the orbital thorns, the upper surface of the disc is smooth on all our specimens except the two largest, a male of 506 mm and a female of 568 mm in total length. On the male there are prickles over the end of the rostral process and these extend to the orbits on the female; a narrow band of small thorns extends along the edge of disc from tip of snout to about three-fourths the distance to outer angle, on the male, and a little further than this on the female, the thorns being more crowded posteriorly. Also, there is 1 small nuchal thorn on the male and 4 on the large female. The alars on the 506 mm specimen are in 1 to 2 rows, the exposed thorns 11 in number on one side, 14 on the other, the length of the longest row equal to the distance between the spiracles. The thorns along the margin of the orbits tend to increase in number along with the growth of this skate. Thus on the smallest specimen, of 151 mm, there is 1 thorn at the inner anterior margin and 1 at the posterior margin of each orbit; on one of 235 mm, 1 anterior and 2 posteriors; on two specimens of 241-267 mm, 2 along the anterior margin and 1 on the posterior; on four specimens of 313-506 mm there are 2 to 4 thorns along the anterior margin, 2 or 3 along the central and posterior margin, and usually 1 thorn immediately adjacent to each spiracle, and on the 568 mm female there are 6 along the anterior margin and 12 along the inner margin to opposite the spiracles. Along the midline of the tail from a little in advance of the axils of the pelvics to the first dorsal fin there

are 12 to 36 thorns, alternating large and small, the number largest on the largest specimens, but the increase in number does not always parallel the size of the skate. There is a single row of from 2 to 6 thorns along the midline between the dorsal fins, the greatest numbers (5 and 6) being on the three largest specimens; there is also an additional row of thorns, usually widely and unevenly spaced, on each side of the mid row, most numerous posteriorly. These first appear on specimens of 235-267 mm and are most conspicuous on the largest, which, in addition, have a few small thorns low down along the sides of the tail. On the 568 mm female the side rows have but few interruptions beginning about opposite the rear margin of the pectorals and developing into 2 rows on each side posteriorly ending at the first dorsal fin beyond which there are a few scattered side thorns. The dorsals, the caudal fin, and the skin over the eyes are smooth.

The lower surface of the disc is smooth on our smallest specimen, but on others of 235-313 mm, of both sexes, and on a female of 401 mm, there are prickles and small thorns on the rostrum and in a narrow band along the margin of the disc from the tip of snout to the level of the nostrils or of the mouth. On a male of 343 mm, the end of the snout in advance of the nostrils is covered with small sharp thorns and prickles, and on the 506 mm male and the 568 mm female these extend to the level of the mouth.

The claspers of the largest male reach beyond the tips of the pelvises by a distance equal to that between the spiracles.

The tooth count ranges from 34 to 42 in both jaws. The jaws of the 506 mm male are strongly arched centrally, those of the other specimens moderately so. The space between the dorsals ranges from 0.82 to 1.40 times the base of first dorsal on all the specimens except the smallest (151 mm) on which it is only 0.62 times. The second dorsal and caudal are confluent on most of the specimens with a barely perceptible interspace on two of them. The caudal base is 1.5-2.1 times as long as the first dorsal base on our specimens of 235-568 mm.

The color of the upper surface varies from light to dark brown. Some specimens have numerous obscure spots, darker than the ground color, scattered over the disc, about half the size of the spiracle opening. An account of the small whitish pores is given in the type description, but it should be added that there is consistently one pair of pores, larger than most of the others,

located between and a little posterior to the spiracles followed by two rows of about 10 to 16 close-set pores, diverging anteriorly and posteriorly. The tail and fins are light to dark brownish. The lower surface of some specimens is pale creamy brown while on others it is dark brown everywhere except the fringes on nasal flap and curtain, edges of gill openings, and immediate vicinity of cloaca. Probably most, if not all, *olseni* are much darker in life, for the types are described as jet black below. The pores are conspicuously darker than the ground color on specimens that are pale enough below for this feature to be apparent.

As our largest male (506 mm) has large claspers and our largest female is 568 mm long, it is probable that this species reaches a length somewhat greater than 600 mm.

All the specimens thus far taken are from the northern part of the Gulf of Mexico between the offings of Cape San Blas and Corpus Christi, in 53-130 fathoms.

RAJA PURPURI-VENTRALIS sp. nov.

Figures 5, 6

Study material. One female 510 mm in total length, holotype, U. S. Nat. Mus. No. 196440, from the northern part of the Gulf of Mexico, Lat. 27°48'N, Long. 88°45'W, in 850-1100 fathoms, "Oregon" station 2577.

Distinctive characters. Characters in combination which distinguish *purpuri-ventralis* from other species of *Raja* known from the Atlantic Ocean and Gulf of Mexico are: upper surface of disc, tail, and pelvics, covered with sharp, closely set prickles; a continuous row of about 40 thorns along midline of disc and tail from nape to first dorsal fin; 3 thorns on each side of midrow in scapular region; an additional row of large thorns each side of midrow on anterior two-thirds of tail; and in its color which was purplish black both above and below at the time of capture. *Purpuri-ventralis* bears some resemblance to *R. macloviana* Norman 1937 and *R. magellanica* Steindachner 1903 from the Patagonian-Falkland region and Strait of Magellan but these species differ in that the prickles are sparsely distributed; in that they have only 1 or 2 scapular thorns (occasionally 3) on each side, with not more than about 30 thorns in the midrow of disc and tail; in that there are no side rows of thorns on the

tail; and in color, both of these species being brownish or grayish above and yellow or white below.

Description of holotype. Proportional dimensions in per cent of total length.

Disc. — Extreme breadth 53.7; length 49.6.

Snout length. — In front of orbits 16.4; in front of mouth 18.8.

Orbits. — Horizontal diameter 2.9; distance between 4.2.

Spiracles. — Length 1.8; distance between 7.4.

Mouth. — Breadth 7.3.

Exposed nostrils. — Distance between inner ends 8.2.

Gill openings. — Length, 1st 1.3; 3rd 1.3; 5th 1.1; distance between inner ends 1st 13.9; 5th 8.3.

First dorsal fin. — Vertical height 1.8; length of base 4.5.

Second dorsal fin. — Vertical height 1.8; length of base 3.7.

Pelvics. — Anterior margin 11.8.

Distance. — From tip of snout to center of cloaca 46.7; from center of cloaca to 1st dorsal 41.9; to tip of tail 53.3; from rear end of 2nd dorsal to tip of tail 2.2.

Interspace. — 1st dorsal and 2nd dorsal 0.0.

Disc 1.08 times as broad as long; tip of snout narrowly rounded; maximum angle in front of spiracles 85° ; anterior margins of disc very slightly concave; outer corners, posterior margins and inner margins broadly rounded. Axis of greatest breadth 74 per cent backward from tip of snout toward axils of pectorals. Tail moderately robust anteriorly becoming very slender posteriorly; the lateral folds, low down, originating in advance of first dorsal by a distance equal to that between spiracles (far rearward as compared with other rajids), scarcely perceptible at their origin but widening opposite second dorsal and continuing almost to extreme tip of tail; length of tail from center of cloaca to origin of first dorsal fin 0.90 times as great, and to its tip 1.14 times as great as distance from center of cloaca to tip of snout.

Upper surface of disc, tail, and pelvics closely covered with small, sharp prickles, most of them with the tip bent rearward, the base with 4 radii; dorsal and caudal fins and skin over eyes also with prickles. A single stout thorn at the inner anterior margin of each orbit, with another at the posterior margin, and a smaller thorn inward and behind the latter, in line with rear margin of the spiracles. A row of 43 sharp, prominent and rather widely spaced, thorns along the midline, 3 of them from nape to scapular region, followed by 40 smaller, closely spaced

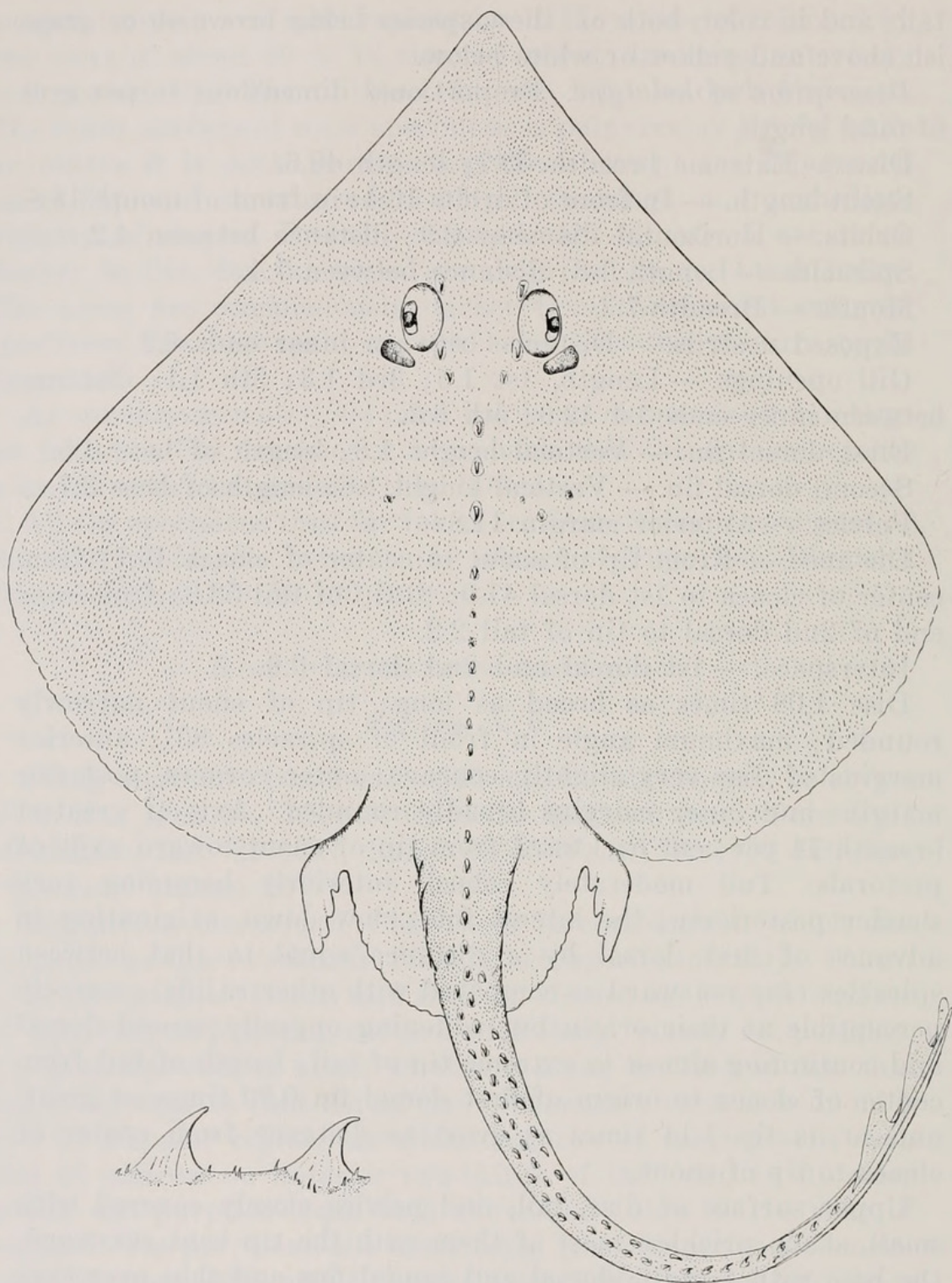


Figure 5. *Raja purpuri-ventralis*, dorsal view of type, female 510 mm long. Lower left, side view of thorns along the midline, about x3.

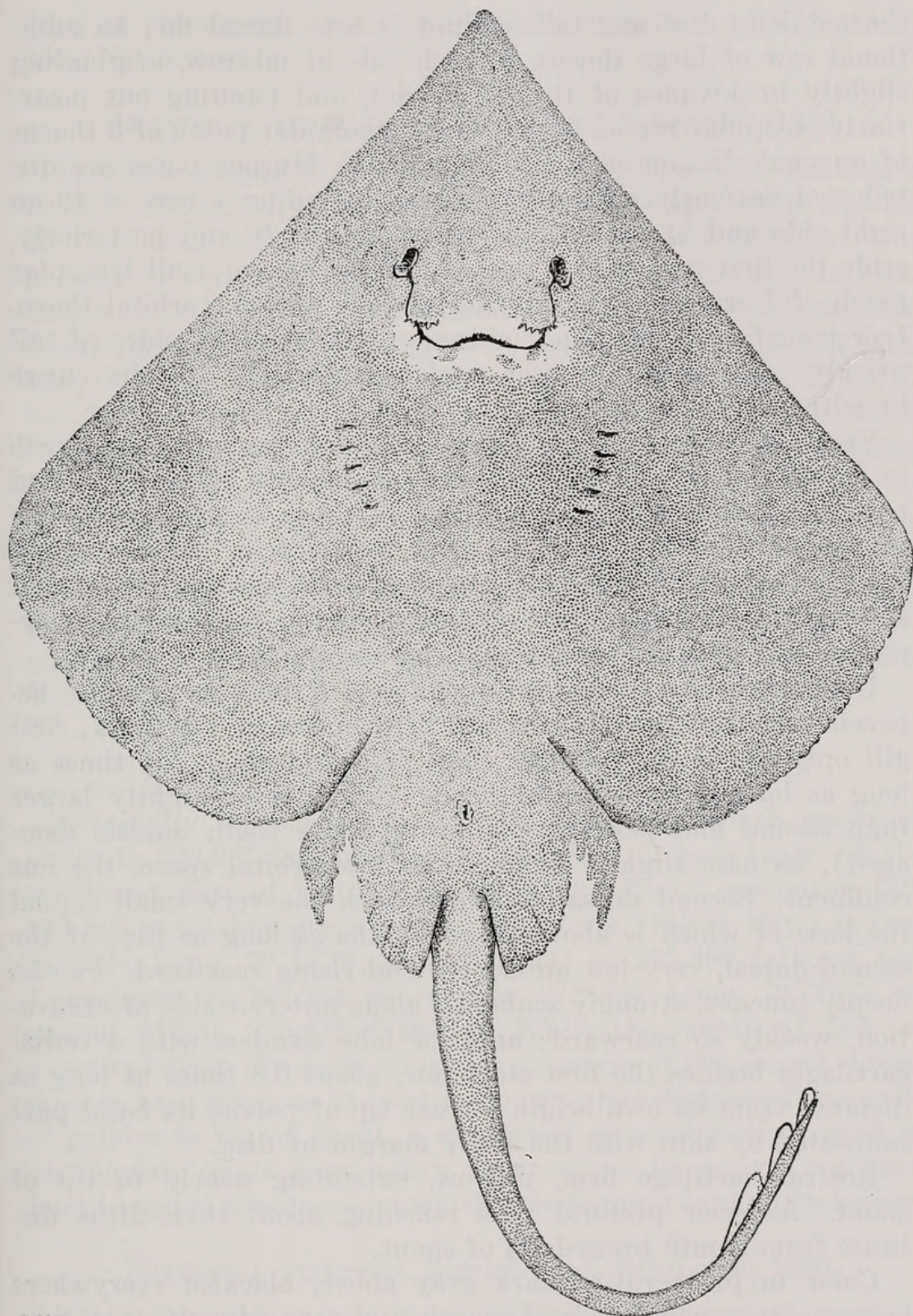


Figure 6. *Raja purpuri-ventralis*, ventral view of type.

thorns along disc and tail, ending at first dorsal fin; an additional row of large thorns on each side of midrow, originating slightly in advance of tips of pelvics, and running out posteriorly; scapular region with a small triangular patch of 3 thorns of unequal size, on each side of midline. Mucous pores are distributed variously on upper surface, including a row of 10 on right side and 11 on left, diverging anteriorly and posteriorly, aside the first and second nuchal thorns; also a small irregular patch of 7 or 8 pores in advance of each anterior orbital thorn. Lower surface of disc and midzone of tail smooth, sides of tail prickly, also edges of lower surface anteriorly and its entire breadth posteriorly.

Snout in front of orbits 5.6 times as long as orbit, its length in front of mouth 2.3 times as great as distance between exposed nostrils. Distance between orbits 1.44 times as great as length of orbit. Orbit 1.7 times as long as spiracle. Nasal curtain fringed; expanded outer margin of nostrils smooth. Upper and lower jaws slightly arched centrally. Teeth $\frac{42}{42}$, in quincunx arrangement, with ovate base and flat crown.

Distance between first gill openings 1.7 times as great as between exposed nostrils; between fifth openings 1.0 times; first gill openings slightly longer than fifth and about 0.4 times as long as longest diameter of orbit. First dorsal slightly larger than second and perhaps similar in shape (both dorsals damaged), its base slightly longer than interorbital space, the fins confluent. Second dorsal confluent with the very small caudal the base of which is about three-fourths as long as that of the second dorsal, very low anteriorly and rising rearward. Pelvics deeply concave, strongly scalloped along anterior side of excavation, weakly so rearward; anterior lobe slender, with 4 radial cartilages besides the first stout one, about 0.8 times as long as distance from its own origin to rear tip of pelvic, its basal part connected by skin with the inner margin of disc.

Rostral cartilage firm, narrow, extending nearly to tip of snout. Anterior pectoral rays reaching about three-fifths distance from mouth toward tip of snout.

Color in preservative dark gray above, blackish everywhere below, except white around mouth and rear edge of nasal curtain. When fresh from the water, this specimen was purplish above and below.

Known only from the type, taken in the northern part of the

Gulf of Mexico in a trawl haul made on bottom at a depth of 850-1100 fathoms.

BREVIRAJA ATRIPINNA Bigelow and Schroeder 1950

Previous accounts of this species (Bigelow and Schroeder 1950, p. 390; 1953, p. 286) are based on three specimens trawled off the north central coast of Cuba, in 250-500 fathoms. Our present collection includes two more, a female 291 mm in total length, M. C. Z. No. 40110, from Santaren Channel, west of Great Bahama Bank, Lat. 23°59'N, Long. 79°43'W, in 350 fathoms, "Combat" station 450; and a male 215 mm long, M. C. Z. No. 39865 from Lat. 33°51'N, Long. 76°18'W, in 225 fathoms, "Combat" station 178, extending the range north to the offing of Cape Fear, North Carolina. Another specimen, from the north coast of Cuba, was taken by the "Oregon" in 280 fathoms.¹

The nasal curtain and flap are usually smooth, or with several tiny lobelets, but on some specimens one or the other, or both, may have a short fringe. The tooth count on both specimens is

$\frac{44}{44}$

BREVIRAJA COLESI Bigelow and Schroeder 1948

Originally recorded from off the north and south coasts of Cuba, in 220-285 fathoms,² *colesi* has recently been taken off the northwest part of Little Bahama Bank. Eight specimens 132-330 mm in total length were trawled by the "Silver Bay" at Lat. 27°39'N, Long. 79°15'W, at station 441 in 275-300 fathoms and 4 specimens of 138-251 mm at Lat. 27°53'N, Long. 79°09'W, at station 442 in 375-415 fathoms. While the length of tail, as measured from the axils of pelvics to origin of the second dorsal fin, has been given as at least no longer than distance from axils of pelvics to tip of snout, a character, in combination, used to distinguish *colesi* from other members of its genus, we have found several specimens on which this distance is slightly longer.

BREVIRAJA CUBENSIS Bigelow and Schroeder 1950

Previously taken only from off the north central coast of Cuba, in 235-405 fathoms, the known range of this species is now

¹ Springer and Bullis 1956, p. 43, "Oregon" station 1342.

² It was again taken off the north coast of Cuba by the "Oregon" at stations 1341, 1344 and 1345. (Springer and Bullis, 1956, p. 44)

extended northward to the offing of the northwest part of Little Bahama Bank, Lat. $27^{\circ}53'N$, Long. $79^{\circ}09'W$, "Silver Bay" station 442 where a male 150 mm long and a female of 212 mm were trawled in 375-415 fathoms; two others were taken nearby at station 441 in 275-300 fathoms. It was also trawled by the "Combat" (3 males 192-210 mm long) at stations 449 and 450 in Santaren Channel, between Cay Sal and Great Bahama Banks in 350 fathoms, and at station 436 about 20 miles to the southward of Key West, in 300 fathoms.

BREVIRAJA ISHIYAMAI sp. nov.

Figures 7, 8

Study material. A female 338 mm in total length, holotype, U. S. Nat. Mus. No. 196447, from Lat. $13^{\circ}18'N$, Long. $82^{\circ}12'W$, in 350 fathoms, "Oregon" station 1916, and a male of 226 mm, M. C. Z. No. 40097, from Lat. $13^{\circ}56'N$, Long. $81^{\circ}50'W$, in 275 fathoms, "Oregon" station 1931, both from off the Atlantic coast of Nicaragua; a female of 362 mm, M. C. Z. No. 40665, from Lat. $24^{\circ}11'N$, Long. $83^{\circ}21'W$, in 400 fathoms, "Silver Bay" station 1196, about 35 miles to the southwestward of Dry Tortugas, Florida, and a female of 296 mm, paratype, M. C. Z. No. 40389, from Lat. $28^{\circ}03'N$, Long. $78^{\circ}44'W$, in 500-520 fathoms, "Silver Bay" station 445, off Cape Canaveral, Florida.

Comparison with previously known species. *Ishiyamai* differs as follows from other western Atlantic species of *Breviraja*: from *atripinna* by a very short space between the dorsal fins which also may be confluent (on *atripinna* the dorsals are widely separated); from *colesi* in its plain coloration, smooth nasal flap and curtain, in the presence of a space between the second dorsal fin and the caudal fin and perhaps in a fewer series (about 34-38) of teeth in the upper jaw (upper surface of disc mottled with irregular spots and blotches, nasal flap and curtain with fringes, second dorsal and caudal confluent, about 40-50 series of teeth, on *colesi*); from *cubensis* by its plain coloration, and by the presence of a space between the second dorsal and caudal fins (disc with spots and blotches, tail with dark cross bars, second dorsal and caudal confluent, on *cubensis*); from *plutonia* in its plain coloration, in shape of disc and in the presence of a space between the second dorsal fin and the caudal (disc with spots and blotches, tail with bars, anterior margin of disc sinuous in both sexes, dorsal and caudal confluent, on *plutonia*);

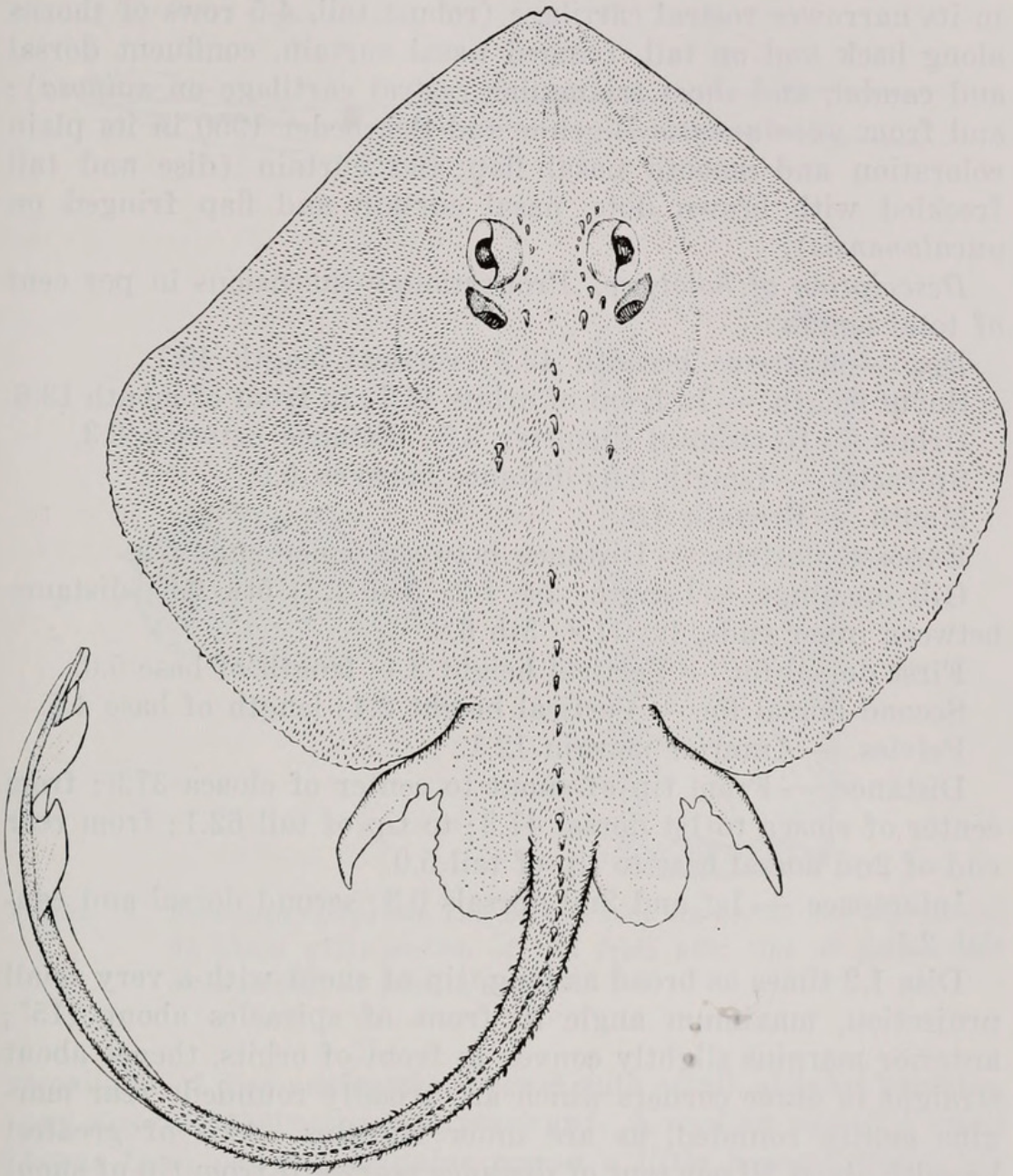


Figure 7. *Breviraja ishiyamai*, dorsal view of type, female 338 mm long.

from *sinus-mexicanus* in the arrangement of the thorns and prickles on the upper surface of its disc and tail, in its smooth nasal flap and curtain, and in its relatively long narrow rostral cartilage (three rows of formidable thorns on tail extending on to disc, fringed nasal flap and curtain and short triangular rostral cartilage, on *sinus-mexicanus*); from *spinosa* in its slender tail, in the presence of a single row of small thorns along the midline of its disc and tail, in its smooth nasal curtain, in the presence of a space between the dorsal fin and the caudal, and

in its narrower rostral cartilage (robust tail, 4-5 rows of thorns along back and on tail, fringed nasal curtain, confluent dorsal and caudal, and short triangular rostral cartilage on *spinosa*); and from *yucatanensis* Bigelow and Schroeder 1950 in its plain coloration and smooth nasal flap and curtain (disc and tail freckled with brown dots, nasal curtain and flap fringed on *yucatanensis*).

Description of holotype. Proportional dimensions in per cent of total length :

Disc. — Extreme breadth 49.2; vertical length 40.7.

Snout length. — In front of orbits 11.1; in front of mouth 13.6.

Orbits. — Horizontal diameter 3.5; distance between 3.3.

Spiracles. — Length 2.5; distance between 6.5.

Mouth. — Breadth 5.3.

Exposed nostrils. — Distance between inner ends 5.9.

Gill openings. — Length, 1st 1.2; 3rd 1.2; 5th 0.9; distance between inner ends, 1st 11.8; 5th 6.8.

First dorsal fin. — Vertical height 2.4; length of base 5.0.

Second dorsal fin. — Vertical height 2.4; length of base 4.5.

Pelvics. — Anterior margin 12.1.

Distance. — From tip of snout to center of cloaca 37.9; from center of cloaca to 1st dorsal 47.3; to tip of tail 62.1; from rear end of 2nd dorsal base to tip of tail 5.0.

Interspace. — 1st and 2nd dorsals 0.3; second dorsal and caudal 2.1.

Disc 1.2 times as broad as long, tip of snout with a very small projection, maximum angle in front of spiracles about 115° ; anterior margins slightly convex in front of orbits, thence about straight to outer corners which are broadly rounded; rear margins gently rounded, as are inner margins. Axis of greatest breadth about 70 per cent of distance rearward from tip of snout to axils of pectorals. Tail very slender, with a lateral fold low down on each side, beginning almost imperceptibly beyond level of tips of pelvics by a distance equal to that between spiracles and continuing almost to extreme tip of tail, widening posteriorly, being widest opposite dorsal fins where its width is about equal to that of tail at that point; length of tail from center of cloaca to origin of first dorsal 1.25 times and to its tip 1.64 times as great as from center of cloaca to tip of snout.

A row of 5 small thorns along inner margin of one orbit and 9 along the other with a single thorn inward from these and opposite rear margin of spiracle. Extreme tip of snout smooth,

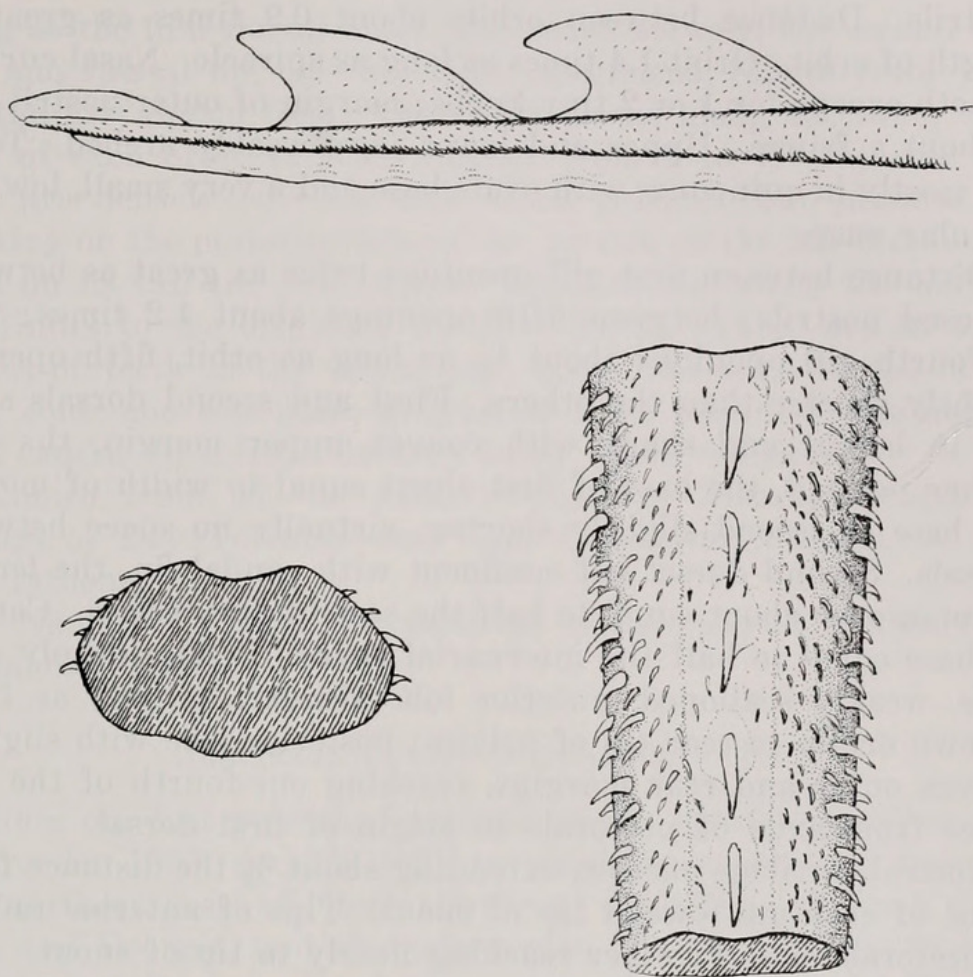


Figure 8. *Breviraja ishiyamai*, end of tail showing dorsal fins and caudal fin about $\times 1.5$; section of tail from near tips of pelvics and cross-section of same about $\times 2$.

remainder of disc uniformly covered with small, slender prickles, very close set, their tips bent rearward. A median row of 4 small thorns from nape to scapular region a little beyond which the row resumes with about 54 thorns of varying sizes extending on to tail and ending before first dorsal fin by a distance about equal to that from tip of snout to orbits. One or two scapular thorns on each side of median row. Tail, in addition to the thorns in midrow, densely prickly, some of the prickles being coarser than those on disc, with a row of smaller thorns varying in size, low down on each side, ending a little posterior to mid-row. Posterior lobe of pelvics, skin over eyes, and dorsals, covered with prickles, with a few on caudal fin and lateral folds. Lower surface smooth.

Snout in front of orbits 3.2 times as long as orbit, its length in front of mouth 2.3 times as great as distance between exposed

nostrils. Distance between orbits about 0.9 times as great as length of orbit. Orbit 1.4 times as long as spiracle. Nasal curtain smooth except for 1 or 2 tiny knobs; margin of outer nostril flap without a fringe. Upper and lower jaws weakly arched. Teeth $\frac{34}{33}$, mostly in quincunx, with ovate base and a very small, low triangular cusp.

Distance between first gill openings twice as great as between exposed nostrils; between fifth openings about 1.2 times; first to fourth gill openings about $\frac{1}{3}$ as long as orbit, fifth opening slightly shorter than the others. First and second dorsals similar in height and shape with convex upper margin, the tips rather pointed, the base of first about equal to width of mouth, the base of second slightly shorter; virtually no space between dorsals. Second dorsal not confluent with caudal fin, the length of interspace about equal to half the second dorsal base. Caudal fin base equal to half the internarial space. Pelvics deeply concave, weakly scalloped, anterior lobe slender, as long as from its own origin to rear tip of pelvics; posterior lobe with slightly convex outer and rear margins, reaching one-fourth of the distance from axils of pectorals to origin of first dorsal.

Rostral cartilage narrow, extending about $\frac{2}{3}$ the distance from front of cranium toward tip of snout. Tips of anterior radials of pectorals close together reaching nearly to tip of snout.

Color. Upper surface plain grayish brown without spots or other markings. Lower surface pale pinkish white, the pectorals darker posterior to the first gill openings.

The paratype, a female of 269 mm, agrees closely with the holotype in proportional dimensions.

The 362 mm female has a somewhat sharper and longer snout than the holotype, the anterior angle being 99° ; the distance from snout to orbit 13.3 per cent and from snout to mouth 16.6 per cent of the total length while the disc width is proportionately greater, 52.1 per cent of the total length, and longer, 45.8 per cent. Also, the length of its tail measured from center of cloaca, 57.3 per cent, is shorter than that of the holotype (62.1 per cent).

The male, 226 mm long, has a strongly arched mouth, a relatively shorter snout, its length to orbit being 9.3 and to mouth 10.2 per cent of total length, and a longer tail which is 66.8 per cent. However, the longer tail might prove to be a juvenile character.

On two of the specimens mentioned above, the dorsals are confluent but on one, the male, there is an interspace about $\frac{1}{3}$ as

long as the first dorsal base. The space between the second dorsal and caudal fin, on these three specimens, ranges from $\frac{1}{5}$ to $\frac{1}{7}$ the first dorsal base. The small thorns along the inner margin of each orbit vary in number from 4 to 7. The disc and tail are densely covered with small prickles, but prickles are lacking on the posterior lobe of the pelvics on the 269 mm female and on its tail the row of very small thorns along the midline continues to the origin of the first dorsal. There are 36 to 38 series of teeth in the upper jaw, about the same in the lower. The color above is plain grayish or light brownish, the dorsals and caudal fin a little darker; below, plain whitish.

Known from off the Atlantic coast of Nicaragua, and the offings of Dry Tortugas and Cape Canaveral, Florida, in 275-520 fathoms.

Named for Reizo Ishiyama in recognition of his work on Japanese batoids.

BREVIRAJA PLUTONIA (Garman) 1881

Since our last published account of this species (Bigelow and Schroeder 1953, pp. 297-302) in which it is recorded from off the northern coast of North Carolina,¹ the offings of South Carolina and Georgia, and of Jacksonville, Florida, in 230-333 fathoms, more than one hundred additional specimens, 62-270 mm long, have been received from many localities ranging from off Cape Lookout, North Carolina, to an area centering about 30 miles southwest of Dry Tortugas, Florida, within the Gulf of Mexico.² They were taken on 7 "Oregon," 18 "Combat," 7 "Silver Bay" and 4 "Pelican" stations in depths of 160-400 fathoms.

A recently hatched specimen 64 mm in total length with a disc 28 mm wide, and one of 84 mm, disc 34 mm, are densely prickly everywhere above on disc and tail, with a few prickles on pelvics, skin over eyes, and on dorsals. There are 2 thorns along anterior margin of orbits and 2 or 3 along posterior margin. The midline row of thorns on disc and tail have not yet appeared. The embryonic tail is present. A specimen of 101 mm has a few thorns in the scapular region, some midline thorns on the tail and a few in the side rows, a total of 8 orbital thorns,

¹ The precise locality for this record, from the winter trawl fishery (Pearson 1932, p. 18), was not given. If the identification be correct, the capture was probably made at a depth of less than 100 fathoms.

² These Dry Tortugas specimens were taken at "Oregon" stations 1010, 1538 and 1542 and "Silver Bay" stations 1195 and 1196.

and it has lost its embryonic tail. On a specimen of 134 mm the midline row of thorns is starting to fill in on the disc. On these young specimens the thorns are very small; the anterior margin of disc is evenly rounded, not concave as it is on older specimens of both sexes; the upper surface of the disc is marked with small dark spots and bars, including one bar across the scapular region, one extending outward and forward from each orbit, and one from the axil of each pectoral, while the tail has from 7 to 9 cross bars.

In our previous account of this species it is stated that the pelvics are naked, but a patch of prickles is present on the posterior pelvic lobes of both sexes, from the smallest to the largest sizes.

The number of teeth on 10 specimens counted ranges from $\frac{28}{26}$ on a male of 219 mm to $\frac{34}{34}$ on a female of 225 mm, but young specimens of both sexes as small as 110-133 mm may have as many as $\frac{30}{30}$ teeth.

A female of 234 mm had an egg capsule which protruded for nearly half its length from the cloaca, the opening of which was distended to a width of 11.5 mm. The capsule, yellow brown and with a smooth surface, is 13 mm wide and 24 mm long, with very slender flexible horns 30 mm long at its straight end and stouter horns 8 or 9 mm long at its concave end.

BREVIRAJA SINUS-MEXICANUS Bigelow and Schroeder 1950

Since the publication of *Fishes of the Western North Atlantic*, No. 1, Part 2 (Bigelow and Schroeder 1953), which records 94 specimens, 117-355 mm long, trawled along the northeastern part of the Gulf of Mexico in depths of 170-347 fathoms, the "Oregon" has again taken *sinus-mexicanus* in this general region and also in the northwest Gulf (Lat. 26°46'N, Long. 96°20'W) and in the southwest (in the Gulf of Campeche, Lat. 19°37', Long. 92°40'), within the above depth range and down to 400 fathoms.

BREVIRAJA SPINOSA Bigelow and Schroeder 1950

At the time of the last published account (Bigelow and Schroeder 1953, p. 306) of this species, based on 7 specimens, its known distribution was limited to the offings of northern Florida, North Carolina and Delaware Bay. Recently a large series was trawled by the "Oregon" (26 stations), "Combat" (11 stations), and "Pelican" (1 station) from the offing of Cape Fear,

North Carolina, off the coast of Georgia, along the east coast of Florida, in the Florida Straits, and off the coasts of Honduras, Nicaragua and the Guianas, between N Lats. 32°58' and 07°05', in 150-400 fathoms. The specimens in this collection range from 77 to 424 mm in total length, with both sexes well represented.

These additional specimens show that there is a wide variation in size and number of thorns and prickles on the disc and the tail and in the color above and below. Thus, the upper surface of disc and tail may be densely covered with small prickles, or these may be sparse or virtually absent. The pelvics may be partly prickled or smooth. The thorns along the midbelt of back are conspicuous on some specimens, rather feeble on others, those in nape-scapular region in a triangular patch followed by from 4-5 to 6-7 more or less irregular rows along disc, to 3-4 or 4-5 rows on tail, the latter thorns usually being the larger. The thorns which line the inner margins of the orbits are in a continuous series on some specimens and may number as many as 10-12 but more often are interrupted and number about 5 to 8. The disc is smooth below, also the tail except for a few prickles along the outer edges on some specimens.

The color above ranges from pale grayish or grayish brown to dark gray or brown, sometimes of marbled appearance and, among the pale varieties, some are indistinctly marked with a few whitish blotches, often in pairs, arranged symmetrically on either side of the median line. The small protuberance at tip of snout is dark-edged on some, plain on others. The dorsals and caudal are either brownish or plain on specimens which are pale above, or black on those which are dark brown above. The lower surface may be pale throughout, grayish on the outer part of the pectorals, variously mottled with blackish brown, or entirely blackish excepting for pale areas immediately around the nasal apertures, around the mouth, around the gill openings and around the cloaca.

The mouth is moderately arched on small specimens, more strongly so on large. The number of teeth, on about a dozen specimens small to large, fell within the range of $\frac{36-46}{36-44}$ already given. The first and second dorsal fins are confluent at the base on most specimens but on an occasional one there is a very short interspace.

A mature male had not previously been seen. A specimen 332 mm in total length, from Lat. 29°34'N, Long. 80°23'W, has a

disc obtusely rounded in front, thence concave opposite the spiracles, with broadly rounded outer corners and rear margins. The jaws are strongly arched. The teeth in the mid sector are arranged in quincunx, with a slender cusp, those toward outer corners tending to be in oblique rows and with a triangular cusp. The claspers extend beyond the axils of pelvics for a distance equal to that from the tip of the snout to the rear margins of the spiracles. The alar thorns are in 2 to 3 rows, the longest row as long as the distance from the tip of the snout to the rear margin of the orbits. The disc has very few prickles, and the thorns, excepting those on the tail, are relatively feeble. This specimen is pale brownish above and mostly blackish brown below.

The smallest three specimens, 77-83 mm in total length, with discs 42-46 mm wide, have a large yolk and an embryonic tail, one 89 mm long with a disc 48 mm wide has a small yolk and has lost its embryonic tail, while the yolk has been absorbed on a specimen of 105 mm, with disc 54 mm wide. Specimens 77 and 130 mm long are covered with prickles and small thorns; the triangular patch of thorns in the nape-scapular region is present followed by 3 rows along the mid zone of the disc and along the tail. The color is pale brown above, whitish below.

Genus *CRURIRAJA* Bigelow and Schroeder 1948

In this genus the outer margin of the pelvic fins is so deeply notched that the anterior division is entirely cut off from the remainder of the fin, thus forming a separate limb-like structure arising independently from the lower surface of the disc some little distance inward from the edge of the disc, with the inner posterior margin of the pectoral continuous with the anterior margin of the posterior division of the pelvic. *C. rugosa* and the new species *cadenati* necessitate the following modification of the characters of the genus. The slender anterior division of the pelvic, described as tapering toward the tip, does not taper on *cadenati* but is blunt at the tip (Fig. 9) and while the posterior division of the pelvic of *cadenati* has 18 radials, there are 11-14 radials on *atlantis*, *poeyi* and *rugosa*.

Key to known species of *Cruriraja*

1. Interspace between 1st and 2nd dorsal fins at least 1.5 times as long as base of 1st dorsal *atlantis*
Bigelow and Schroeder 1948. North coast of Cuba.

- Interspace between 1st and 2nd dorsal fins not more than about half as long as base of 1st dorsal2
2. No thorns in the nuchal region*poeyi*
Bigelow and Schroeder 1948. Cuba
and east coast of Florida. p. 204
- Thorns present in the nuchal region3
3. Thorns in a broken series along midline of back4
Thorns in an unbroken series along midline of back from close behind
level of spiracles rearward along disc and tail5
4. Midzone of tail with a single row of thorns*rugosa*
Bigelow and Schroeder 1958. Gulf
of Mexico; Atlantic coast of Cen-
tral America. p. 204
- Midzone of tail with 2 or more rows of thorns*cadenati*
new species, off Anguilla, Leeward
Islands and east coast of Florida.
p. 199
5. A group of thorns on tip of snout, others along anterior half of rostral
ridge, and 2 thorns in the space between the two dorsal fins
parcomaculata von Bonde and
Swart, 1924. Off Natal Coast,
South Africa; 298 fathoms.
- No thorns on tip of snout, along rostral ridge, or in the space between
the two dorsals
durbanensis von Bonde and Swart,
1924. Off Natal Coast, South Af-
rica; 420 fathoms.

CRURIRAJA CADENATI sp. nov.

Figure 9

Study material. Female, 376 mm in total length, holotype, U. S. Nat. Mus. No. 196443 from off the western coast of Puerto Rico, Lat. 18°16.5'N, Long. 67°17'W, in 250 fathoms, "Oregon" station 2650, and a mature male of 347 mm, paratype, M. C. Z. No. 40240 from the offing of Cape Canaveral, Florida, Lat. 27°59'N, Long. 78°56'W, in 480-490 fathoms, "Silver Bay" station 443.

Distinctive characters. *Cruriraja cadenati* differs from *C. rugosa* in the arrangement and number of thorns, there being 11 evenly spaced along the inner margin of each orbit, 5 in nuchal region, 11-12 immediately in advance of axils of pectorals, followed by 1 to 2 or more rows along the top of tail, and in lacking prickles on its under surface (*rugosa* has 2 to 8 orbital thorns, not evenly spaced, 0-3 nuchal thorns, 0-5 immediately

in advance of axils of pectorals, only 1 row on the top of the tail, and prickles on the under surface of the tail on specimens larger than about 250 mm). It differs from *atlantis* in that the space between its dorsal fins is not more than about half as long as the first dorsal base (about 2.5 times dorsal base on *atlantis*); from *poeyi* in a more generally prickly disc, and in the presence of several nuchal thorns (disc without prickles, except along part of the midzone posterior to the pectoral girdle, no nuchal thorns, on *poeyi*); from *parcomaculata* and from *durbanensis* in lacking thorns along part of the midzone of the disc.

Description of holotype. Proportional dimensions in per cent of total length:

Disc. — Extreme breadth 62.0; vertical length 46.1.

Snout length. — In front of orbits 11.0; in front of mouth 14.1.

Orbits. — Horizontal diameter 5.3; distance between 3.5.

Spiracles. — Length 2.0; distance between 6.9.

Mouth. — Breadth 6.1.

Exposed nostrils. — Distance between inner ends 6.1.

Gill openings. — Length 1st 1.9; 3rd 1.9; 5th 1.2; distance between inner ends 1st 13.1; 5th 8.0.

First dorsal fin. — Vertical height 2.5; length of base 3.7.

Second dorsal fin. — Vertical height 2.5; length of base 3.5.

Pelvics. — Length of limb 12.2.

Distance. — From tip of snout to center of cloaca 42.1; from center of cloaca to 1st dorsal 47.8, to tip of tail 57.9; from rear end of 2nd dorsal base to tip of tail 2.4.

Interspace. — 1st and 2nd dorsals 0.5.

Disc. — 1.35 times as broad as long; maximum angle in front of spiracles 105° ; anterior margins from snout to outer corners of pectorals slightly sinuous, the corners abruptly rounded; posterior and inner margins very gently rounded. Axis of greatest breadth 72 per cent of distance back from tip of snout to axils of pectorals. Tail with a lateral fold, low down on each side beginning a little posterior to tips of pelvics, very narrow anteriorly but widening on approaching tip of tail; length of tail from center of cloaca to origin of first dorsal 1.13 times as great, and to its tip 1.38 times as great as distance from center of cloaca to tip of snout.

Inner margin of orbits with 11 thorns, evenly spaced, with 2 or 3 in addition inward from the most posterior ones. A staggered row of about 10 thorns on anterior part of rostral process.

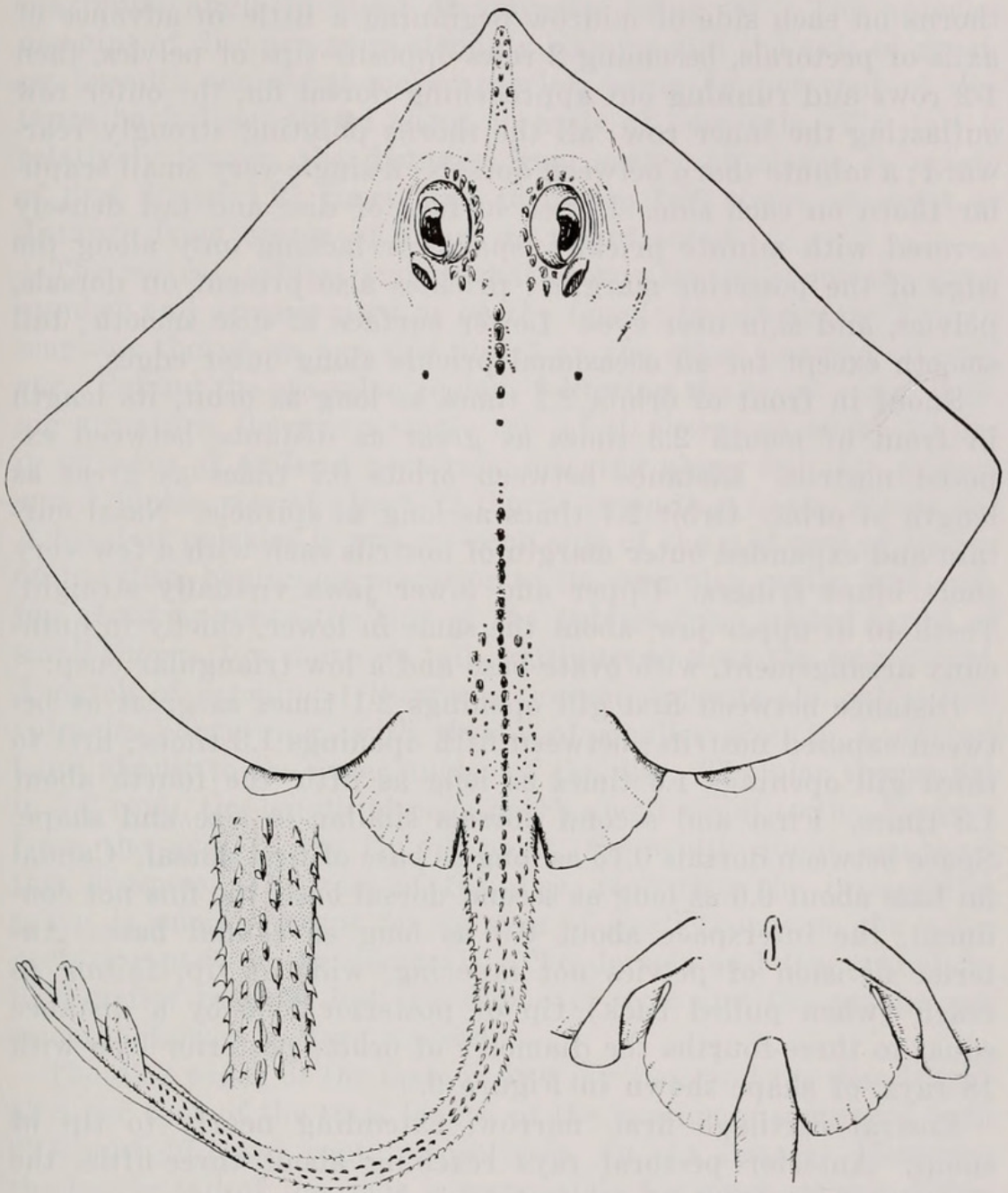


Figure 9. *Cruriraja cadenati*, dorsal view of type, female 376 mm long; ventral view of pelvis about $\times 0.4$; section of tail from near tips of pelvis about $\times 0.7$.

Five prominent thorns in midline from nuchal to scapular region followed by a space equal to $1\frac{1}{3}$ eye's diameter lacking thorns, then a single row of 27 closely spaced thorns, of which 11 are in advance of axils of pectorals, merging a little posterior to tips of pelvis into a double row of 35 thorns, many of them opposite each other, extending to dorsal fin; 2-3 rows of small

thorns on each side of midrow beginning a little in advance of axils of pectorals, becoming 2 rows opposite tips of pelvics, then 1-2 rows and running out approaching dorsal fin, the outer row outlasting the inner row; all the thorns pointing strongly rearward; a minute thorn between dorsals; a single very small scapular thorn on each side. Upper surface of disc and tail densely covered with minute prickles, sparse or lacking only along the edge of the posterior margins; prickles also present on dorsals, pelvics, and skin over eyes. Lower surface of disc smooth; tail smooth except for an occasional prickle along outer edges.

Snout in front of orbits 2.1 times as long as orbit, its length in front of mouth 2.3 times as great as distance between exposed nostrils. Distance between orbits 0.7 times as great as length of orbit. Orbit 2.7 times as long as spiracle. Nasal curtain and expanded outer margin of nostrils each with a few very short blunt fringes. Upper and lower jaws virtually straight. Teeth 46 in upper jaw, about the same in lower, chiefly in quincunx arrangement, with ovate base and a low triangular cusp.

Distance between first gill openings 2.1 times as great as between exposed nostrils; between fifth openings 1.3 times; first to third gill openings 1.6 times as long as fifth, the fourth about 1.3 times. First and second dorsals similar in size and shape. Space between dorsals 0.15 as long as base of first dorsal. Caudal fin base about 0.6 as long as second dorsal base, the fins not confluent, the interspace about 0.3 as long as caudal base. Anterior division of pelvics not tapering, wide at tip, failing to reach (when pulled back) tip of posterior lobe by a distance equal to three-fourths the diameter of orbit; posterior lobe with 18 rays, of shape shown in Figure 9.

Rostral cartilage firm, narrow, extending nearly to tip of snout. Anterior pectoral rays reaching about three-fifths the distance from front of orbits toward tip of snout.

Color. Upper surface of disc light brown with numerous dark brown rather vague irregular spots ranging in size from about one-fourth to as large as the area of the orbit, the spots extending along tail, where they are more intense, nearly to dorsal fin. Pelvics pale brown, unspotted; dorsals pale without prominent markings. Below, the disc is marked with a broad irregular band of grayish along its margins from outer angles rearward, otherwise whitish. Pelvics with gray along their posterior margin; tail white.

The male has a somewhat sharper snout than the female, the

maximum angle in front of spiracles being 90° . The anterior margins of disc are more strongly sinuous and the axis of greatest breadth somewhat more anterior, being 68 per cent of distance back from tip of snout to axils of pectorals. The tail is relatively longer, the distance from center of cloaca to origin of first dorsal 1.21 times, and to its tip 1.58 times, as great as distance from center of cloaca to tip of snout.

The rostral, orbital and nuchal thorns are in about the same number and arrangement as on the female but there are 2 small scapular thorns on one side and 3 on the other, instead of only one. Behind the scapular region, following the short space lacking armature, there is a single row of 30 thorns of which 12 are in advance of axils of pectorals, merging along tail into a staggered double row of about 32 thorns extending to the dorsal fin. A band of prickles is present each side of the mid row of thorns on the disc, beginning posterior to the scapular region and ending about opposite the tips of the pelvics from where a row of small thorns, low down on tail, continues to near the first dorsal. A patch of prominent thorns is present opposite the orbits and spiracles continuing, with thorns of smaller size, in a narrow band almost to the outer angles of the disc. The alar thorns are in 5-6 rows, the length of each patch about equal to the distance from the eyes to the tip of snout, the width about one-third this distance. The rest of the disc, including the interorbital space, is smooth except for an area of small thorns on the inner posterior part of the pectorals. The dorsals and the caudal fin have a few prickles but the skin over eyes and the pelvics are smooth. Lower surface smooth.

The disc width of the male is 58.3 per cent and the disc length 43.3 per cent of the total length of the specimen, compared with 62.0 and 46.1 per cent, respectively, on the female. However, the longer tail of the male is responsible for much of this difference in proportions as the disc width is 1.50 times and the length 1.11 times the distance from tip of snout to the center of the cloaca, or virtually the same as that of the female on which these proportions are 1.47 and 1.10, respectively. The dorsal interspace is greater, being half the length of the first dorsal base but only one-seventh on the female. The posterior lobe of the pelvics has only 12 rays and is pointed at the tip. The claspers are well developed reaching a little more than half the distance from axils of pectorals to the first dorsal fin. There are 44 series of teeth in the upper jaw, 40 in the lower, arranged in oblique

rows, those in the mid sector of the jaws with a prominent conical cusp, those in the outer sectors with a triangular cusp. Color above light brown, the vague spots present on the female not apparent. Dorsals, caudal, and posterior section of tail fold dusky. Lower surface whitish in advance of gill openings, pale brownish posteriorly.

Known only from the holotype, a female 376 mm in total length, trawled in 250 fathoms off the western coast of Puerto Rico, and the paratype, a mature male of 347 mm taken off Cape Canaveral, Florida, in 480-490 fathoms. Named for Dr. J. Cadenat of the University of Dakar in recognition of his work on elasmobranchs of the west coast of Africa.

CRURIRAJA POEYI Bigelow and Schroeder 1948

Four specimens, all females, 235-343 mm in total length, were trawled off the northwest edge of Great Bahama Bank by the "Combat," stations 446 and 447, in 250-300 fathoms. This species has previously been reported from off the south central and north central coasts of Cuba and off St. Augustine, Florida, in 210-475 fathoms.

CRURIRAJA RUGOSA Bigelow and Schroeder 1958

Figure 10

The original account of this species is based on a single specimen, an immature male 367 mm in total length, taken in the northeastern part of the Gulf of Mexico in 200-300 fathoms. We can now amplify our description from a large series of specimens, as follows.

Study material. Thirty-nine specimens, males and females, 90 to 465 mm in total length, taken at 19 "Oregon" stations off the Atlantic coasts of Nicaragua and Honduras, ranging in North Latitude from 12°50' to 16°46' and in West Longitude from 81°25' to 82°44', in 200-350 fathoms.

Distinctive characters. *Cruriraja rugosa* was described as differing from all other known members of its genus in that the under side of its tail is covered with minute prickles, this area being smooth in the other species. Our additional material shows that while these prickles are present on specimens larger than about 250 mm in total length, of both sexes, on some specimens being sparse in distribution, on others dense, the prickles are entirely lacking on small individuals. Young and half-grown

rugosa (larger ones as well) may be distinguished from other western Atlantic *Cruriraja* as follows: from *atlantis* by a short space between the dorsal fins, about 0.2-0.4 times the length of first dorsal base (about 2.5 times the dorsal base on *atlantis*); from *poeyi* by the prickles that cover the disc, the presence of

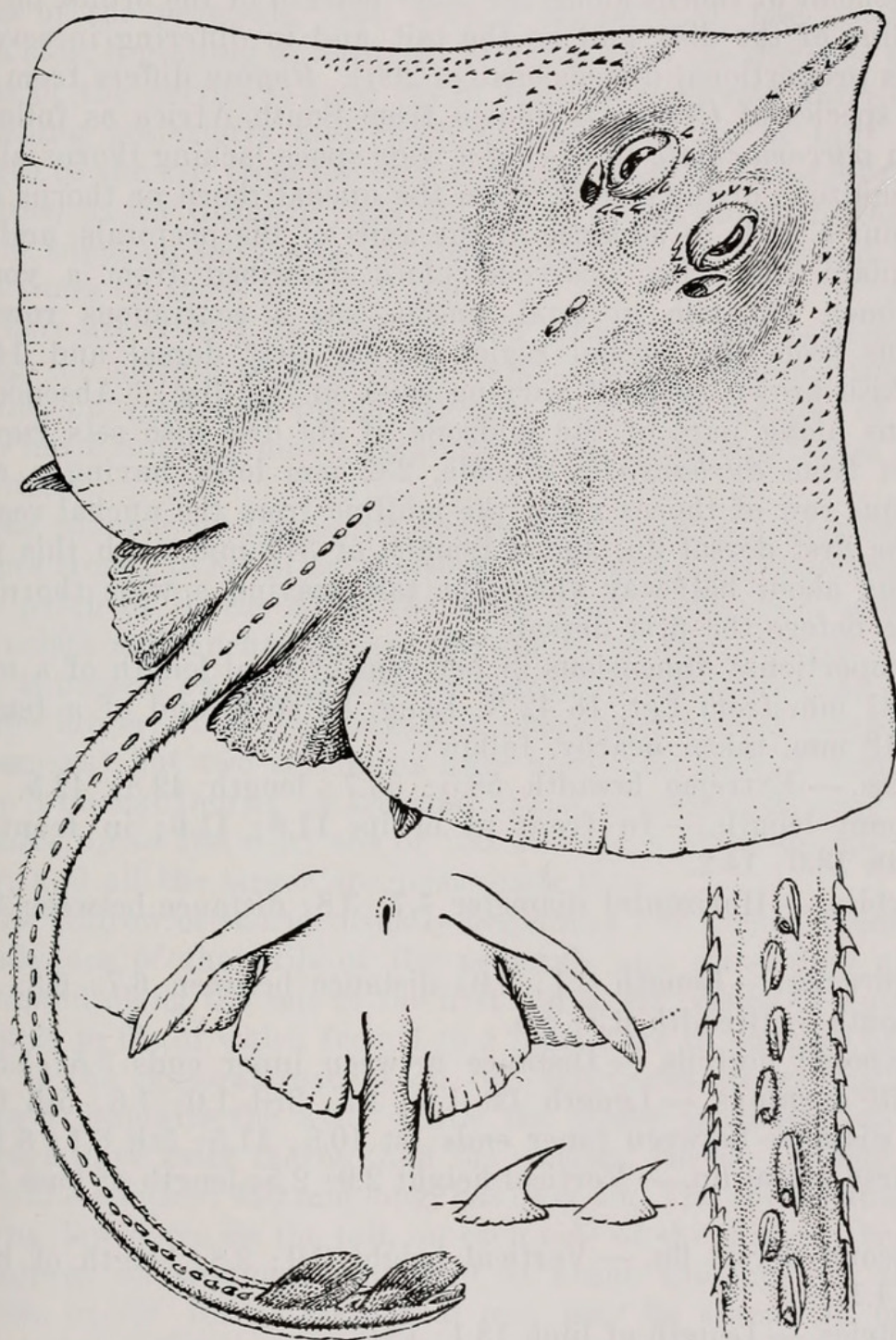


Figure 10. *Cruriraja rugosa*, type, immature male 367 mm long; pelvic fins about $\times 0.5$; section of tail about $\times 2$; first 2 thorns in front of dorsal fin about $\times 3$. (After Bigelow and Schroeder 1958.)

one or more nuchal thorns (occasionally absent) and a single row of thorns along the midline of the tail (disc without prickles, except along part of the midzone posterior to the pectoral girdle, no nuchal thorns, midline of thorns on tail divides into two rows posteriorly, on *poeyi*); from *cadenati* in the number and arrangement of thorns along the inner margin of the orbits, on the midline of the disc, and on the tail, and in differing in several of its proportional dimensions (p. 200). *Rugosa* differs from the two species of *Cruriraja* known from South Africa as follows: from *parcomaculata* in having a wide space lacking thorns along the midzone of the disc between the nuchal thorn or thorns and a point a little in advance of the axils of the pectorals, and by its plain coloration (*parcomaculata* described from a young specimen 181 mm in total length, has a continuous row of thorns from the nuchal region to the first dorsal and 14-18 blackish brown spots of varying sizes on the disc). Absence of thorns along part of the midzone of its disc also sets *rugosa* apart from *durbanensis*, a male, 232 mm long, having a continuous row of thorns along the midline from the nuchal region to the first dorsal fin, and a female, of 311 mm, with this row ending about half-way along the tail, leaving a wide thornless space before the first dorsal.

Proportional dimensions in per cent of total length of a male of 381 mm from Lat. 16°42'N, Long. 82°36'W and of a female of 318 mm, taken nearby, follow:

Disc. — Extreme breadth 58.5; 56.7; length 42.8; 42.5.

Snout length. — In front of orbits 11.8; 11.6; in front of mouth 13.0; 14.2.

Orbits. — Horizontal diameter 4.7; 3.8; distance between 3.2; 3.2.

Spiracles. — Length 2.1; 2.0; distance between 6.7; 6.3.

Mouth — Breadth 6.3; 5.5.

Exposed nostrils. — Distance between inner ends 5.5; 5.5.

Gill openings. — Length 1st 1.3; 1.5; 3rd 1.0; 1.6; 5th 0.9; 1.3; distance between inner ends 1st 10.8; 11.5; 5th 6.1; 6.1.

First dorsal fin. — Vertical height 2.9; 2.5; length of base 3.9; 3.8.

Second dorsal fin. — Vertical height 2.9; 2.8; length of base 4.2; 4.1.

Pelvics. — Length of limb 13.1; 12.0.

Distance. — From tip of snout to center of cloaca 38.9; 37.1; from center of cloaca to 1st dorsal 46.9; 49.3; to tip of tail 61.1; 62.9; from rear end of 2nd dorsal base to tip of tail 4.8; 4.4.

Interspace. — 1st and 2nd dorsals 1.3; 1.3.

A dozen or so males and females have the following characteristics. Maximum angle in front of the spiracles 75° - 90° with no apparent difference between the sexes. Axis of greatest breadth 62-77 per cent of the distance back from tip of snout to axils of the pectorals. Tail with a lateral fold, low down on each side, beginning at about 45-55 per cent of the distance from axils of the pelvics toward tip of tail, very narrow anteriorly, widening posteriorly and reaching nearly to tip of tail. The length of the tail from the center of the cloaca is 1.66-1.83 times as great as the distance from the center of the cloaca to the tip of the snout on specimens less than about 200 mm long and 1.50-1.73 times on those of larger size.

There are from 1 to 3 thorns, both anteriorly and posteriorly, along the margin of each orbit, with a space between lacking thorns, on specimens up to 420 mm long. The largest, of 465 mm, has 5 anterior and 3 posterior at one orbit and 3 and 3 at the other.

The number of thorns on the anterior half of the rostrum ranges from 1 to 8, but an occasional specimen lacks these thorns. The patch of thorns along the outer part of the disc opposite the orbits and nuchal region, illustrated on the holotype (Fig. 10), is present on all our smaller specimens but lacking on some of the larger. There is usually 1 prominent nuchal thorn (15 specimens) but two specimens have none, two have 2, and two have 3 nuchal thorns. A scapular thorn is present on each side on sizes up to 186 mm; one of 250 mm has a thorn on one side only, and all the larger specimens lack them.

The midrow of thorns, usually beginning 1 to 2 eyes' diameter in advance of the axils of the pectorals and continuing uninterrupted along the tail to the first dorsal fin, range in number from 24 to 61, of which from 1 to 8 thorns are in advance of the axil of the pectorals except on two specimens where the first thorn is opposite the axil. While the larger specimens on the average have more thorns than the smaller, one of 186 mm has 50, while another, 420 mm long, has only 39. The row of smaller thorns, low down on the tail, on each side of the midrow, begins to appear on specimens as small as about 130 mm but these thorns, except for an occasional one, may be absent on much larger sizes. They are generally spaced unevenly and run out a little in advance of the first dorsal fin, in some cases not extending rearward beyond the anterior half of the tail. There are from 1 to 3 thorns between the dorsals.

The upper surface of the disc, including the smallest specimens, is covered with minute prickles, as described for the holotype. Prickles are present on the dorsals, on skin over eyes, and on the pelvics but are usually absent on specimens smaller than about 170 mm long. The lower surface of the disc is smooth but the tail is more or less prickly on sizes larger than about 250 mm (p. 204).

The teeth are in series from 34 to 44 in the upper jaw and about the same in the lower, arranged chiefly in quincunx with a low triangular cusp, except on mature males on which they are more in a straight series than in quincunx and have a slender sharp cusp. The mouth of females and immature males is slightly arched but is moderately arched on mature males.¹

The space between the dorsals ranges from about $\frac{1}{5}$ to $\frac{2}{5}$ as long as the base of the first dorsal on most specimens but on one is only $\frac{1}{8}$ as long. The space between the second dorsal and caudal fins is equal to about $\frac{1}{4}$ to $\frac{1}{3}$ the base of the first dorsal. The base of the caudal is a little shorter than the base of the first dorsal. The anterior pectoral rays reach about 55 per cent of the distance from the front of the orbits toward the tip of the snout.²

A nearly mature male of 390 mm has well developed claspers which reach beyond the tips of pelvics a distance equal to about that from tip of snout to mouth, and there are 9 exposed alar thorns on the left side and 10 on the right, but on one of 415 mm, fully mature with clasper hooks exposed, the alars are in a patch of about 40 on each side, the thorns slender and pointing obliquely inward and rearward.

The upper surface of the disc is plain brownish, the dorsals and caudal ranging from somewhat darker brownish to dusky. Below pale, some specimens with brownish mottlings on the pectorals.

All the specimens were taken within a depth range of 200-350 fathoms. Although the "Oregon" has made many hauls within these depths throughout the Gulf of Mexico and southward to about Lat. 7° N, with a few to Lat. $01^{\circ}45'N$, *rugosa* was taken at only 1 station within the Gulf (type locality) and only along the Atlantic coasts of Nicaragua and Honduras.

¹ In the original published account (Bigelow and Schroeder 1958, p. 229) the description of teeth and shape of mouth was scrambled in printing. It should have read, "Upper and lower jaws nearly straight. Teeth $\frac{43}{42}$, arranged in quincunx, with ovate base and short triangular cusp."

² This was erroneously given as 22 per cent in the original published account.

Family PSEUDORAJIDAE Bigelow and Schroeder 1954

Rajoidea without dorsal fins; tail with a lateral fold low down on each side; with a well developed upper and lower caudal fin, not quite confluent around tip of tail, supported by a great number of very slender raylike strands, apparently cartilaginous; with outer margins of pelvics pointed or rounded and posterior margin straight or slightly convex if spread widely; anterior wall of spiracles with a transverse row of low vertical ridges, representing the vestiges of the embryonic gill filaments; pelvis with transverse element nearly straight, each of its outer corners with a short projection directed forward.

Genus PSEUDORAJA

Pseudorajidae with shape of disc, and of tail relative to disc, as in skates of the family Rajidae; tip of snout with a short protuberance; pelvic fins very large, wing-like, with anterior outline about transverse to main axis of disc; front of cranium with a rostral projection, longer or shorter; a pit on ventral surface of head on either side, close posterior to nostril but entirely separate from the latter. Other characters those of the family Pseudorajidae.

Key to Species

- 1a Pelvics with outer margins broadly rounded; tip of snout with a short fusiform protuberance *fischeri* p. 216
 1b Pelvics with outer margins pointed; tip of snout with a short flat protuberance *atlantica* n. sp. p. 209

PSEUDORAJA ATLANTICA sp. nov.

Figures 11-13

Study material. Female, 450 mm in total length, holotype, U. S. Nat. Mus. No. 196444, from Lat. 13°20'N, Long. 82°02'W in 325 fathoms, "Oregon" station 1917, and 2 males, 421-435 mm, paratypes, M. C. Z. Nos. 40167, 40168, from Lat. 13°31'N, Long. 81°54'W in 300 fathoms, "Oregon" station 1920, both from off the Atlantic coast of Nicaragua. Also 57 others, males and females, taken at 18 "Oregon" stations as follows: 12 specimens, 230-447 mm, from 8 stations off Nicaragua (12°33'-13°34') in 275-350 fathoms; 20 specimens, 170-481 mm, from 9 stations made SW of Grenada (11°31'-11°40') in 185-290 fathoms; and

23 specimens, 190-375 mm, from 8 stations off British Guiana ($07^{\circ}05'-07^{\circ}38'$) in 135-275 fathoms; also 2 abnormal specimens (p. 215), 250-349 mm, from 2 stations off the mouth of the Amazon River (Lat. $01^{\circ}45'-01^{\circ}49'N$) in 225-275 fathoms.

Distinctive characters. This species differs further from *fischeri*, its only known genus mate, in lacking enlarged thorns along the margin of orbits and in the scapular region and in having the prickles on the tail sparsely distributed and minute in size while on *fischeri* there are prominent orbital and scapular thorns and the prickles on the tail are densely distributed and large in size. Also, the pelvic fins have 12 to 15 radials, in addition to the first stout one, whereas *fischeri* has 18 to 20.

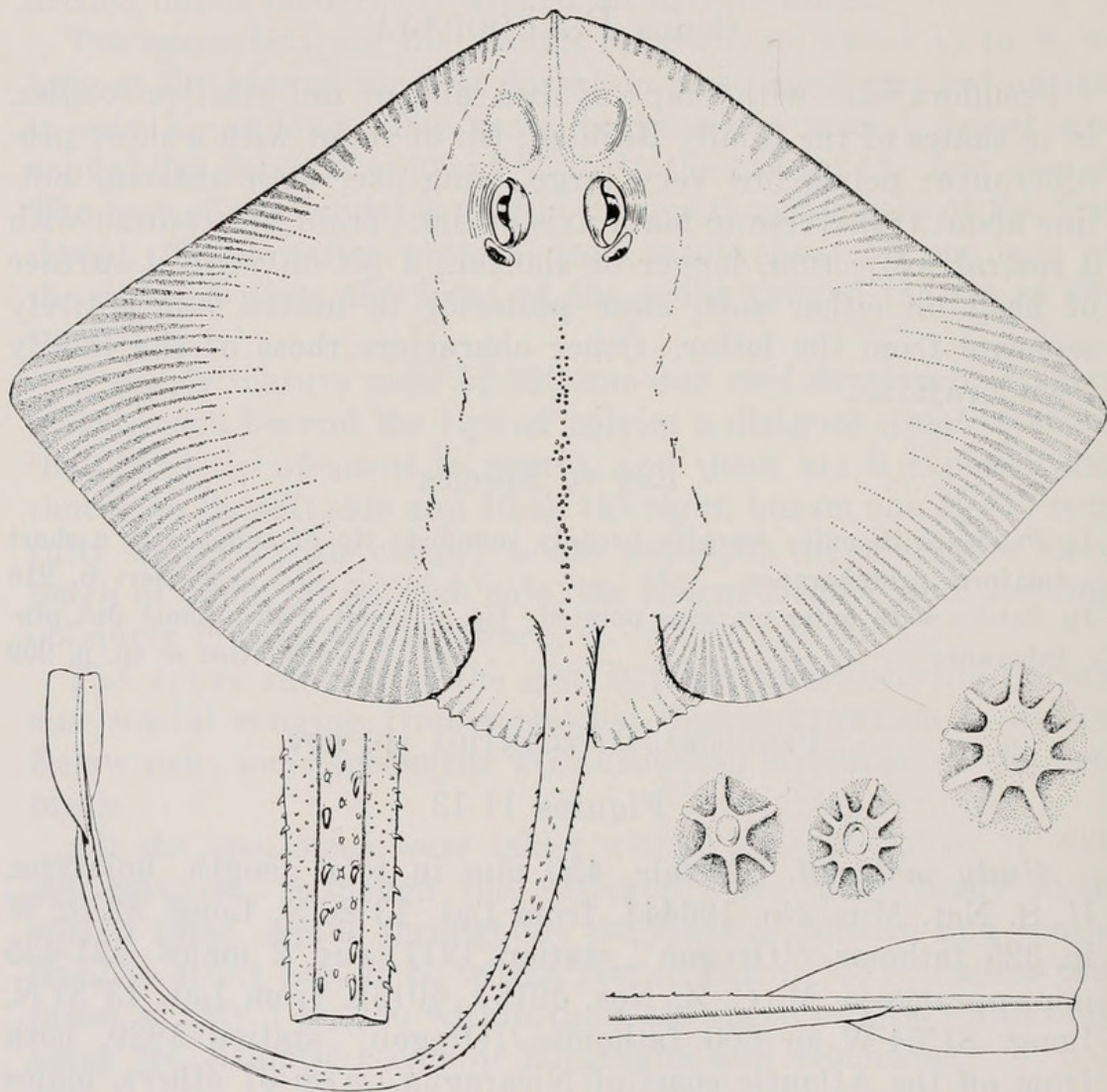


Figure 11. *Pseudoraja atlantica*, dorsal view of type, female 450 mm long; section of tail about $\times 1.8$; thorns from along middle of disc, about $\times 12$; caudal fin and ending of tail fold, about $\times 1$.

Description of holotype. Proportional dimensions in per cent of total length:

Disc. — Extreme breadth 61.8; vertical length 36.7.

Snout length. — In front of orbits 9.9; in front of mouth 10.4.

Orbits. — Horizontal diameter 3.6; distance between 3.1.

Spiracles. — Length 2.0; distance between 5.9.

Mouth. — Breadth 6.0.

Exposed nostrils. — Distance between inner ends 4.9.

Gill openings. — Length, 1st 1.1; 3rd 1.1; 5th 0.9; distance between inner ends, 1st 10.4; 5th 6.9.

Pelvics. — Length of anterior margin 12.7.

Caudal fin. — Length of base, upper 10.0; lower 8.0.

Distance. — From tip of snout to center of cloaca 33.8; from center of cloaca to tip of tail 66.2.

Disc 1.68 times as broad as long, maximum angle in front of spiracles 148° ; margins from tip of snout to about opposite orbits slightly convex thence slightly concave to outer corners of disc which are sharply rounded; posterior margins beginning straight and then gently rounded to very short inner margin.

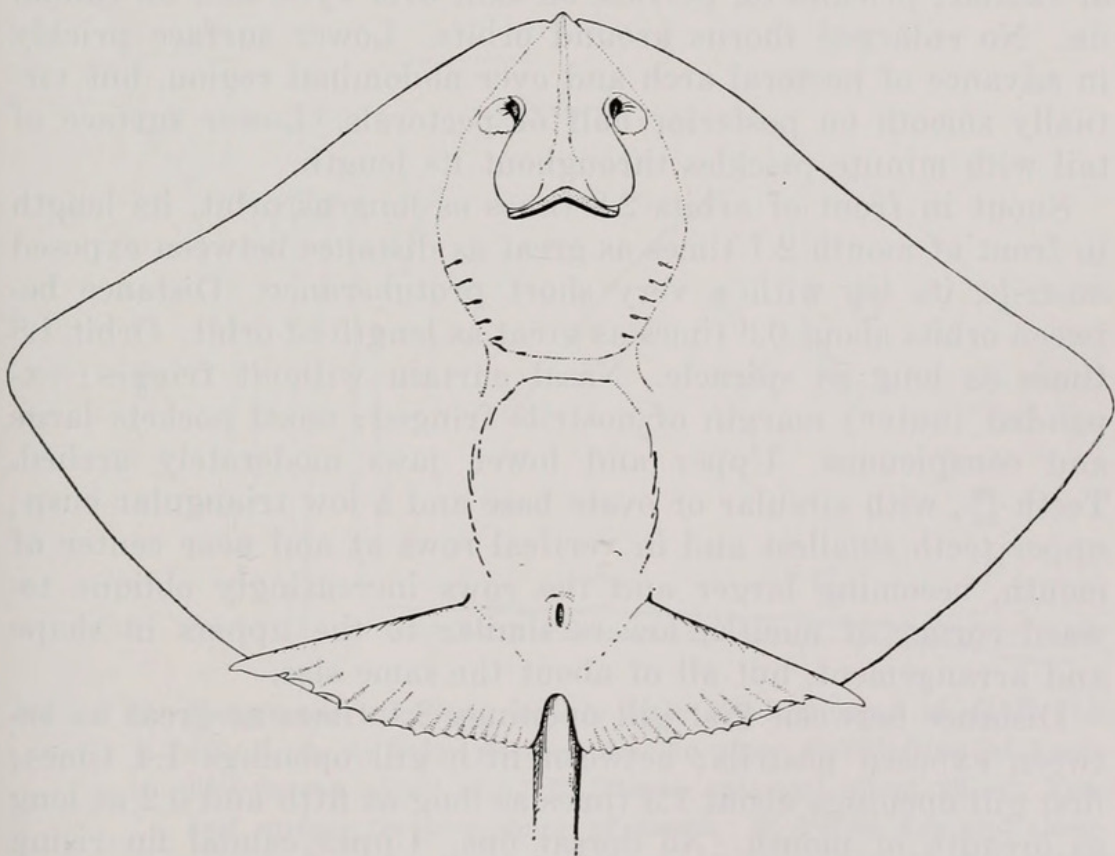


Figure 12. *Pseudoraja atlantica*, ventral view of type, with pelvics spread out.

Axis of greatest breadth about 66 per cent of distance back from tip of snout to axil of pectorals. Tail very slender, its width, about midway between cloaca and its tip, only one-fourth the diameter of eye; a lateral fold low down on each side, beginning almost imperceptibly beyond level of tips of pelvics by a distance equal to about twice diameter of eye and ending an eye's diameter beyond origin of upper caudal fin, very narrow anteriorly but gradually widening rearward until, a little in advance of caudal fin, the fold on each side is nearly as wide as tail at that point; length of tail from center of cloaca 1.96 times distance from tip of snout to center of cloaca.

Upper surface of disc covered everywhere with very small sharp prickles, on stellate bases, somewhat more dense and a trifle larger between and in advance of orbits than posteriorly. Several irregular rows of very small bluntish thorns, with an occasional sharp one, forming a narrow band along midzone of disc from nape to origin of tail from which 2 to 3 interrupted rows of larger thorns, sharp pointed and directed rearward, reduced to 1 or 2 rows posteriorly, extend to a little in advance of caudal; prickles on pelvics, on skin over eyes, and on caudal fin. No enlarged thorns around orbits. Lower surface prickly in advance of pectoral arch and over abdominal region, but virtually smooth on posterior half of pectorals. Lower surface of tail with minute prickles throughout its length.

Snout in front of orbits 2.8 times as long as orbit, its length in front of mouth 2.1 times as great as distance between exposed nostrils, its tip with a very short protuberance. Distance between orbits about 0.9 times as great as length of orbit. Orbit 1.8 times as long as spiracle. Nasal curtain without fringes; expanded (outer) margin of nostrils fringed; nasal pockets large and conspicuous. Upper and lower jaws moderately arched. Teeth $\frac{38}{38}$, with circular or ovate base and a low triangular cusp; upper teeth smallest and in vertical rows at and near center of mouth, becoming larger and the rows increasingly oblique toward corner of mouth; lowers similar to the uppers in shape and arrangement, but all of about the same size.

Distance between first gill openings 2.1 times as great as between exposed nostrils; between fifth gill openings 1.4 times; first gill openings about 1.3 times as long as fifth and 0.2 as long as breadth of mouth. No dorsal fins. Upper caudal fin rising very gradually, its base about as long as distance from tip of snout to orbits, its margin convex and its maximum width about

0.4 times diameter of eye; lower caudal fin originating a little posterior to upper, its base 0.8 times as long and its width 0.6 as great as upper, the fins not confluent although reaching tip of tail. Pelvics with rear margins about straight when spread except for short lobe formed by first ray which is stout and 4-jointed; anterior margin 1.3 times as long as distance from its own origin to rear margin of pelvics.

Rostral cartilage very narrow, extending to tip of snout, firm along the first three-fifths of its length in front of cranium, thence flexible to tip. Pectoral rays reaching anterior part of edge of disc, close together at tip of snout.

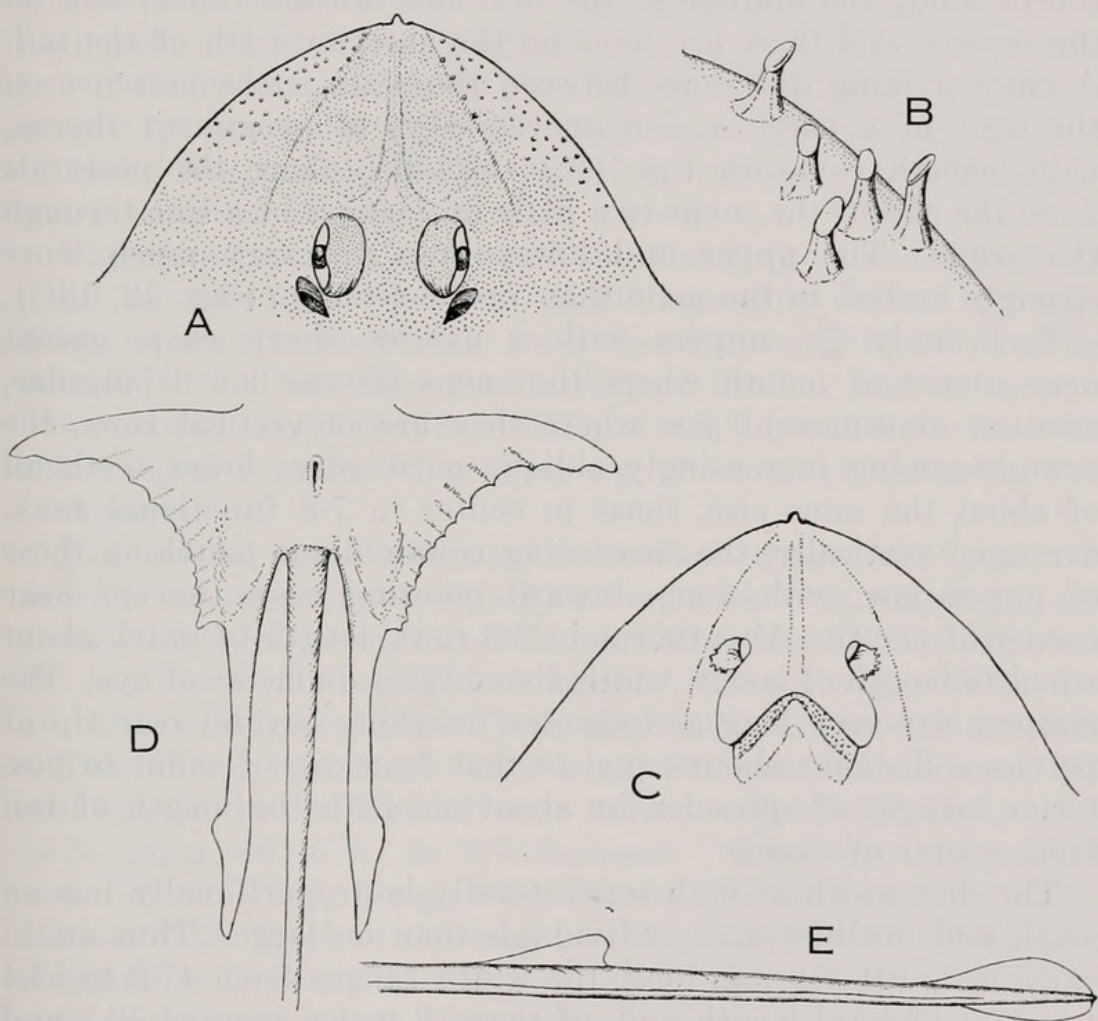


Figure 13. *Pseudoraja atlantica*, mature male 421 mm long, M. C. Z. No. 40168, A, Anterior part of disc to show distribution of knob-like thorns, about $\times 0.5$. B, Thorns enlarged about $\times 6$. C, Ventral surface to show shape of mouth. D, Pelvic fins and claspers about $\times 0.5$. E, Male 349 mm long, M. C. Z. No. 40406, end of tail to show position of dorsal fin, about $\times 1$.

Color. Upper surface of disc pale brownish without distinctive markings in preserved state; tail brownish. Lower surface of disc pale pinkish and brownish, tail mottled with brownish or dusky markings; caudal fin black.

A mature male 421 mm long (the paratype) differs from the holotype chiefly as follows: breadth of disc 1.45 times its length; breadth across anterior edge of orbits 21.8 per cent of total length of specimen (33 per cent on holotype); maximum angle in front of spiracles 123° ; margins from opposite orbits to outer corners more strongly concave; axis of greatest breadth about 74 per cent back from tip of snout to axil of pectorals. The thorns along the midline of the disc and tail are fewer than on the female, and there are none on the anterior sixth of the tail. A more striking difference between the sexes is the presence on the male of a patch of 5-6 uneven rows of prominent thorns, with smooth roundish tips (Fig. 13A-B), along the pectorals from the end of the snout to a little in advance of a line through the orbits. The upper and lower jaws are very much more strongly arched in the male than in the female (Figs. 12, 13C).

Teeth only $\frac{26}{26}$, uppers with a narrow sharp cusp, except near corner of mouth where the cusps become low triangular, smallest at center of jaw where they are in vertical rows, the rows becoming increasingly oblique outwardly; lower teeth all of about the same size, those in center in 7-8 functional rows, arranged vertically, the succeeding rows oblique matching those of upper jaw, with sharp inward pointing cusps, except near corner of mouth. Alar thorns in 2-3 rows, length of patch about equal to length of snout, width about $\frac{1}{2}$ - $\frac{2}{3}$ diameter of eye. The claspers are very long and slender, reaching beyond rear tip of pelvics a distance about equal to that from tip of snout to posterior margin of spiracles, or about one-fifth the length of tail from center of cloaca.

The disc width of both sexes usually is proportionally less on small and medium-sized individuals than on large. Thus on 15 examined, 191-379 mm long, the width ranges from 47.2 to 55.4 per cent of total length and, of these, 9 males average 49.1 and 6 females 53.1 per cent. On 3 mature males, 421-432 mm long, the width is 53.2-54.4 per cent, but on 2 females of 437 and 450 mm it is 63.2 and 61.8 per cent, respectively. One specimen which falls out of line with the above, a male 315 mm long, has a disc width of 58.0 per cent.

Prickles cover the upper surface of disc on all our specimens

but the tail thorns are relatively fewer on the smaller sizes, there being 1 to 2 rows on a female of 198 mm in total length and a scattering few on a male of 190 mm. A male of 349 mm is the smallest which shows a few of the peculiar knob-like thorns which, on adult males, are present in a conspicuous patch on each pectoral, in advance of the orbits. The lower surface, on the larger specimens, is covered with prickles, in varying degrees of density, anterior to the scapular arch, over the abdominal region and on the tail, the rest of disc being smooth; on the smaller specimens the prickles are restricted to the rostrum, and sparsely, to the tail.

The teeth of females 198-450 mm long are in 32-40 series, in each jaw, and of males of 242-432 mm in 26-34 series, the number of the latter smallest on two males 390 and 421 mm long and largest on two males of 306 and 425 mm, respectively. The jaws of males less than about 300 mm long are only slightly arched but become increasingly so with growth.

The claspers of males around 300 mm long extend a trifle beyond the tips of the pelvics; at 350 mm they extend beyond a distance equal to about that from tip of snout to mouth, and are pliable; at 390 mm they are starting to harden, and on those of 395 mm and larger they are stiff and reach beyond pelvics a distance equal to about that from tip of snout to spiracles, or a little more.

The disc of some specimens is marked above with many obscure to rather prominent darkish brown blotches ranging in size from a little less than to a little more than that of the orbit, and the tail has a number of dark bars or blotches, up to from 6 to 10, with pale interspaces. The caudal fin in all cases is blackish.

Two of our specimens deserve special mention, a female 250 mm long and a male of 349 mm taken, respectively, in Lat. $01^{\circ}45'N$, Long. $46^{\circ}46'W$, in 275 fathoms, "Oregon" station 2084, and Lat. $01^{\circ}49'N$, Long. $46^{\circ}48'W$, in 225 fathoms, "Oregon" station 2083. Each of these has one small dorsal fin (Fig. 13E), originating from tip of tail a distance equal to about 18-20 per cent of the total length of the specimen, the length of the base of the fin being almost one-fifth this distance and the height about one-third the base. A similar abnormality has been recorded, for the type specimen of *Raja garmani* (Garman 1881 and Garman 1913, pl. 18, fig. 2, as *Raja ornata*) has 3 dorsal fins instead of the usual 2 and other instances of accessory dorsal fins on rajids are described by Schnakenbeck (1942).

Known from the Atlantic coast of Nicaragua to the offing of the Amazon River in 135-350 fathoms.

PSEUDORAJA FISCHERI Bigelow and Schroeder 1954

One specimen, a female 270 mm in total length, is included in an "Oregon" and "Silver Bay" collection of elasmobranchs taken in otter trawl hauls made chiefly within and near the Straits of Florida in depths of 185-305 fathoms, but lacks a station number. Known previously from 4 specimens taken at "Oregon" station 726 from the southern part of the Gulf of Mexico, near Campeche Bank, in 225 fathoms.

The present specimen differs somewhat in coloration from the specimens previously seen, brown above on disc with many dark spots of a size about $\frac{1}{4}$ to nearly as large as orbits, and lacking whitish spots; the tail has 8 dark cross-bars, narrow to wide, and the upper and lower caudal fin is partly dusky.

Family ANACANTHOBATIDAE

Two new species of anacanthobatids, collected by the "Oregon," necessitate a revision of our recently published account (Bigelow and Schroeder 1953, pp. 327-331), as follows:

Characters of the family. Rajoidea with snout expanded terminally or not, its tip with a filament. No dorsal fins. Tail slender, rounded or squarish, with or without a narrow thickened lateral fold, or with a crease, low down on each side and with a small upper and lower caudal fin. Pelvics so deeply notched outwardly that the anterior subdivision is leglike, of three segments, resembling the pelvics of *Cruriraja* among rajids and of *Typhlonarke* among electric rays; inner margin of posterior lobes of pelvics attached to sides of tail nearly or quite to their tips; outer margin of pelvics attached along part of its length to inner margin of pectoral on females and immature males but entirely free from pectorals on mature males so far as known. Skin smooth everywhere except for alar thorns on disc of mature males. Outer corners of pelvis with a well developed prepelvic spur.

The type genus of this family, *Anacanthobatis* von Bonde and Swart 1924, is placed in the suborder Myliobatoidea (family Dasyatidae) by Fowler (1941, p. 397) and by Smith (1949, p. 71). But the nature of its pelvics (see above) and the presence of a rostral projection from the cranium actually locates it in the Rajoidea.

Genera. Two genera are known, *Anacanthobatis*, von Bonde and Swart, 1924, Natal Coast, South Africa, Central America to British Guiana, probably the Gulf of Mexico also (p. 224); and *Springeria* Bigelow and Schroeder 1951, Gulf of Mexico.

Key to Genera

1. Snout not expanded terminally *Anacanthobatis*
2. Snout expanded terminally in leaf-like form *Springeria*

Three species of *Anacanthobatis* are now known.

Key to Species of *Anacanthobatis*

1. Pelvics completely fused along their whole length with root of tail
marmoratus
 von Bonde and Swart 1924 off Durban, Natal.
- Pelvics not completely fused along their whole length with root of tail. 2
2. Length of snout about 4 to 5 times as long as diameter of eye
americanus n. sp., p. 217
- Length of snout about 9 times as long as diameter of eye
longirostris n. sp., p. 223

ANACANTHOBATIS AMERICANUS sp. nov.

Figures 14-16

Study material. Female, 337 mm in total length to base of terminal filament, holotype, U. S. Nat. Mus. No. 196445, from Lat. 11°35'N, Long. 62°41'W, in 212-250 fathoms, "Oregon" station 2353, and two mature males, and a female, 326-328 mm, paratypes, M. C. Z. Nos. 40364, 40365, 40366 from same station, between Grenada and Venezuela; a female of 350 mm and two males 310-330 mm from the same region, "Oregon" stations 2771, 2779; also 7 males and 6 females, 95 to 349 mm, from 4 stations 2009, 2010, 2011, 2012) off British Guiana in 150-400 fathoms and 1 station (1890) about midway between Jamaica and Honduras in 100 fathoms.

Distinctive characters. Evident differences between *americanus* and *marmoratus* are that on *americanus* the rostral filament is brownish, the upper surface of disc is plain grayish brown, the caudal fin obvious though small, and the skin is without papillae, whereas on *marmoratus* the rostral filament is dark red, the disc mottled with very small white spots and faintly brown ocelli, the caudal fin so small as to be hardly noticeable and that dark red, soft, papilla-like projections, about 1 to 3

mm long, are sparsely scattered over the upper surface of disc and pelvics. It differs from *longirostris* in its shorter snout and longer tail (see p. 224).

von Bonde and Swart (1924, p. 19) have described, as *dubius*,

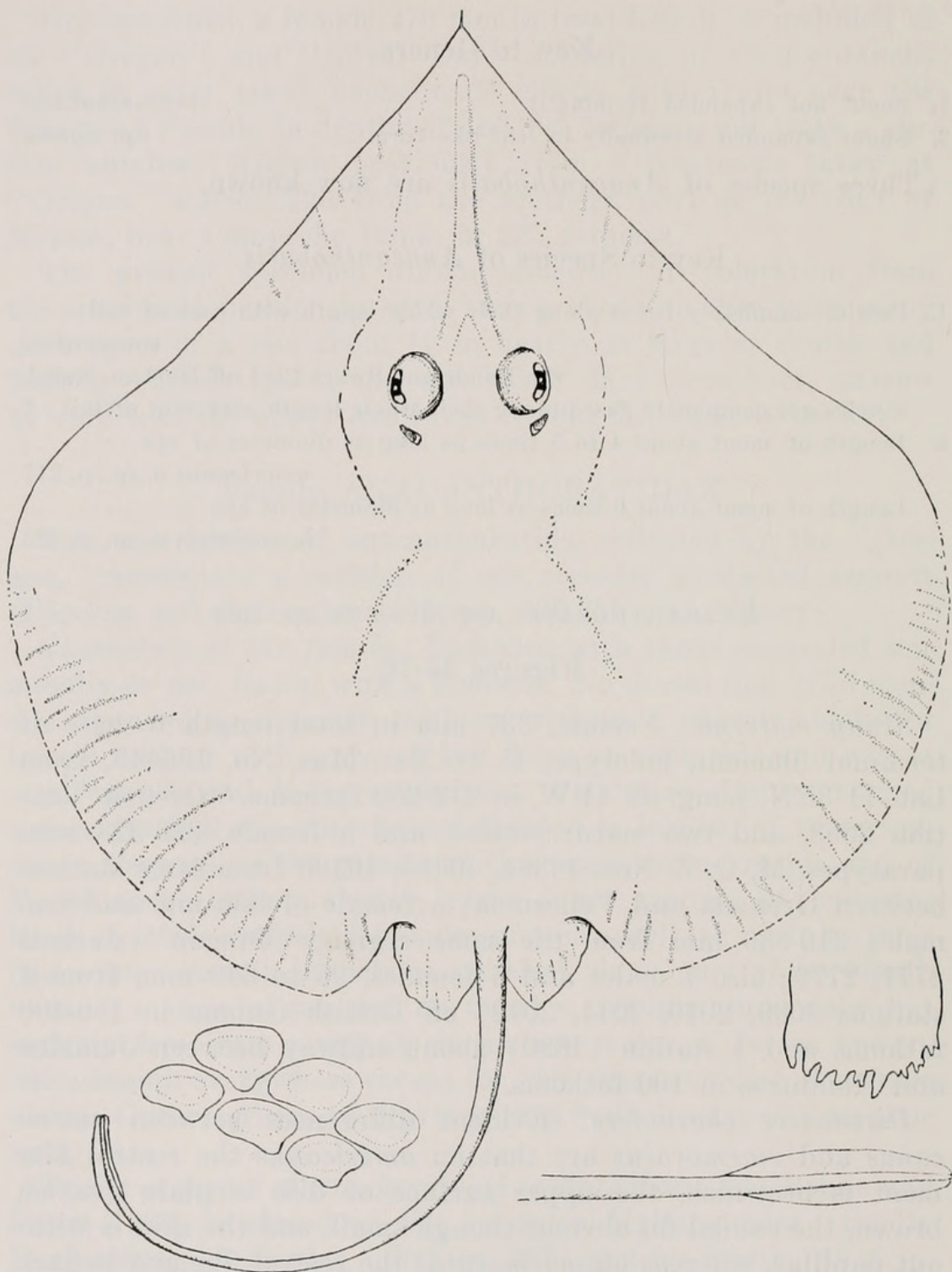


Figure 14. *Anacanthobatis americanus*, dorsal view of type, female 337 mm long; teeth from upper jaw, about x10; caudal fin about x1, left section of nasal curtain to show fringes, about x4.

a male differing from *marmoratus* in that its pelvics are fused with its pectorals along about one-half their length as they are in female *marmoratus*. Our series of *americanus* shows, however, that immature males have the pectorals fused as they are in *dubius*, but that this fusion disappears on mature males so that the pectorals and pelvics are completely separated (p. 222) as they are on mature males of *marmoratus*. Hence it is probable that *dubius* is an immature *marmoratus*.

Description. Proportional dimensions in per cent of total length. Female, 337 mm long, holotype, and mature male, 327 mm long, paratype.

Disc. — Extreme breadth 58.5, 58.6; length 57.0, 55.7.

Snout length. — In front of orbits 19.3, 17.4; in front of mouth 22.2, 20.5.

Orbits. — Horizontal diameter 4.0, 4.0; distance between 3.0, 2.2.

Spiracles. — Length 1.2, 1.4; distance between 6.4, 6.0.

Mouth. — Breadth 4.5, 5.8.

Exposed nostrils. — Distance between inner ends 3.6, 4.0.

Gill openings. — Length, 1st 0.8, 0.6; 3rd 0.8, 0.6; 5th 0.6, 0.5; distance between inner ends, 1st 11.6, 10.7; 5th 6.1, 5.1.

Caudal fin. — Length of base, upper 6.8, 7.6; lower 5.6, 6.7.

Pelvics. — Length of anterior limb 13.1, 14.4; distance, origin anterior limb to tip of posterior lobe 16.4, 17.1.

Distance. — From tip of snout (from base of filament) to center of cloaca 46.6, 46.0; from center of cloaca to tip of tail 53.4, 54.0.

Disc 1.03 times as broad as long; maximum angle in front of spiracles 88° on the female, 80° on the male; end of snout with a very short slender filament. Anterior margins of disc nearly straight on female but sinuous on male being slightly convex in front of orbits and concave between orbits and outer angles; outer and posterior margins broadly rounded; axis of greatest breadth about 62 per cent of distance back from tip of snout (exclusive of filament) to axils of pectorals, on female, about 70 per cent on male. Tail exceedingly slender, without lateral folds but with a crease low down along each side more or less in evidence from near axils of pelvics to origin of caudal fin, tail mostly roundish in cross section but flattened below posteriorly, its length from center of cloaca 1.15 times distance from center of cloaca to tip of snout on female, 1.17 times on male.

Skin completely naked everywhere, without armature of any sort except for alar thorns on male. Upper surface with mucous pores aside the rostral process and extending rearward along the median zone from nuchal to pelvic region.

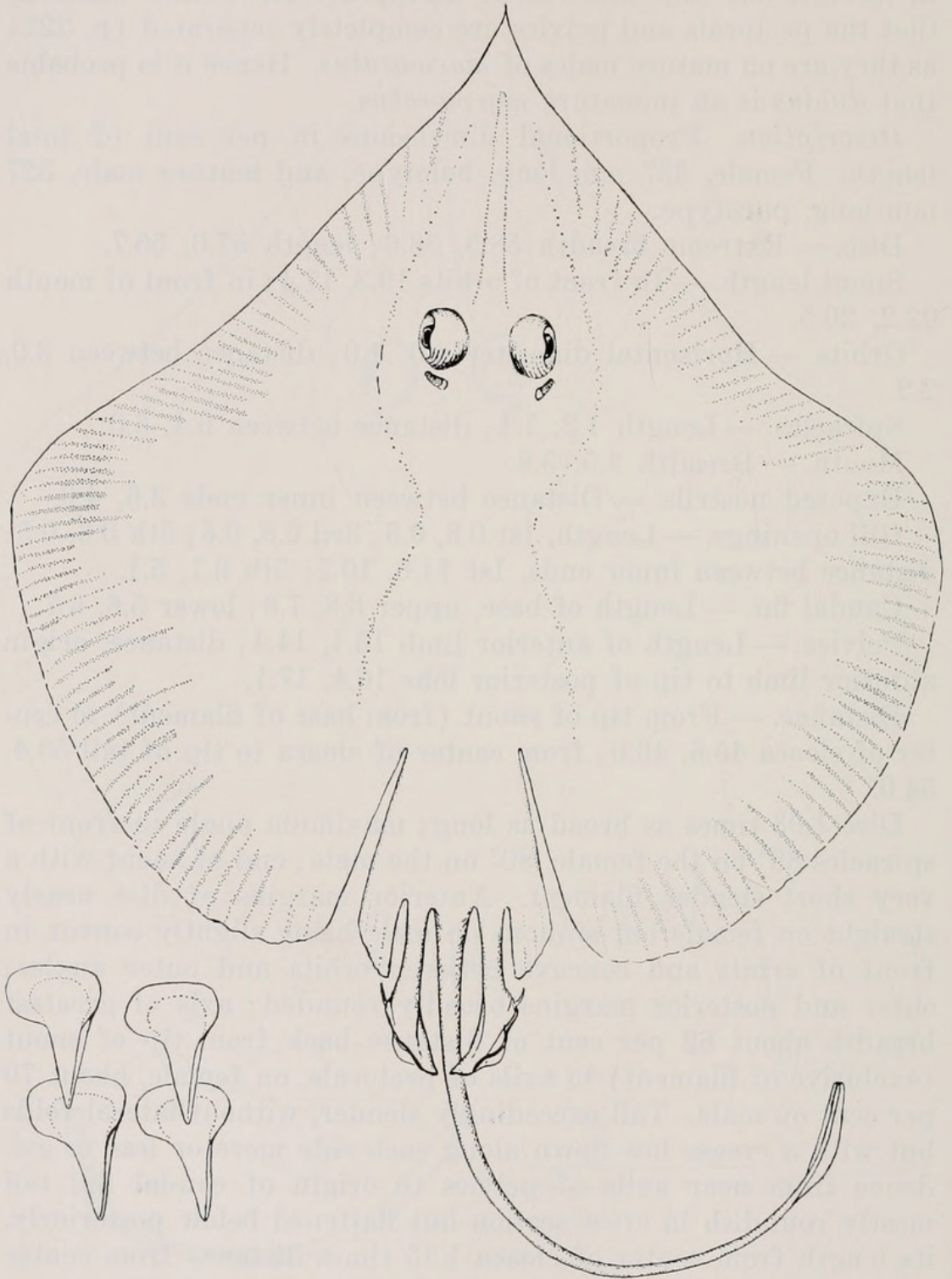


Figure 15. *Anacanthobatis americanus*, dorsal view of mature male 327 mm long, M. C. Z. No. 40364; teeth from upper jaw, about x10.

Snout in front of orbits 8.0 times as long, to base of rostral filament, as distance between orbits on female, 8.7 times on male; its length in front of mouth 6.2 and 5.1 times as great, respectively, as distance between exposed nostrils. Orbits 1.7-1.8 times

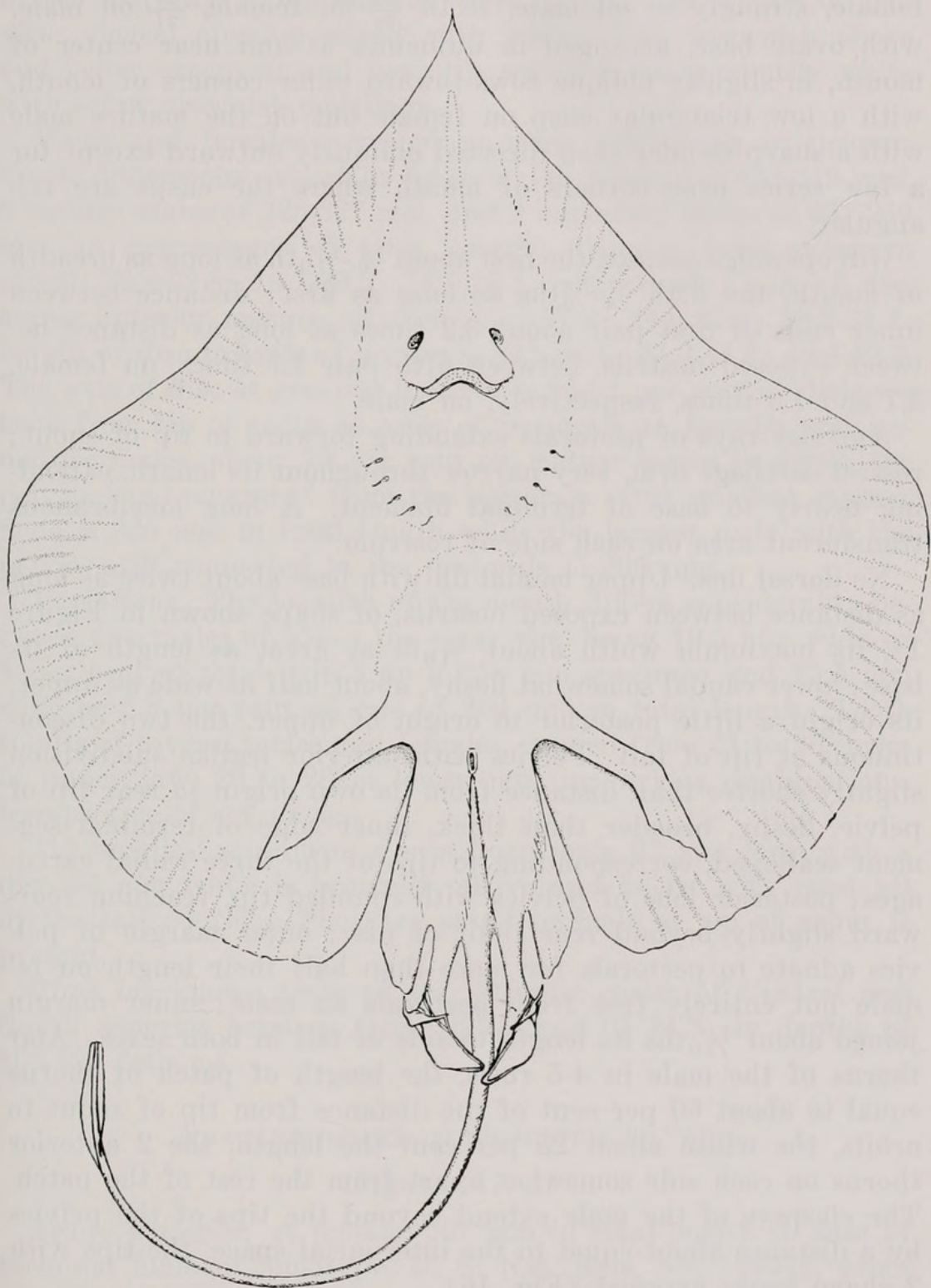


Figure 16. *Anacanthobatis americanus*, ventral view, same specimen as Figure 15.

as long as distance between orbits and 3.3 times as long as spiracles which are noticeably small. Nasal curtain with fine fringe; outer margin of nostrils only slightly expanded, with irregular edge; exposed nostrils very small. Mouth slightly arched on female, strongly so on male, teeth $\frac{25}{24}$ on female, $\frac{24}{21}$ on male, with ovate base, arranged in quincunx at and near center of mouth, in slightly oblique rows toward outer corners of mouth, with a low triangular cusp on female but on the mature male with a sharp slender cusp directed obliquely outward except for a few series near corners of mouth where the cusps are triangular.

Gill openings minute, the first about $\frac{1}{6}$ - $\frac{1}{10}$ th as long as breadth of mouth, the fifth $\frac{3}{4}$ - $\frac{5}{6}$ ths as long as first; distance between inner ends of first pair about 3.2 times as long as distance between exposed nostrils, between fifth pair 1.7 times, on female, 2.7 and 1.3 times, respectively, on male.

Anterior rays of pectorals extending forward to tip of snout; rostral cartilage firm, very narrow throughout its length, extending nearly to base of terminal filament. A long membranous translucent area on each side of rostrum.

No dorsal fins. Upper caudal fin with base about twice as long as distance between exposed nostrils, of shape shown in Figure 14, its maximum width about $\frac{1}{10}$ th as great as length of its base; lower caudal somewhat fleshy, about half as wide as upper, its origin a little posterior to origin of upper, the two discontinuous at tip of tail. Pelvics with anterior leglike subdivision slightly shorter than distance from its own origin to rear tip of pelvic, fleshy, broader than thick, inner edge of terminal segment scalloped, corresponding to tips of the three radial cartilages; posterior lobe of pelvics with rounded tip, reaching rearward slightly beyond rear limit of disc; outer margin of pelvics adnate to pectorals for more than half their length on female but entirely free from pectorals on male; inner margin joined about $\frac{7}{10}$ ths its length to side of tail in both sexes. Alar thorns of the male in 4-5 rows, the length of patch of thorns equal to about 60 per cent of the distance from tip of snout to orbits, the width about 25 per cent the length, the 2 anterior thorns on each side somewhat apart from the rest of the patch. The claspers of the male extend beyond the tips of the pelvics by a distance about equal to the internarial space, the tips with 2 sharp hooks exposed (Fig. 16).

Color. Upper surface grayish brown, terminal filament slightly

darker. Lower surface pale grayish white in advance of axis through nostrils and around mouth, becoming mottled with dark brown from a little posterior to mouth to scapular arch; remaining disc and pelvics dark brown except for broken white and brown markings along anterior part of limb-like section of pelvics; cloacal opening edged with white. Tail brownish above and below except at and near tip which is conspicuously white with a few brownish mottlings.

Males and females revealed no wide differences in proportional dimensions except as follows. On 3 females 325-349 mm, 2 mature males of 325-327 mm, and 2 immature males of 257-269 mm, in percentages of total length: distance from snout to mouth 22.2-22.8; 19.7-20.5; 18.6-18.6, respectively; axis of disc across anterior margin of orbits 31.0-34.8; 24.6-27.8; 28.2-31.1; length of disc to axils of pectorals 52.3-53.3; 44.3-44.5; 48.4-49.3. The axis of disc at greatest breadth is 55-62 per cent of distance back from tip of snout to axils of pectorals on females and immature males, about 70 per cent on mature males in which the pelvics have separated from the pectorals. Our smallest mature male is 325 mm in total length while the largest male with the pelvics still connected to the pectorals is 266 mm.

Variations. The breadth of the mouth differs considerably between two males of about the same size, being 10.5 mm wide or 4 per cent of total length on a 258 mm specimen and 15.5 mm wide or 5.8 per cent on one of 266 mm in total length. Tooth counts of several males and females, ranged from 21 to 26 series in upper jaw, 20 to 26 in lower jaw, in various combinations, irrespective of sex or age.

The smallest specimen, a new born male 95 mm long with a disc 54 mm wide, is brownish above and below with most all of the tail whitish. The very small tentacle at tip of snout is present.

Thus far known from off the Atlantic coasts of Central and South America between Lats. $16^{\circ}35'$ and $07^{\circ}34'N$, in depths of 100-400 fathoms.

ANACANTHOBATIS LONGIROSTRIS sp. nov.

Figures 17, 18

Study material. A female, 507 mm in total length to base of terminal filament, holotype, U. S. Nat. Mus. No. 196446, probably from the northern part of the Gulf of Mexico off the Mississippi Delta, Lat. $29^{\circ}09'N$, Long. $87^{\circ}53'W$, in 500-575 fathoms,

"Oregon" station 2823;¹ and a very young male 135 mm long from Santaren Channel, Lat. 23°59'N, Long. 79°43'W, in 350 fathoms, "Combat" station 450.

Distinctive characters. Its extraordinarily long snout sets *longirostris* apart from its closest relatives *A. americanus*, described herein, and also from *A. marmoratus*. The snout length from the base of the small terminal filament to the orbits is 9.3 times the diameter of orbit whereas this distance is 3.9-4.8 times the orbit on *americanus* (5 specimens) and only about 3 times as long on the type of *marmoratus*. The tail of *longirostris*, also, is relatively much shorter being little more than two-fifths the total length of the specimen, measured from center of cloaca, while on the other two species it is at least half the total length.

Description of holotype. Proportional dimensions in per cent of total length.

Disc. — Extreme breadth 56.8; length 66.4.

Snout length. — In front of orbits 29.8; in front of mouth 32.8.

Orbits. — Horizontal diameter 3.2; distance between 3.3.

Spiracles. — Length 1.4; distance between 5.3.

Mouth. — Breadth 4.9.

Exposed nostrils. — Distance between inner ends 4.8.

Gill openings. — Length, 1st 1.1; 3rd 1.1; 5th 0.9; distance between inner ends, 1st 10.1; 5th 7.1.

Caudal fin. — Length of base, upper 3.6; lower 2.0.

Pelvics. — Length of anterior limb 13.6; distance, origin of anterior limb to tip of posterior lobe 14.0.

Distance. — From tip of snout (from base of filament) to center of cloaca 57.4; from center of cloaca to tip of tail 42.6.

Disc 0.86 times as broad as long; maximum angle in front of spiracles 72°; end of snout with a very short slender filament. Anterior margins of disc sinuous; outer and posterior margins broadly rounded; axis of greatest breadth about 65 per cent of distance back from tip of snout (exclusive of filament) to axils of pectorals. Tail exceedingly slender, squarish in cross section (Fig. 18), its four sides very slightly rounded, with a thickened fold beginning beyond tips of pelvics a distance equal to that between the spiracles, low down on each side, continuing to origin of upper caudal fin, the greatest width (posteriorly) of fold about 1 mm or about half the width of tail approaching the

¹ This specimen lacked a station number or locality data when received but Harvey R. Bullis, Jr. informs us that it probably was taken at "Oregon" station 2823.

caudal fin. Length of tail from center of cloaca 0.74 times distance from center of cloaca to tip of snout.

Skin completely naked everywhere, without armature of any sort. Upper surface with an irregular longitudinal row of 9 or

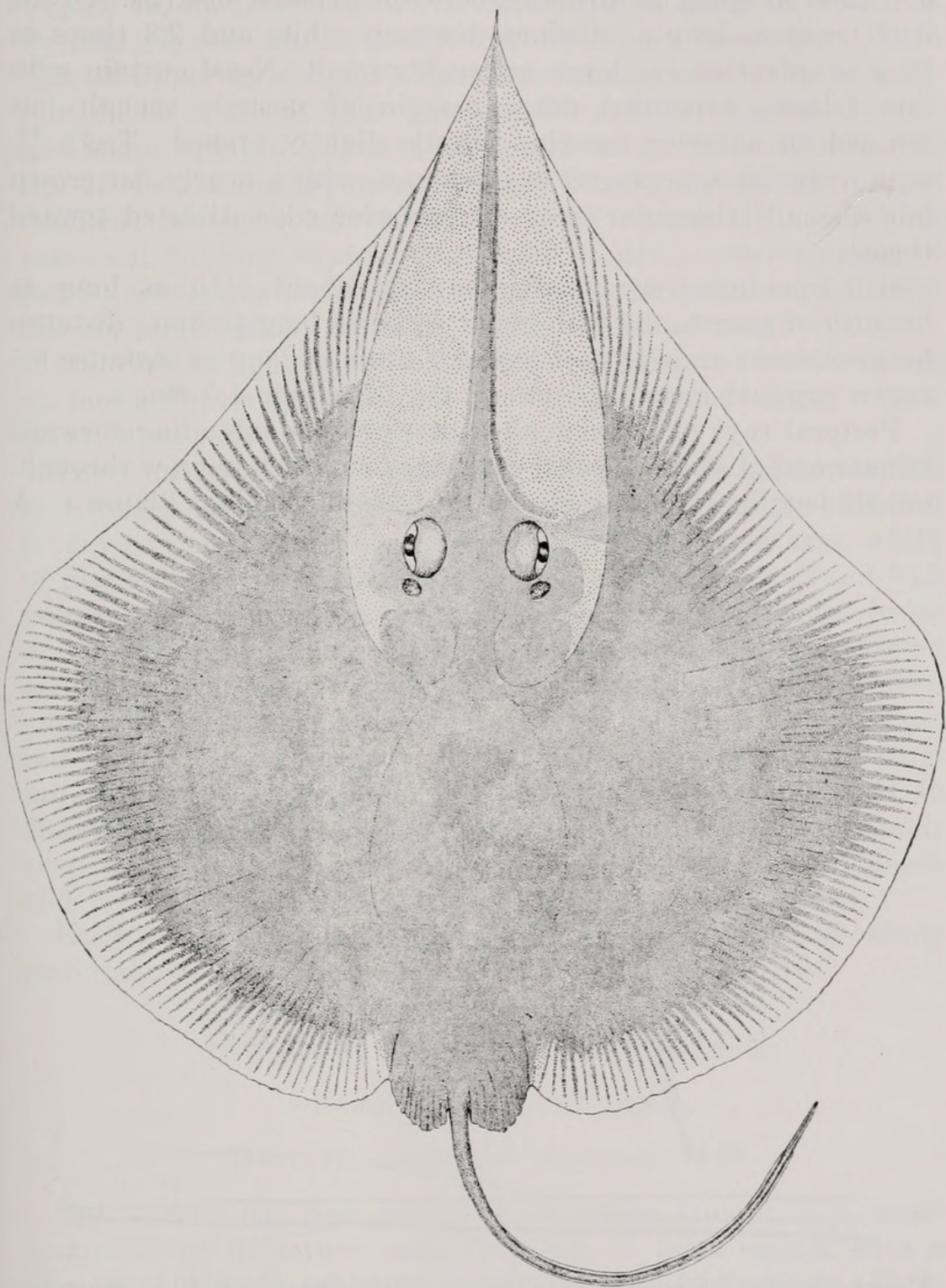


Figure 17. *Anacanthobatis longirostris*, dorsal view of type, female 507 mm long.

10 pale-edged mucous pores extending from nuchal to scapular region, and close to the midline of disc on each side.

Snout in front of orbits 9.0 times as long, to base of rostral filament, as distance between orbits; its length in front of mouth 6.8 times as great as distance between exposed nostrils. Orbits 0.97 times as long as distance between orbits and 2.3 times as long as spiracles which are noticeably small. Nasal curtain with fine fringe; expanded outer margin of nostrils smooth but fringed on anterior margin. Mouth slightly arched. Teeth $\frac{28}{27}$, with ovate base, arranged in quincunx, with a nearly flat crown but a small triangular cusp on posterior edge directed toward throat.

Gill openings very small, the first about $\frac{1}{5}$ th as long as breadth of mouth, the fifth about $\frac{4}{5}$ ths as long as first; distance between inner ends of first pair 2.1 times as long as distance between exposed nostrils, between the fifth pair 1.5 times.

Pectoral rays prominent, the anterior ones extending forward to near end of snout; rostral cartilage firm, very narrow throughout its length, extending nearly to base of terminal filament. A

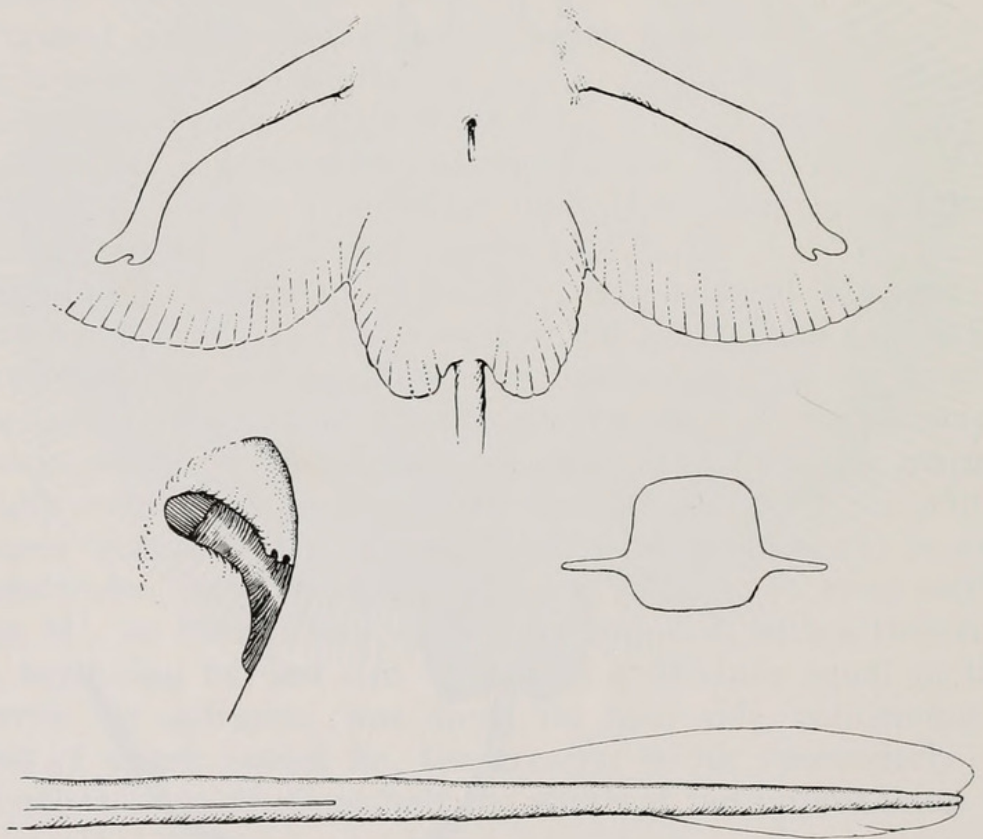


Figure 18. *Anacanthobatis longirostris*, pelvic fins, about $\times 0.5$; cross section of tail about $\times 6$; nostril, to show knobs on anterior part of flap, about $\times 4$; caudal fin, about $\times 3$.

large and long membranous translucent area each side of the rostrum.

No dorsal fins. Upper caudal fin with base about $\frac{3}{4}$ ths as long as distance between exposed nostrils, of shape shown in Figure 18, its maximum width about $\frac{1}{9}$ th as great as length of its base; lower caudal barely discernible, its base about $\frac{2}{3}$ rds that of upper caudal, its height less than one-half, the two discontinuous at tip of tail. Pelvics with anterior leglike subdivision about equal in length to distance from its own origin to rear tip of pelvic, fleshy, broader than thick, its distal margin notched; posterior lobe of pelvics with rounded tip, reaching rearward slightly beyond rear limit of disc; outer margin of pelvics adnate to pectorals for about $\frac{2}{3}$ rds their length; inner margin joined about $\frac{5}{6}$ ths its length to side of tail.

Color above light purplish, the terminal filament black. Lower surface a lighter shade of that above; end of snout dusky. Preservation may have changed its color.

The young male has a relatively shorter snout, narrower disc and longer tail than the much larger type. Thus the distance from tip of snout (less filament) to mouth is 24.1 per cent, width of disc 49.6 per cent and distance from cloaca to tip of tail 54.8 per cent, respectively, in the total length, these proportions being 32.8, 56.8 and 42.6 per cent on the large female. It is usual among the Rajoidea for new born and juveniles to differ considerably in proportional dimensions from half-grown and larger individuals. Particularly is this so in the lengths of snout and tail. The teeth of the male are similar to those of the female, in 28 series in the upper jaw, with flat crown and a small triangular cusp pointing inward. In color the male is pale brown above and below, including the terminal filament.

Known only from the localities and depths given in the study material.

Suborder MYLIOBATOIDEA

Family DASYATIDAE

DASYATIS GEIJSKESI Boeseman 1948

This species has been known in literature from only a single specimen, an immature male 1060 mm in total length, with a disc about 340 mm wide, taken off the coast of Surinam. However, it appears to be not rare in this region for, according to Dr. D. C. Geijskes who collected the holotype, it is known locally

by the vernacular name of "sesée spari" (Boeseman 1948, p. 42). Two specimens are included in our collection, a male and a female, both with the tail complete.

Study material. Immature male 1000 mm in total length with a disc 235 mm wide, and a female 890 mm long, disc width 227 mm, M. C. Z. No. 40425, from the offing of Ilha de Maracá, Brazil, Lat. 02°34'N, Long. 49°18'W, in 10 fathoms, "Oregon" station 2055.

Distinctive characters. This species differs noticeably from all other known dasyatid rays of the Atlantic in shape of disc with narrowly projecting snout, and in pelvic fins with long anterior margins and narrowly pointed and somewhat falcate outer corners.

Description. Proportional dimensions in per cent of disc width of a male and a female 235 mm and 227 mm wide, respectively.

Disc. — Vertical length 107, 105; width across anterior edge of orbits 90.3, 91.4.

Snout length. — In front of orbits 42.5, 40.0; in front of mouth 43.5, 41.8.

Orbits. — Horizontal diameter 3.6, 3.5; distance between 11.5, 11.5.

Visible eye. — Horizontal diameter 2.1, 2.6.

Spiracles. — Length 5.1, 5.7.

Mouth. — Breadth 9.0, 8.6.

Exposed nostrils. — Distance between inner ends 12.8, 11.7.

Gill openings. — Length 1st 2.8, 2.4; 3rd 2.8, 2.4; 5th 2.1, 1.8; distance between inner ends 1st 16.8, 17.0; 5th 12.8, 13.2.

Distance. — From tip of snout to center of cloaca 92.5, 92.7; from center of cloaca to origin of tail spine 42.5, 43.5.

Disc 0.89-0.95 times as broad as long; anterior margins deeply concave, the snout projecting conspicuously, slightly blunted at tip; outer margin broadly rounded, outer posterior margins moderately and evenly convex, but posterior corners well rounded; inner margins weakly convex and somewhat excavate at axils. Axis of greatest breadth about 57-58 per cent of distance rearward from tip of snout to axils of pectorals and 50 per cent to rear limit of disc.

Tail from center of cloaca about 3.6 times as long as distance from center of cloaca to tip of snout on the male, 3.3 times on the female, slender, whip-like, flattened dorsoventrally in advance of tail spine but rounded posteriorly; a very narrow and short cutaneous fold below beginning opposite origin of tail

spine, its length about twice the distance between the 5th pair of gill openings; no fold above. One tail spine, its length about equal to the distance between the orbits, its origin from center of cloaca about equal to the distance from tip of snout to mouth.

Disc above, on the male, with a mid row of 5 flattened thorns from nuchal to scapular region, the 3 rear thorns the largest, followed by about 16 tiny thorns ending in advance of axils of pectorals, between which and the tips of pelvics there are 4 unevenly spaced flattened thorns and another large one between pelvics and tail spine; pelvics and rest of disc smooth. Upper surface of tail encrusted with prickles throughout its length, with prickles sparsely distributed along sides and below on anterior half. Lower surface of disc smooth. The disc and tail of our female lack armature but it is apparent that, on the disc at least, thorns will appear on older individuals.

Snout in front of orbits about 11 times as long as orbit or 3.5-3.7 times as long as distance between orbits, its length in front of mouth 3.4-3.6 times as great as distance between exposed nostrils and 2.5-2.6 times as great as that between inner ends of first gill openings. Distance between orbits 3.2 times as great as length of orbit. Orbit about $\frac{2}{3}$ as long as spiracle. Nasal curtain with posterior margin somewhat arched forward on the male, nearly straight on the female, its free edge finely fringed, with a small median notch. Jaws moderately arched, nearly straight on central sector.

Teeth $\frac{47}{58}$ on male, $\frac{52}{56}$ on female, oval or rhomboid, in quincunx, with a flat roughened crown.

Distance between inner ends of first gill openings 1.3-1.4 times as long as distance between exposed nostrils; between fifth gill openings about 0.8 times as long as that between first pair.

Pelvic fins with a straight anterior margin which is about 1.7 times as long as distance from origin of pelvic to its rear limit, this proportionately the longest yet reported for any dasyatid.

Color. Plain brown above on disc, pelvics, and anterior half of tail, the posterior part of which is faintly colored. Disc below whitish, the anterior margins narrowly edged with grayish, the posterior margins with a wider band of gray; rear margins of pelvics vaguely gray; tail faintly mottled on anterior half, white posteriorly.

Known from off the coast of Surinam and off Brazil at Lat. $02^{\circ}34'N$, Long. $49^{\circ}18'W$, in a depth of about 10 fathoms.

DASYATIS VIOLACEA (Bonaparte) 1832

Figure 19

During the course of exploratory long-line fishing, the U. S. Fish and Wildlife vessel 'Delaware' took a large specimen of this little known pelagic stingray south southeast of Nantucket Island; Lat. $38^{\circ}35'N$, Long. $68^{\circ}14'W$, on a hook fished somewhere between 25 and 50 fathoms, over a total depth of about 2200 fathoms. We wish to express our gratitude to Ernest D. McRae, Jr., Field Party Chief on the "Delaware" and to Frank J. Mather III of the Woods Hole Oceanographic Institution for preserving the specimen for us. A second specimen, also, was taken by the "Delaware" in the offing of Chesapeake Bay, Lat. $36^{\circ}46'N$, Long. $70^{\circ}00'W$, about 300 miles out from the coast. Unfortunately this specimen was lost overboard.

Study material. Female 1635 mm in total length with a disc 800 mm wide and 603 mm long, from the offing of Nantucket Island, Lat. $38^{\circ}35'N$, Long. $68^{\circ}14'W$, M. C. Z. No. 40233; a Mediterranean specimen (male) from the collection of C. L. Bonaparte, 175 mm wide and 164 mm long to origin of spine (remainder of tail missing), Acad. Nat. Sci., Phila., No. 385, evidently newly born; an embryo 157 mm wide from the Pacific Ocean; and a female 556 mm wide from the east-equatorial Pacific, M. C. Z. No. 39977.

Distinctive characters. *D. violacea* is set sharply apart from all other known members of the family Dasyatidae in that the entire lower surface as well as its upper is of a very dark purplish violet or chocolate plum color. In shape of disc it most nearly resembles *Himantura schmardae* (Werner) 1904 among western Atlantic species, but differs conspicuously from *schmardae* in the relative distance from cloaca to base of tail spine, this being 30-35 per cent of width of disc in our Atlantic and Mediterranean specimens of *violacea* as against 78-80 per cent in the two specimens of *schmardae* that we have measured (Bigelow and Schroeder 1953, p. 390).

Proportional dimensions in per cent of width of disc of the above three specimens with disc widths of 800 mm, 175 mm, and 556 mm, respectively.

Disc. — Vertical length 75.5, 69.7, 77.7.

Snout length. — In front of orbits 8.3, 11.1, 11.2; in front of mouth 14.0, 14.3, 14.4.

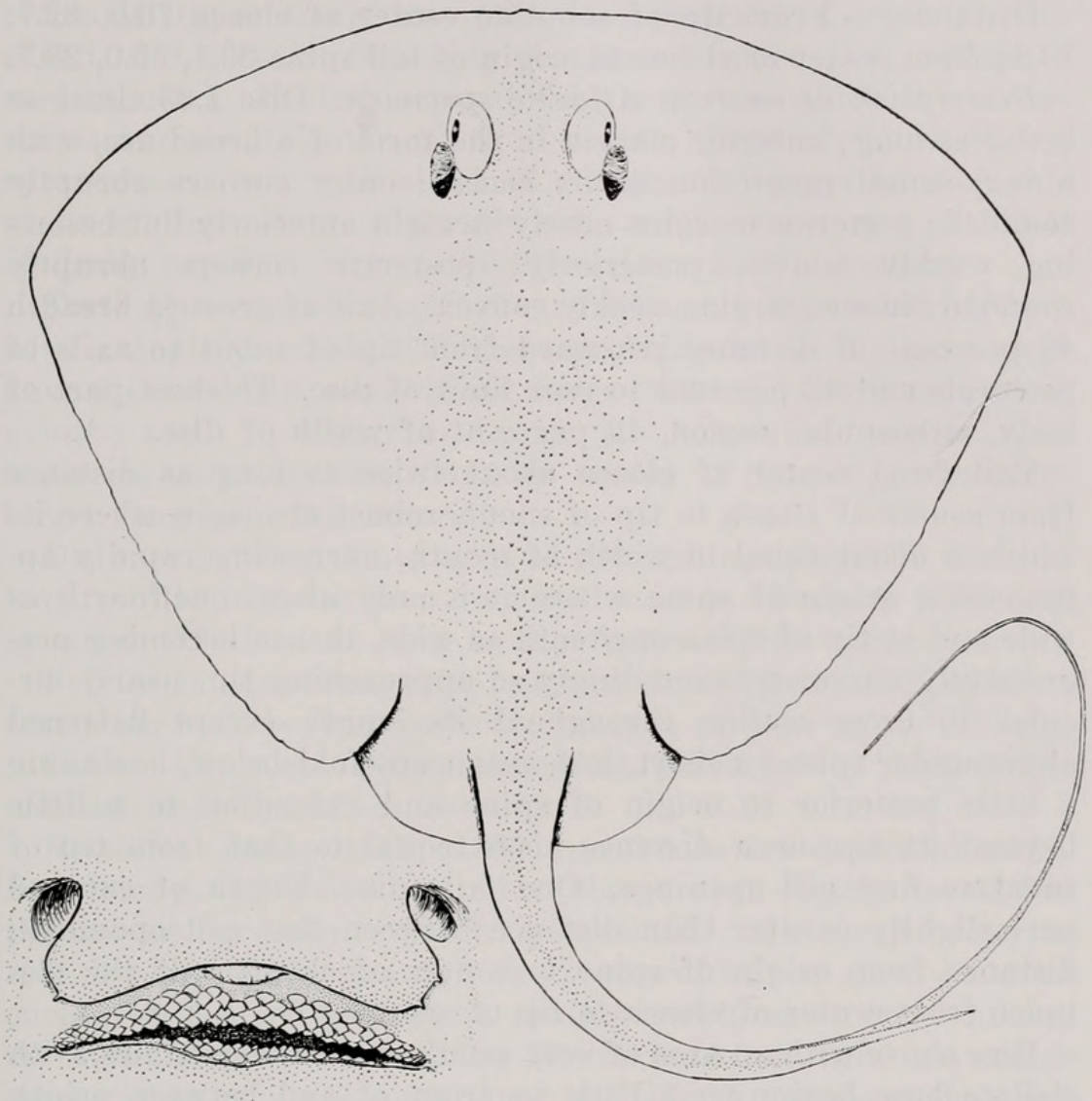


Figure 19. *Dasyatis violacea*, female 800 mm in disc width, from offing of Nantucket, Massachusetts, M. C. Z. No. 40233; jaws, nostrils and nasal curtain of same, about $\times 0.5$.

Orbits. — Horizontal diameter 6.7, 9.4, 5.1; distance between 7.5, 9.2, 8.7.

Visible eye. — Horizontal diameter 2.5, 3.6, 3.4.

Spiracles — Length 5.0, 5.7, 6.0; distance between 15.6, 18.3, 17.3.

Mouth. — Breadth 10.2, 9.2, 10.4.

Exposed nostrils. — Distance between inner ends 8.4, 9.2, 9.5.

Gill openings. — Length 1st 3.2, 2.5, 3.1; 3rd 3.3, 2.5, 3.2; 5th 1.9, 2.0, 2.0; distance between inner ends 1st 16.0, 19.4, 19.8; 5th 13.4, 12.6, 13.7.

Distance. — From tip of snout to center of cloaca 70.0, 62.7, 73.8; from center of cloaca to origin of tail spine 35.1, 35.0, 29.7.

Description of western Atlantic specimen. Disc 1.33 times as broad as long; anterior margin in the form of a broad arc, with a very small projection at its center; outer corners abruptly rounded; posterior margins nearly straight anteriorly but becoming weakly convex posteriorly; posterior corners abruptly rounded; inner margins weakly convex. Axis of greatest breadth 48 per cent of distance rearward from tip of snout to axils of pectorals and 42 per cent to rear limit of disc. Thickest part of body, at scapular region, 19 per cent of width of disc.

Tail from center of cloaca about twice as long as distance from center of cloaca to tip of snout, robust at origin where its width is about equal to width of mouth, narrowing rapidly approaching origin of spine where it is only about one-fourth as wide and at tip of spine one-tenth as wide, thence becoming progressively narrower, exceedingly so approaching tip, nearly circular in cross section throughout its length except flattened above under spine; a short, low, cutaneous fold below, beginning a little posterior to origin of spine and extending to a little beyond its tip, or a distance about equal to that from tip of snout to first gill openings. One tail spine, length of exposed part slightly greater than distance between first gill openings; distance from origin of spine to center of cloaca half the distance from center of cloaca to tip of snout.

Disc above with an area of very small, erect, sharp spines, with stellate base beginning a little in front of and between orbits, scattered on interorbital, becoming progressively more sparse toward scapular region where they are somewhat larger, more irregularly spaced and cover a broader band, present over most of back above abdominal region and extending on to tail. Tail with small, sharp, close set prickles along most of its length; also a very narrow median band of slightly larger spines, some of them bluntish, in haphazard arrangement, extends from the scapular region on to tail, more or less losing their identity, approaching origin of spine. Tail spine 153 mm long, 10 mm wide at base, lateral teeth about 100 on each side. Pectorals and pelvics smooth. Lower surface smooth.

Snout in front of orbits 1.2 times as long as orbit, its length in front of mouth 1.7 times as great as distance between exposed nostrils. Distance between orbits 1.1 times as great as length of orbit. Orbit 1.3 times as long as spiracle. Nasal curtain not

reaching upper tooth band, its free posterior margin smooth edged, and arcuate, following contour of upper jaw, without a median notch. Nostrils separated by a septum which at narrowest part is about $\frac{1}{4}$ the width of mouth. Roof of mouth with a cutaneous curtain with about 13 notches or fringes on each side of its midline; floor of mouth with a transverse row of about 10 fleshy papillae. Upper and lower jaws nearly straight.

Teeth $\frac{34}{38}$, arranged in quincunx, with ovate base, most of them with a single short bluntish cusp, probably worn, for some teeth have a sharp cusp, some of the cusps slanting toward corners of mouth; teeth in center of upper jaw somewhat smaller than those on outer sectors, those in center of lower jaw notably larger than on outer sectors.

Distance between inner ends of first gill openings 1.9 times as long as distance between exposed nostrils; between fifth gill openings 0.8 times as long as that between first pair.

Pelvics sub-quadrangular, but with broadly rounded corners, extending well beyond posterior margin of disc.

Color. Chocolate plum, somewhat paler below than above, without markings of any sort.

Remarks. Bonaparte's (1832) specimens are described as being violet purple below as well as above, when freshly taken, but the one we have seen (see Study material), after long preservation, is pale reddish brown both above and below. Also, its nasal curtain is fringed and has a median notch, as is usual among the Myliobatoidea (except the Mobulidae) but there are exceptions within a species where some individuals may have the nasal curtain smooth edged and without a median notch, for example the Butterfly Ray *Gymnura altavela* (see Bigelow and Schroeder 1953, fig. 95B and p. 403). The newborn Mediterranean ray¹ has only $\frac{15}{17}$ teeth, of various sizes, pavement-like, without cusps, while a full term embryo with a disc width of 157 mm, from the Pacific Ocean,² has a tooth count of $\frac{16}{18}$. It is to be noted that among most species of rays there is a wide disparity in the number of teeth as between very young and old individuals.

In 1955 Ishiyama and Okada³ described, from Japanese waters and from the Marianas Islands east of the Philippines, a pelagic stingray which they named *Dasyatis atratus*, closely resembling *violacea* of the Atlantic. Thanks to the kindness of Dr. C. L.

¹ We thank Dr. James E. Böhlke for the loan of this specimen.

² Dr. C. L. Hubbs presented this specimen to the M. C. Z. collection.

³ Jour. Shimonoseki Coll. Fisher, 4 (2), p. 211.

Hubbs, we have received an excellent specimen that was taken in the equatorial Pacific eastward from the Marquesas Islands, 5°5'N, 110°28'W, that is clearly identical with *atratus*. The proportional dimensions of this specimen (p. 230) agree closely throughout with the ranges covered by our Mediterranean and Atlantic specimens, as does the shape of its disc and of its pelvics. In short, we see no basis for separating *atratus* from *violacea*.

Habits. This ray is pelagic in habit and both of the western Atlantic specimens were hooked about 25-50 fathoms below the surface, over very deep water. No information in this respect is available for the several specimens that have been taken in the Mediterranean at one time or another.¹

The stomach of the Atlantic specimen pictured here (Fig. 19) contained 1 small sea horse (*Hippocampus*), 2 small shrimps, fragments of 2 small squids, the herring (*Clupea harengus*) with which the hook was baited, and a small amount of unidentifiable material.

Size. The largest specimen yet recorded (see Study material) is 800 mm broad and 1635 mm long to tip of tail.

Range. In the Atlantic (including tributary seas) *violacea* is known only from the Mediterranean and from the western Atlantic between latitudes 36°46' and 38°35'N, over deep water, well out from the coast. In the Pacific it has been reported in print only from Japanese waters and from the Marianas Islands to the east of the Philippines, but Dr. C. L. Hubbs has informed us (letter of June 13, 1959) that the collection of the Scripps Institution of Oceanography contains specimens of *violacea* from the Pacific, northwest of the Galapagos, off Lower California, north and south of Hawaii, off the Marshall Islands, and off Japan, all taken on long-lines near the surface where the total depth was about 2000 fathoms, except for one found in the stomach of a shark.

It seems probable too that *Dasyatis purpurea* (Müller and Henle 1841) recently reported from southern Africa by Smith (1949, p. 71), like *atratus* Ishiyama and Okada, is a synonym of *violacea*. If this identification be correct *violacea* can justly be characterized as cosmopolitan in all the great oceans in temperate and tropical latitudes for which it doubtless has its pelagic habit to thank.

¹ For a list of these, see Tortonese, 1956 : 273.

Family UROLOPHIDAE

UROTRYGON MICROPTHALMUM Delsman 1941

Figures 20-23

Thanks to the material listed below, we now are able to give a more detailed description of this species than we could in *Fishes of the Western North Atlantic, Part 2* (Bigelow and Schroeder 1953, p. 428) when we had no specimens at hand.

Study material. Eleven specimens from off the mouth of the Amazon River, vicinity of Lat. 02°N, Long. 49°W, "Oregon" stations 2055, 2057, and 4 specimens from off the east coast of Venezuela, Lat. 09°39'N, Long. 60°49', and vicinity, stations 2210, 2211, and 2215, males and females, 117-234 mm in total length, from depths of 9-15 fathoms.

Distinctive characters. The only known western Atlantic rays with which *Urotrygon microptalmum* might be confused are *Urotrygon venezuelae* Schultz 1949 and *Urolophus jamaicensis* (Cuvier) 1817. A relatively smaller orbit (diameter about $\frac{1}{5}$ of interorbital width) and a nearly smooth disc set *microptalmum* apart from *venezuelae* in which the orbit diameter is about $\frac{2}{5}$ the interorbital width and the disc and tail are roughened with small prickles, and by an irregular row of blunt somewhat larger prickles from nuchal region to tail spine. It differs from *Urolophus jamaicensis* in that the tip of its snout is pointed, its orbits are much smaller (they are about equal to the interorbital in *jamaicensis*), its caudal fin is narrower relatively, and its tail from center of cloaca to tip is longer than the distance from center of cloaca to tip of snout (shorter than distance from cloaca to snout in *jamaicensis*).

Description. Proportional dimensions in per cent of total length. Male 221 mm long and female of 234 mm from off the mouth of the Amazon River, M. C. Z. No. 40237.

Disc. — Extreme breadth 46.6, 46.7; length 50.0, 46.2.

Snout length. — In front of orbits 17.2, 14.1; in front of mouth 15.8, 14.1.

Orbits. — Horizontal diameter 1.3, 1.2; distance between 7.0, 6.0.

Spiracles. — Length 2.2, 1.9; distance between 7.7, 6.8.

Mouth. — Breadth 5.9, 5.4.

Exposed nostrils. — Distance between inner ends 6.8, 4.7.

Gill openings. — Length 1st 0.9, 1.1; 3rd 1.2, 1.1; 5th 0.8, 0.9; distance between inner ends 1st 12.2, 11.6; 5th 7.2, 6.9.

Pelvics. — Length of outer margin 9.7, 8.1; rear margin 8.1, 11.5.

Distance. — From tip of snout to center of cloaca, 44.8, 44.1; from center of cloaca to origin of tail spine 21.7, 23.9; to tip of tail 55.2, 55.9.

Disc 0.93-1.01 times as broad as long (0.98-1.06 on 4 other specimens); margins of disc rounded, the inner margin being very short. Some of our specimens have a nearly circular disc while on others the disc is slightly convex anteriorly and strongly so posteriorly. The anterior margin on Delsman's (1941, fig. 8)

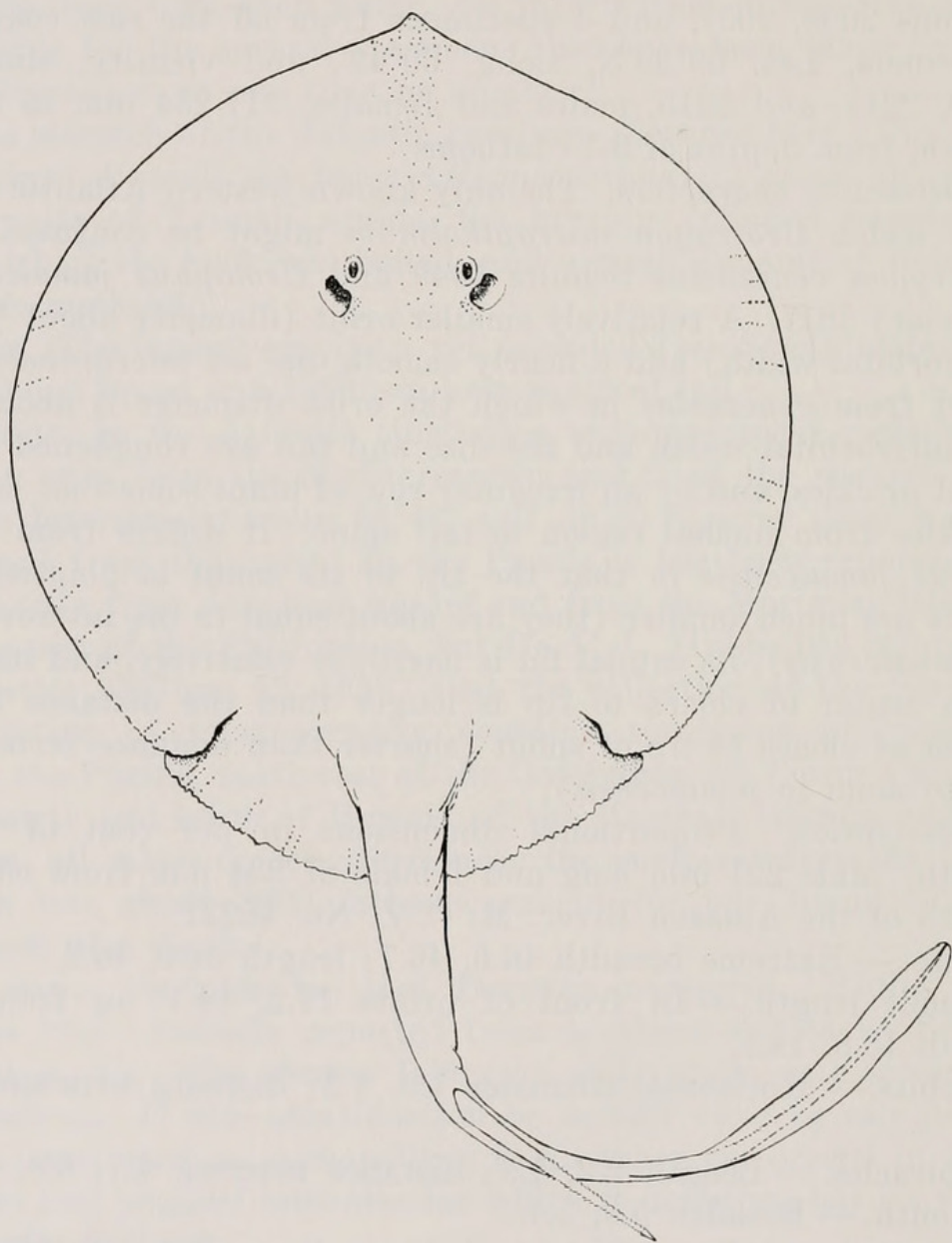


Figure 20. *Urotrygon microphthalmum*, dorsal view of female 234 mm long, M. C. Z. No. 40237.

illustration is angular but in his description he states "margins of disc circular." Axis of greatest breadth about 50 per cent of distance back from tip of snout to rear limits of disc. A lateral ridge extends from opposite axils of pelvics to about opposite origin of tail spine. Tail strongly depressed dorso-ventrally from origin (where its width about equals interorbital space) to origin of spine, posterior to which it becomes much more slender and laterally compressed, ending in a point; its length from center of cloaca 1.23-1.27 times distance from tip of snout to center of cloaca.

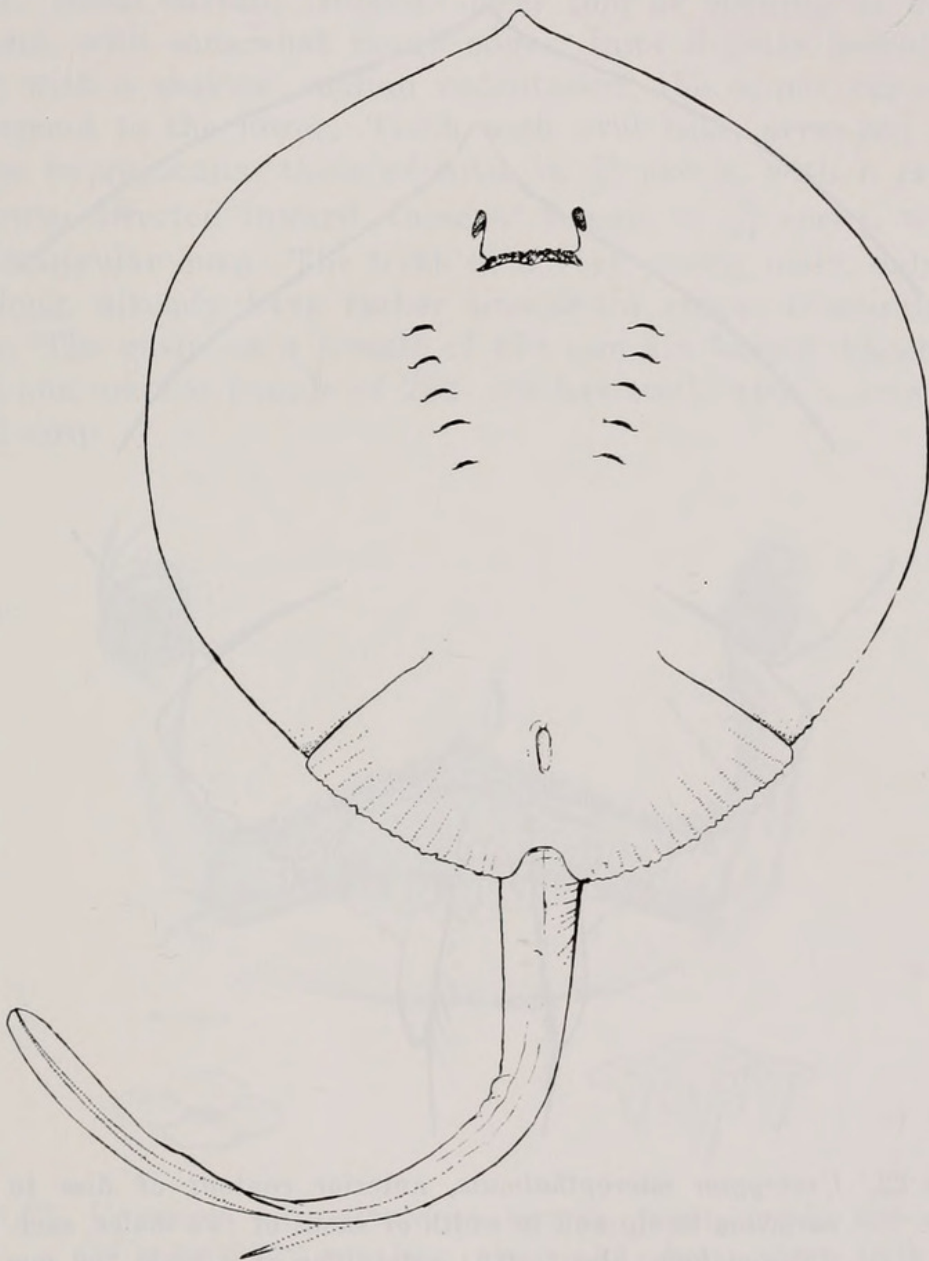


Figure 21. *Urotrygon micropthalmum*, ventral view of specimen shown in Fig. 20.

Upper surface of male smooth except for a few minute prickles on tip of snout, 1-2 rows along inner margin of spiracles and an occasional prickle elsewhere on disc and tail; female with a patch of minute prickles from tip of snout, where densest, to scapular region, including area close in advance of orbits, those along margin of spiracles more numerous than on male; a few prickles scattered elsewhere on disc and on tail nearly to its extremity. Small females have few or no prickles. Lower surface smooth on male but the female has a few prickles on extreme tip of snout and a single row along edge of disc in advance of nostrils.

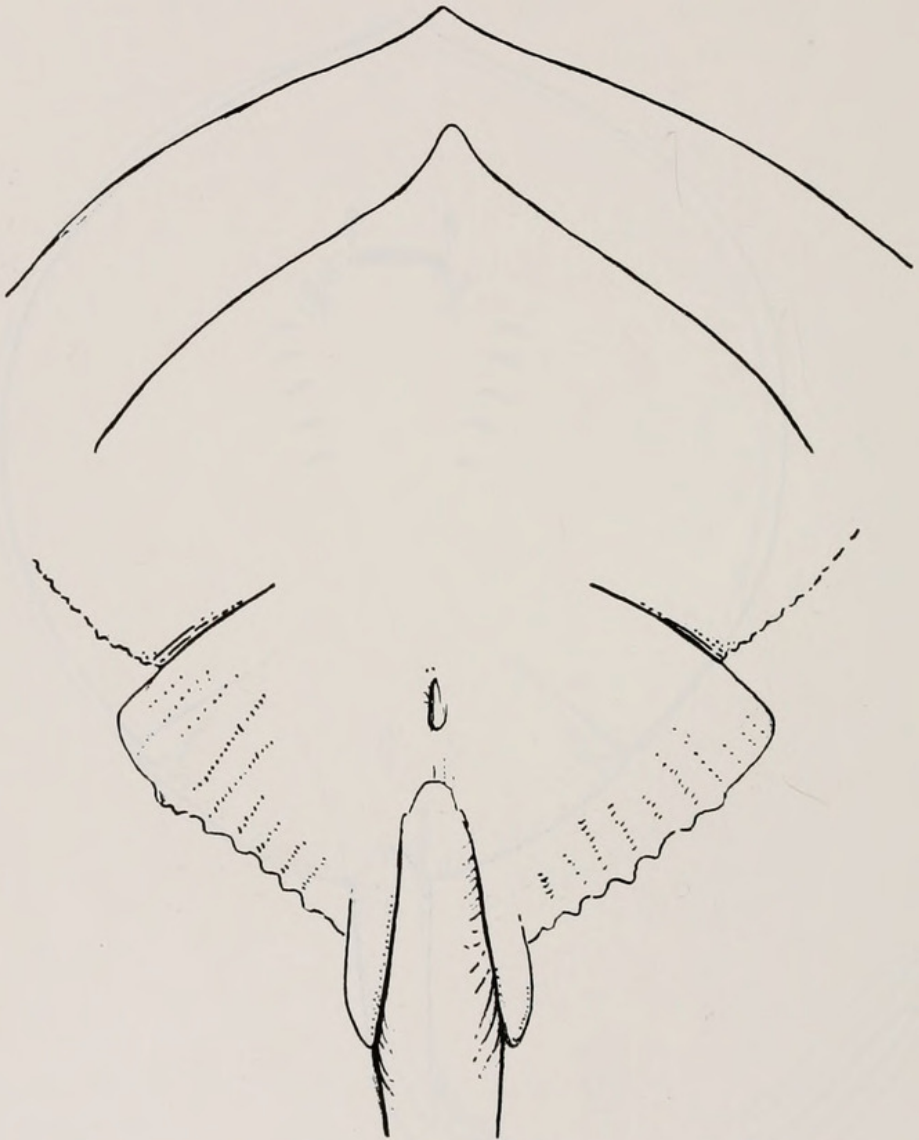


Figure 22. *Urotrygon microphthalmum*, anterior contour of disc to show variation in tip and in width of snout of two males, each about 200 mm long, about $\times 0.6$; pelvic fins of a male 206 mm long, about $\times 0.9$.

One tail spine, the distance of its origin from center of cloaca about equal to distance from snout to first pair of gill openings, its length a little greater than distance from snout to mouth; very narrow, with a sharp point.

Snout in front of orbits 11.8-13.5 times as long as orbit, its length in front of mouth 2.3-3.0 times as great as distance between exposed nostrils, its tip slightly produced in a sharp point (see Fig. 22 for variations). Distance between orbits 5.0-5.5 times as great as length of orbit. Orbit 0.6 times as long as spiracle which is immediately aside and behind and notably larger. Nasal curtain fringed; outer fold of opening of nostril deep-set, with somewhat rough edge. Jaws slightly bowed, the lower with a shallow median indentation, the upper curved to correspond to the lower. Teeth with oval base, arranged more or less in quincunx, those of male in $\frac{31}{30}$ series, with a canine-like cusp directed inward, those of female in $\frac{36}{34}$ series, with a low triangular cusp. The teeth of a very young male, only 117 mm long, already have rather prominent cusps, triangular in shape. The cusps on a female of 170 mm are barely discernible while one mature female of 232 mm has teeth with a very low, broad cusp.

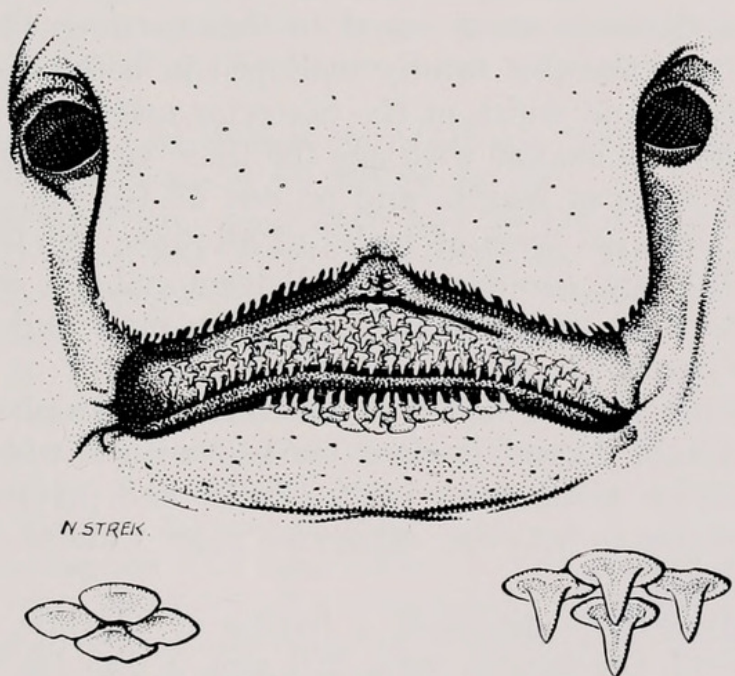


Figure 23. *Urotrygon micropthalmum*, nostrils, nasal curtain and mouth of a male 222 mm long, about x3.5; lower right, teeth from upper jaw about x14; lower left, teeth from upper jaw of female 234 mm long, about x14. Drawing by N. W. Strekalovsky.

Distance between first gill openings, 1.8 times as great as space between exposed nostrils in male, 2.4 times in female whose internarial space is notably shorter; distance between fifth gill openings 1.1 and 1.4 times; first and fifth gill openings on male and fifth on female slightly shorter than the others, the longest a little shorter than diameter of orbits. On two other males, 199-206 mm long the distance between first gill openings is 1.6-1.7 times as great as between exposed nostrils, while on three females, 169-238 mm, it is 1.9-2.0 times as great. Caudal fin originates as an upper and lower fleshy fold; its dorsal origin under rear part of tail spine just beyond which it widens and is supported by rays to extremity of tail; its ventral origin a little in advance of origin of dorsal fold, its first rays appearing about midway between its origin and tip of tail; upper and lower fins of about same width, the maximum about equal to width of fifth gill opening, the fins extending to extreme tip of tail, but not confluent there (barely confluent on 1 of our 15 specimens). Pelvics of male squarish, the rear margin 8.1 per cent of total length of specimen, extending beyond disc by a distance equal to about half that between the spiracles; pelvics of female wing-shaped, with straight to slightly convex anterior and convex posterior margins, the latter 11.5 per cent of total length, extending beyond disc a distance about equal to that between the spiracles (Fig. 20); rear margins faintly scalloped in both sexes. Apparently the shape and width of the posterior margin of the female pelvics undergo a change with age for those on a newborn specimen 85 mm in total length, and on one of 161 mm, closely resemble the squarish form of males of all sizes, but we have one female of 197 mm, containing a full term embryo, with pelvics intermediate in shape between that of the male and the female shown in Figures 21, 22.

Color. Plain grayish brown or chocolate brown above on disc, pelvics and tail. Lower surface marked with a wide irregular band of grayish along outer parts of disc and pelvics, with one or more blotches in between, otherwise pale. Caudal dark brown above and below.

Size. Our longest specimen, a female of 234 mm, has a disc 109 mm broad, the longest male, 221 mm, a disc 103 mm broad, immature to judge from the development of its claspers. The type specimen, a juvenile male, is 220 mm in total length, accord-

ing to Delsman (1941, p. 66).¹

Remarks. A specimen 232 mm long contains a full term embryo which was protruding from the cloaca head first, with tail bent forward over the back so that its tip reached the snout. Its pectorals are tightly folded under the body and the total length of the "capsule," in situ, is 42 mm, its width 17 mm. If stretched out, the embryo would be about 85 mm in total length. Its coloration above and below is essentially the same as that of the adult. Two other specimens, 187 and 197 mm long, respectively, each had an embryo with nearly all of the tail protruding; evidently these would have been born tail first.

Known from off the mouth of the Amazon River and the east coast of Venezuela, from depths of 9-30 fathoms, in localities given under Study Material. The type locality, off the Amazon, is Lat. 1°06'N, Long. 47°53'W.

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¹ Erroneously described by Bigelow and Schroeder 1953, p. 429, as 220 mm broad.

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Plate I. *Diplobatis pictus*. Photograph of a freckeled and a non-freckled color variety.



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