DEEP-SEA FISHES OF THE BERMUDA OCEANOGRAPHIC EXPEDITIONS

Family SERRIVOMERIDAE

Part I: Genus Serrivomer[1]

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(Figs. 23-42 incl.)

CONTENTS

INTRODUCTION

For detailed data in regard to nets, locality, dates, etc. concerning the capture of the deep-sea eels treated in this monograph, refer to ZOOLOGICA, Vol. XIII, Nos. 1, 2 and 3 and Vol.

[1] Contribution No. 505, Department of Tropical Research, New York Zoological Society.

XX, No. 1, pp. 1-2. For physical data, methods of measurement and definitions of growth stages, see ZOOLOGICA, Vol. XVI, No. 1.

The drawings in the present papers are the work of George Swanson.

Our thanks are due to the following persons for their cooperation in enabling us to examine specimens of *Serrivomer* deposited in various museums: Dr. George S. Myers of the U. S. National Museum, Miss Erna W. Mohr of Ahrensburg, Germany; Dr. Albert Eide Parr and Y. H. Olsen of the Peabody Museum, New Haven, and the summer custodian of the collections of the Museum of Comparative Zoology in Cambridge.

IMPORTANT POINTS IN THE FOLLOWING STUDY OF SERRIVOMER

TAXONOMY AND DISTRIBUTION: The recorded specimens of *Serrivomer* comprise three distinct species, *S. beanii* Gill and Ryder 1883 and *S. brevidentatus* Roule and Bertin 1929, both confined to the Atlantic Ocean, and *S. sector* Garman 1899, confined to the Pacific and Indian Oceans.

ECOLOGY AND DEVELOPMENT: *S. beanii* is the most common deep-sea eel found in our Bermuda trawling area, although it is a rare fish compared with *Cyclothone signata, Cyclothone microdon, Sternoptyx diaphana* and certain paralepids and myctophids. *S. sector,* on the other hand, is one of the rarest of all the fishes in the region.

The jaws of members of the genus *Serrivomer* are long and strong with numerous fine, sharp teeth, while there is a long, saw-like ridge of large, compressed teeth on the vomer; the stomach is only moderately distensible; the digestive organs are crowded into the anterior one-sixth of the fish; the principal foods of the eels and elvers are shrimps and euphausids (chiefly of one genus), with occasional myctophids and cyclothones, while the leptocephalids eat diatoms and minute crustaceans.

Bathysphere observations of *Serrivomer* showed that these eels are brilliantly iridescent, fast swimmers, and travel alone, in pairs and in groups of four or five; they were recognized on six different occasions, between 125 and 250 fathoms. They have been taken in the trawling nets off Bermuda between 50 and 1,000 fathoms and elsewhere down to 3,281 fathoms. No satisfactory correlation has been found between depth and growth stage, as large fish were seen from the Bathysphere much higher than eels of equal size were caught in the nets, whereas larvae were caught at very low, as well as at high levels. Off Bermuda there seems to be a chief breeding season in late spring and early summer.

The larva of *Serrivomer* is a typical leptocephalus, distinguishable by its moderate depth (7.8 to 10 in length), long snout and characteristic number of myomeres (a total of 154 to 165, of which 89 to 97 are preanal). It grows to about 63 mm. in length before metamorphosis, which takes place rapidly. Elvers of 100 mm. have all the general characters of the adults. The great majority of the Bermuda specimens are immature fish measuring between 100 and 300 mm. Probably no fully adult fish is less than 500 mm. in length. The largest known specimen is the type, 594 mm. long. It seems likely that individuals breed only once, as is the case with *Anguilla*. All of the Bermuda specimens in which the sex can be determined are females.

Genus *Serrivomer*, with a Taxonomic Revision of the Species

Generic Characters: Snout less than half length of head; gradually tapering, not sharply constricted, in front of eye; vomerine teeth forming a high, serrated ridge along roof of mouth. Trunk decreasing gradually in height and thickness from shoulder to tail; no nuchal constriction; no caudal filament; jaws strong, the lower slightly the longer; maxillary teeth strong and pointed, in several rows; mandibular teeth similar; vomerine teeth large, flattened, triangular, forming the above-mentioned serrated ridge along the roof of the mouth; pectorals rudimentary; dorsal beginning well behind pectorals and continuing to the tip of the tail; anal origin immediately behind anus, at a distance about mid-way between pectoral base and dorsal origin, and continuing to the end of the body; posterior portions of dorsal and anal fins lax, not forming a pseudocaudal; about 30 anal rays in the last 3.5 per cent of the total length of the fish, and about 20 rays occupying a space per ray of less than one-tenth of one per cent. of the total length; branchial clefts confluent; lateral line without pores, or with a single series of small, inconspicuous pores immediately below it. Three species.

Discussion and Taxonomic Revision of the Species: Due both to the inadequacy of the early descriptions of the species of *Serrivomer* and to the scattered locations of the various collections, the validities of the described species have always been questionable. The present discussion should, however, clear up the major taxonomic issues for, in addition to studying in detail our extensive Bermuda collection, we have been able to examine the following specimens: the type of *S. beanii* Gill and Ryder 1883 (U. S. National Museum, Washington, D. C.) ; the type of *S. sector* Garman 1899 and the other Pacific specimens of the *Albatross* collection (Museum of Comparative Zoology, Cambridge, Mass.) ; four of the six *Valdivia* specimens from the East Indies and the Indian Ocean (Berlin Museum and the Museum of Leipzig) ; nine specimens taken by the Bingham Oceanographic Expeditions from the Atlantic (Peabody Museum, New Haven, Conn.) ; four specimens of the Iselin Expedition in the North Atlantic; and, finally, a number of unrecorded specimens from the eastern Pacific and the Gulf of California taken, respectively, on the *Arcturus* Oceanographic Expedition (1925) and the Templeton Crocker Expedition (1936), both trips having been undertaken by this department of the New York Zoological Society. The only important collection which has not been inspected is that of the *Dana* Expedition of 1920-1922, but since these specimens were reported upon fully by Roule and Bertin in 1929, it has been found possible to establish, in a general way, the taxonomic status of this collection as well.

From our study, it is apparent that there are three distinct species of *Serrivomer*: *S. beanii* Gill and Ryder 1883 from the Atlantic, *S. brevidentatus* Roule and Bertin 1929 (described as *S. sector* type *brevidentatus*), which is also from the Atlantic, and *S. sector* Garman 1899, which is confined to the Pacific and Indian Oceans. (Fig. 23).

In the differentiation of the species, four main characters are involved, which may best be shown in the following tabular form:

	S. beanii (Atlantic)	*S. brevidentatus* (Atlantic)	*S. sector* (Pacific)
Vomerine teeth	50-80, 3-4 times as long as wide.	20-30, twice as long as wide.	like *S. beanii.*
Anterior tips of first 5 brr. rays	project far beyond hyoid element to which they are attached. (See Fig. 31).	project not at all. (See Fig. 40).	like *S. brevidentatus.*
Distance from snout to anal origin contained in length	4.0-4.5 times.	3.4-3.8 times.	like *S. brevidentatus.*
No. of anal rays	124-140	159-173	150-160

The dental characteristics described by Roule and Bertin (1929, p. 39) as distinguishing their two groups of specimens, *S. sector,* type *longidentatus* (= *S. beanii*) and *S. sector,* type *brevidentatus* (= *S. brevidentatus*) are fully corroborated by Bermuda specimens measuring more than 300 mm. in length: *S. beanii* differs from *S. brevidentatus* chiefly in having the teeth of the vomerine ridge longer and more numerous and in having those of the maxillary fewer and more scattered, there being a distinct row of much longer, more pointed teeth. The larger teeth of the mandible also, although no fewer than in *S. brevidentatus,* are longer and more slender in *S. beanii.* We have found in addition that the dentition of true *S. sector,* from the Pacific, is practically identical with that of *S. beanii.* The details of the dentition in the two forms may be presented as in the table on page 58.

Specimens of *Serrivomer* smaller than about 300 mm. are indistinguishable specifically on the basis of the dentition, since the teeth of all three species resemble those of adult *S. brevidentatus*: the vomerine ridge teeth are relatively short and broad, and few in number, while those of the maxillary and mandible are comparatively homogeneous. Therefore, since it is chiefly by means of the dentition that *S. sector* is distinct from *S. brevi-*

TABLE SHOWING THE RELATIVE DENTAL CHARACTERISTICS OF THE SPECIES OF *Serrivomer*.

	S. beanii and *S. sector*	*S. brevidentatus*
Vomer	50-80 teeth on ridge, each tooth three to four times as high as wide, alternating in 2 parallel rows forming a ridge from anterior part of eye to point 4/5 of distance from eye to snout tip; elevation greatest in middle of ridge; its greatest height almost equals vertical diameter of eye. From end of ridge to snout tip are numerous small teeth irregularly arranged.	20-35 teeth on ridge, each tooth twice as high as wide; ridge extends from nostril to point 3/5 of distance from eye to snout tip, a little before maxillary's end; greatest height of ridge equals 2/3 vertical diameter of eye; otherwise identical with *S. beanii* and *S. sector*.
Maxillary	3 to 4 rows of teeth, increasing in size from outer to inner; the inner row is formed of 20 to 25 very long, needle-like teeth, sharply differentiated from those of the other rows. Teeth and bones end about 4/5 of preorbital distance.	3 rows of teeth, increasing in size from outer to inner; the inner row is formed of 30 to 40 teeth, only moderately larger than those of the other rows, and triangular in shape; otherwise identical with *S. beanii* and *S. sector*.
Mandible	3 to 5 rows of teeth, increasing in size from outermost to next to innermost row; innermost very small; 35 to 45 teeth, slender like the long teeth of the maxillary, in next to innermost row, this row ending about 3/4 of distance from eye to tip of jaw; from here on the arrangement is irregular.	4 to 6 rows of teeth; less varied than in the other species, the large teeth of the next to the innermost row being relatively shorter and broader; and ending about 3/5 of distance from eye to tip of jaw; otherwise identical with *S. beanii* and *S. sector*.

dentatus, we cannot distinguish the young of these two species, although there is no danger of confusing them since they inhabit different oceans. The young of the two Atlantic species, however, can be easily differentiated by the anal count and, more easily, by the mode of attachment of the branchiostegal rays to the hyoid arch. In *S. brevidentatus*, the first five rays are fastened to the hyoid bones in the usual manner, by the extreme anterior tips of the rays. In *S. beanii*, on the other hand, each

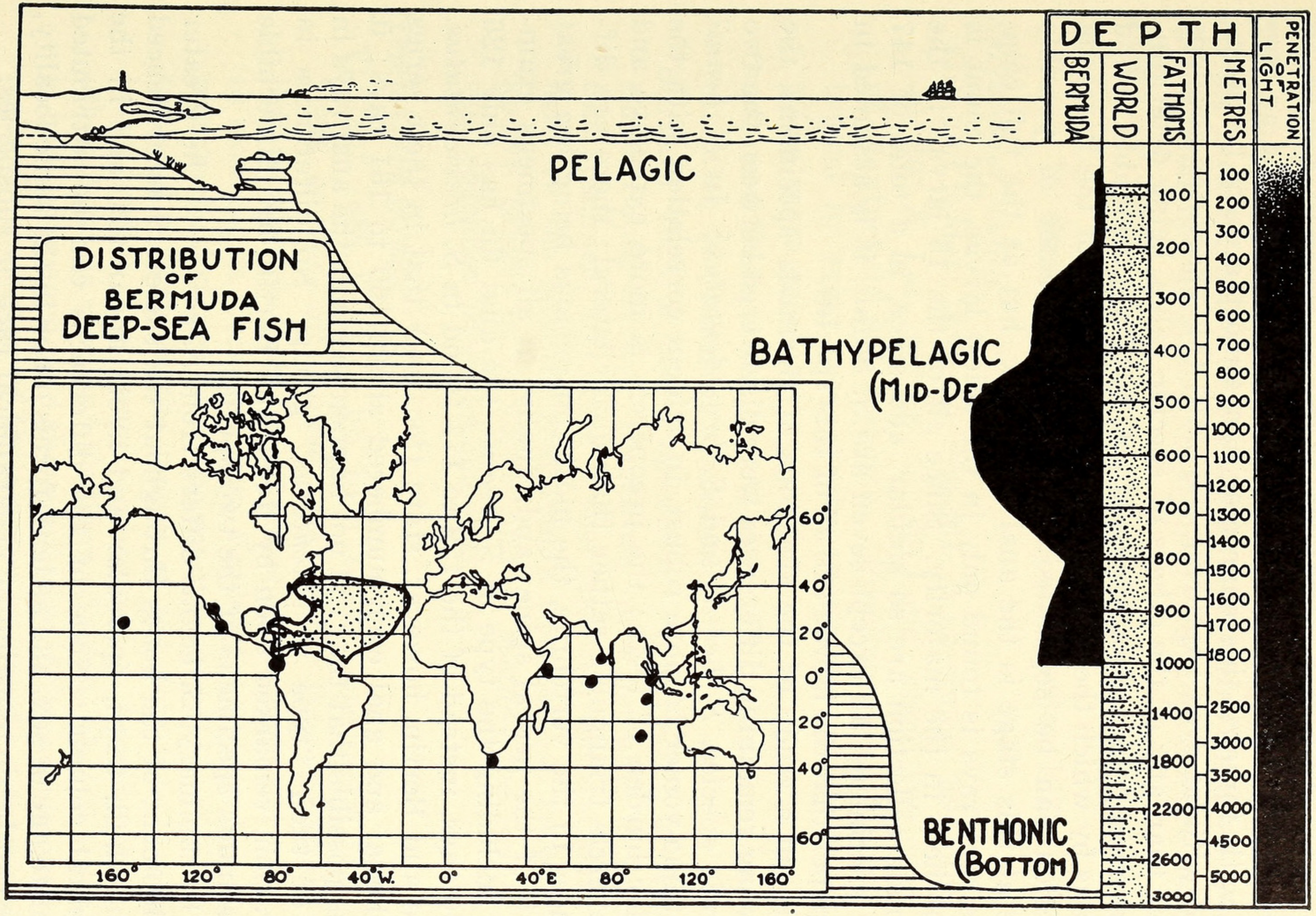


Fig. 23. The geographical and vertical distribution of the genus *Serrivomer*. The shaded area in the Atlantic Ocean indicates the range of the two species, *S. beanii* and *S. brevidentatus*; the specimen marked by the circle at the tip of South Africa is of questionable identity; all others are *S. sector*. The relative numbers of specimens of *Serrivomer* taken at different depths by the Bermuda Oceanographic Expeditions are shown diagrammatically at the left of the column which gives the vertical range of the genus.

corresponding ray projects considerably in front of the hyoid element to which it is attached. If the specimen is turned on its back and the angles of the jaw are separated as far as possible with forceps, this character can almost always be determined without even rupturing the skin; this character develops earlier than any of the others of specific value, being determinable even in post-larvae. We have not, however, been able to find a means by which the larvae (true leptocephali) of the Bermuda collection can be separated. The only character of possible value at this stage is the anal ray count, but as the full complement of rays is found only in the oldest larvae, the count is not of help in the majority. Since all of the 15 larvae in the Bermuda collection are so similar, and since, in a total of 147 older specimens, all except seven are *S. beanii,* it is assumed in this paper that the larvae are all of this species.

From a study of the skeletons of Bermuda specimens, the following remaining differences were discovered between the two Atlantic species, *S. beanii* and *S. brevidentatus*: In *S. beanii* the ethmo-vomer is more robust, in evident correlation with the heavier burden of teeth; the preopercle is more extensive and the opercle triangular rather than quadrilateral; there are differences in the vertebrae, the most conspicuous being the great length of the neural spine; and, finally, in all specimens examined, including the type of *S. beanii,* the anal fin has only 126 to 140 rays, instead of the 159 to 173 found in *S. brevidentatus.* Roule and Bertin, however, state (*loc. cit.*) that in their series the dorsal and anal each numbered about 160 to 161 rays; it seems possible that they did not happen to count the anal rays in any of their "type *brevidentatus*" group. No differences in coloration, remarked upon by Roule and Bertin, are discernible in Bermuda specimens of the two species.

In summary, *S. beanii* differs from *S. sector* in the greater development of the bones throughout the skeleton, as evidenced in the skull, teeth, opercular and hyoid apparatus, and in the vertebral column. None of the differences can be attributed either to age or sex, and as both forms occur in the same locality, there can be no question of geographical race or subspecies.

Of the three species of *Serrivomer,* about 145 specimens have previously been recorded from the Atlantic, Pacific and

Indian Oceans. They measured between 103 and 629 mm. and were taken down to a depth of 3,281 fathoms (6,000 metres). The following annotated synonymies of the three species, based on the reexamination of the actual specimens or upon a study of the published data, as indicated, are for convenience herewith presented together:

1. **Serrivomer beanii** Gill and Ryder 1883

Serrivomer beanii:

Gill and Ryder, 1883, pp. 260-261. 1 specimen; 594 mm.; 41° 40′ 30″ N. Lat., 65° 28′ 30″ W. Long., about 200 miles east of Nantucket; 855 fathoms. (Specimen reexamined; it is typical in every way of the specimens which have been taken more recently).

Goode and Bean, 1895, p. 155, fig. 175. (Supplementary description of preceding specimen).

?Barnard, 1925, p. 200. 1 specimen; ? mm.; south of Agulhas Bank, South Africa. (Since we were not able to examine this specimen, and since it was taken on the boundary line between the Atlantic and Indian Oceans—i.e. between the known ranges of *S. beanii* and *S. sector*—the identity of this specimen remains questionable.)

Nemichthys infans:

Vaillant, 1888, p. 93, pl. vii, Figs. 1, 1a. 1 specimen; 240 mm.; 2,995 metres; off Azores. (We refer this specimen with little hesitation to *S. beanii* although we have not been able to examine it, because, from Vaillant's published measurements, the distance from the snout to the anal origin is contained 4.5 times in the length of the fish, this proportion being typical of *S. beanii* and not of *S. brevidentatus*, the other Atlantic species. Vaillant mentions that the anal fin is badly damaged, and the small size of the specimen would make the dentition of little value in specific determination. The fourth character, the mode of attachment of the branchiostegal rays, is unknown).

Nemichthys richardi:

Vaillant, 1888, p. 385. Above specimen designated as new species.

Serrivomer richardi:

Goode and Bean, 1895, p. 155. Above specimen referred to *Serrivomer.*

Serrivomer sector:

Roule and Bertin, 1929, p. 35. Above specimen verified as a *Serrivomer,* from a reexamination of the type by Roule and Bertin.

ibid., pp. 39-47, *part.* An indeterminable number of specimens, measuring between 79 and 629 mm. in length, taken between 150 and 6,000 metres in the North Atlantic (comprising all the specimens referred to *S. sector* type *longidentatus* with the exception of those taken in the Gulf of Panama).

Parr, 1932, pp. 2-3. 7 specimens; 186 to 291 mm.; 4,000 to 8,000 feet of wire; Bahamas and Bermuda. (Reexamined by the present authors and found to be typical *S. beanii*).

Gavialiceps microps:

Borodin, 1931, p. 74. 2 specimens; 216, 252 mm.; 1,500 metres; off Bermuda. (Reexamined by the present authors and found to be typical *S. beanii*).

Incertae sedis:

Parr, 1932, p. 3, *part.* 2 specimens; 126, 128 mm.; 10,000 feet of wire; off Bermuda. (Reexamined by the present authors and found to be typical *S. beanii*).

Serrivomer sp.

Beebe, 1933, p. 180, *part.* Preliminary note of specimens of *Serrivomer* taken by the Bermuda Oceanographic Expeditions.

Serrivomer sector longidentatus:

Parr, 1934, p. 6. 1 specimen; ? mm.; 1,050-1,100 metres; Bahamas.

2. **Serrivomer sector** Garman 1899

Serrivomer sector:

Garman, 1899, pp. 320-323, pl. LXIII. 11 specimens; up to 570 mm.; 134 to 1,772 fathoms; 9 stations off Colombia, from 325 miles west of Bahia del Choco to just south of Cape Mala, Panama; 1 station in Gulf of California, 50 miles south of Guaymas. (Reexamined by the present authors).

Brauer, 1906, p. 132, pl. VIII, fig. 4. 6 specimens; 205 to 392 mm.; 1,213 to 2,400 metres; Indian Ocean: between New Amsterdam and Sumatra, Binnen Bay on the west coast of Sumatra, west of Chagos Archipelago, and off the coast of Italian Somaliland. (4 of the specimens—3 from the Sumatra and Sumatra-to-New Amsterdam regions and 1 from off Somaliland—have been reexamined by the present authors. In spite of the fact that the examples are not in good condition and that two of them, including the one from Somaliland, measure only 205 and 210 mm. respectively, still enough characters remain in the group as a whole to show that these individuals do not differ specifically from those taken in the eastern Pacific: in no specimen do the branchiostegal tips overlap the hyoid elements as in *S. beanii;* the two largest [330 and 392 mm.] are old enough to show typical *S. sector* dentition; in the three specimens where the measurement could be taken, the snout-to-anal distance is contained 3.6 to 3.8 times in the length; and, finally, the anal count of the largest example [the fins of all others are damaged] is 152).

Lloyd, 1909, p. 152. 1 specimen; ? mm.; 930 fathoms; Arabian Sea, off Travancore.

Weber and Beaufort, 1916, pp. 331-332, text-fig. 160. Mention of known Pacific specimens.

Townsend and Nichols, 1925, p. 12. 2 specimens; 485 and ?

mm.; 590 and 630 fathoms; Gulf of California, off Todos Santos Bay and off Cape San Lucas, respectively.

Roule and Bertin, 1929, pp. 39-47, *part.* An indeterminable number of specimens, measuring between 79 and 629 mm. in length, taken, between 150 and 6,000 metres, in the Gulf of Panama. (Probably these specimens were among those referred to *S. sector* type *longidentatus*).

Serrivomer beanii:

Gilbert, 1905, p. 386. 3 specimens; 311 to 1,067 fathoms; Hawaiian Islands.

3. **Serrivomer brevidentatus** Roule and Bertin 1929

Serrivomer sector:

Roule and Bertin, 1929, *part.* An indeterminable number of specimens, measuring between 79 and 629 mm. in length, taken between 150 and 6,000 metres in the North Atlantic (comprising all the specimens referred to *S. sector* type *brevidentatus*).

?Trewavas, 1932, p. 650, pl. III. 1 specimen; 160 mm.; depth ?; locality ? Description of the skull. (The illustration shows that this specimen is unquestionably not *S. beanii.* In placing it under *S. brevidentatus* instead of under *S. sector,* we are assuming that it was captured in the Atlantic rather than in the Pacific or Indian Ocean).

Serrivomer sp.

Beebe, 1933, p. 180, *part.* Preliminary note of specimens of *Serrivomer* taken by the Bermuda Oceanographic Expeditions.

Note: The specimens of *Serrivomer* and *Serrivomer*-like fish, which have been recorded by Beebe (1933a and 1934) as observed from the Bathysphere, may obviously have belonged to either or both of the Bermuda species of *Serrivomer* and possibly to the genus *Platuronides* as well, since all of these forms are superficially much alike.

The specimens recorded by Borodin, 1931, p. 74, from near Bermuda as *Serrivomer sector* proved upon reexamination by us to be adolescent nemichthyids.

The Bermuda Oceanographic Expedition specimens of *S. beanii* and *S. brevidentatus* will now be discussed in detail.

Serrivomer beanii Gill and Ryder 1883

SPECIMENS TAKEN BY THE BERMUDA OCEANOGRAPHIC EXPEDITIONS

155 specimens; April to October, 1929 to 1931; 50 to 1,000 fathoms; from a cylinder of water 8 miles in diameter (5 to 13 miles south of Nonsuch Island, Bermuda), the center of which is at 32° 12′ N. Lat., 64° 36′ W. Long.; Standard lengths from 55 to 440 mm.

DESCRIPTION OF ADULT
(Figs. 24J, 25J)

COLOR: Black, with a fragile coating of silver skin which, when fresh, has a high bronzy iridescence.

PROPORTIONS (from the three largest Bermuda specimens, standard lengths 400, 405, 440 mm., and the type specimen, standard length 596 mm.): Depth in length 30 to 41; head in length 5.3 to 6.4; eye (horizontal) in head 16 to 17.2; eye is horizontally elongate; maxillary reaching well beyond vertical from posterior margin of eye; snout in head 2.4 to 2.8; snout to dorsal in length 3.1 to 3.3; snout to anal in length 4 to 4.3.

TEETH: The dentition has been described in detail on p. 58.

FINS: Pectoral rays 6 or 7, very delicate, equal in length to horizontal diameter of eye, inserted at upper angle of branchial cleft. Dorsal rays 159 to 165, commencing well behind the anal origin, at a distance 1.3 to 1.5 times the postorbital length of the head; the first dorsal ray is inserted above the eleventh to thirteenth anal ray. Anal rays 124 to 140, longer than those of dorsal. The rays of both fins are longest, and the spaces between successive rays greatest, in the anterior halves, behind the first 10 or 15 rays. Caudal rays 5 or 6, scarcely distinguishable from

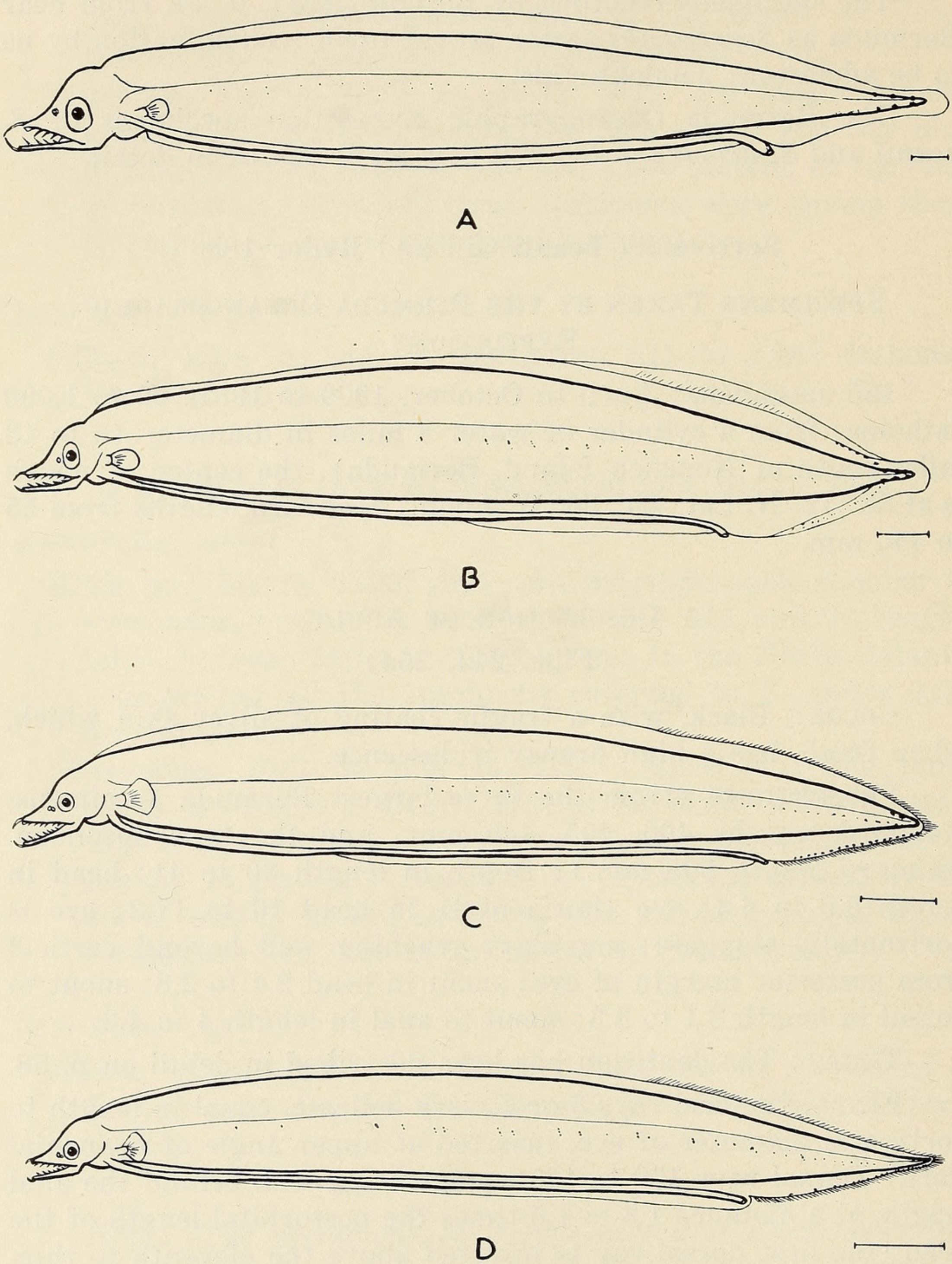


Fig. 24. *Serrivomer beanii.* A to D, incl., larvae, 17, 25, 36, and 43 mm., respectively.

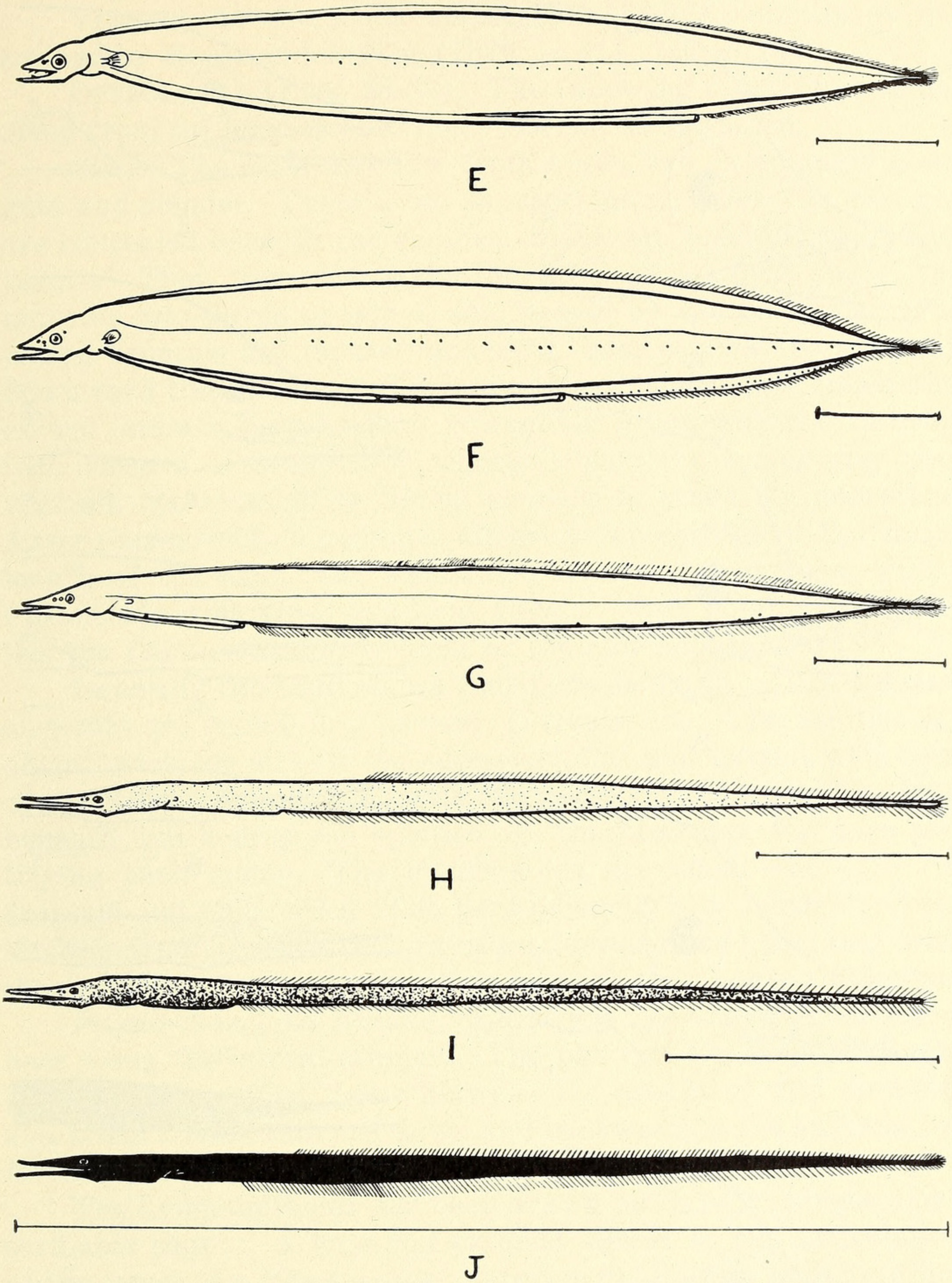


Fig. 24, cont. *Serrivomer beanii.* E, larva, 57 mm.; F, post-larva, 59 mm.; G and H, adolescents, 59 and 61 mm.; I, transitional adolescent, 127 mm.; J, adult, 440 mm.

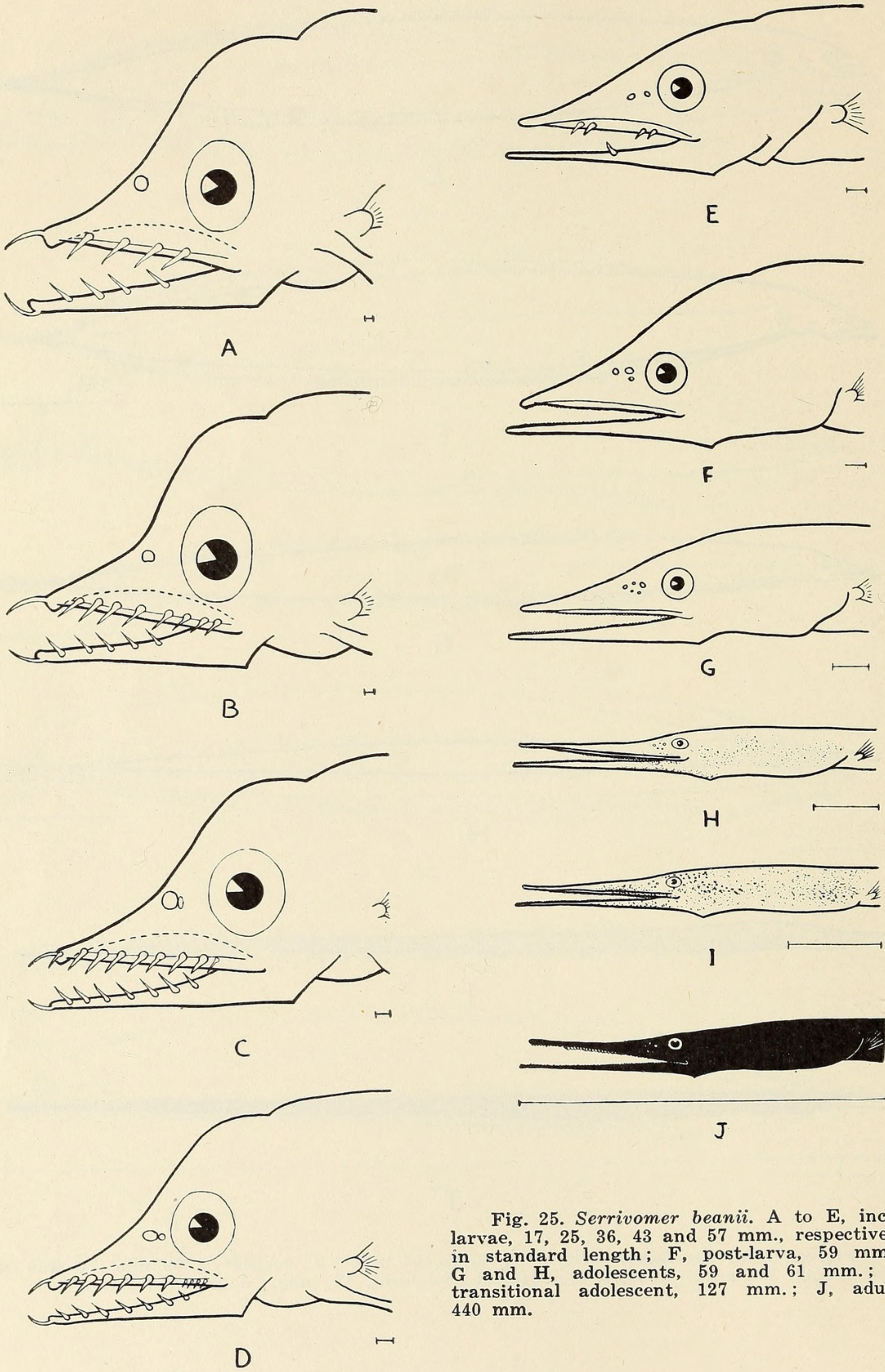


Fig. 25. *Serrivomer beanii.* A to E, incl., larvae, 17, 25, 36, 43 and 57 mm., respectively in standard length; F, post-larva, 59 mm.; G and H, adolescents, 59 and 61 mm.; I, transitional adolescent, 127 mm.; J, adult, 440 mm.

those of dorsal and anal, with which the caudal fin is confluent.

VERTEBRAE: Bermuda specimens, 154-168; specimens described by Roule and Bertin (1929, p. 41), 143 to 155.

OSTEOLOGY: (Figs. 28-33). The following description is derived from the largest (440 mm.) Bermuda specimen.

Skull: The skull and jaw from above are exceedingly elongate and slender. There is no supraoccipital, unless its vestiges are concealed beneath the epiotics, which are medially united by suture. They form the posterior third of an oval space, the anterior two-thirds of which are formed by the parietals. The paired frontals are narrow and long, bent midway so abruptly downward that they look like two pairs of bones. The sphenotics extend laterally as two large, triangular wings with the anterior face concave. Disregarding whatever part the vomer may play ventrad, the ethmoid or dorsal element is relatively enormous. Antero-posteriorly it occupies almost seven-eighths of the entire length of the head, and equals the frontals in extreme width. Posteriorly it narrows to a long, slender spear point which overlies the frontals to the vertical of the sphenotics.

Laterally the skull shows considerable depth. All the dorsal elements are visible in a narrow, elongate line. The epiotics are about twice the size of the supraoccipital and extend well back of that bone. Articulating with the parietals and extending back beneath and behind the epiotics are the pterotics, for once justifying their name. The alisphenoids are small and join the frontals and sphenotics. The parasphenoid is a slender rod extending from beneath the braincase forwards and merging with the dentigerous vomer somewhere beneath the covering palatines.

Palato-pterygoid Arcade: Each palatine shows an extended base along the lateral ethmoid. The pterygoid is large, triangular, set in unossified tissue between the maxillary and ethmoid, and sends a long, thin rod down and backward to the articulation of the hyomandibular and quadrate with the jaw angle.

The hyomandibular has been drawn out into an almost indescribable shape: A long rod extends almost to the articulation of the lower jaw, then a stout anterior projection, matching but not touching the posterior outline of the pterygoids; posteriorly another long rod underlies the pterotic, while to the lower face is applied the short and wide quadrate.

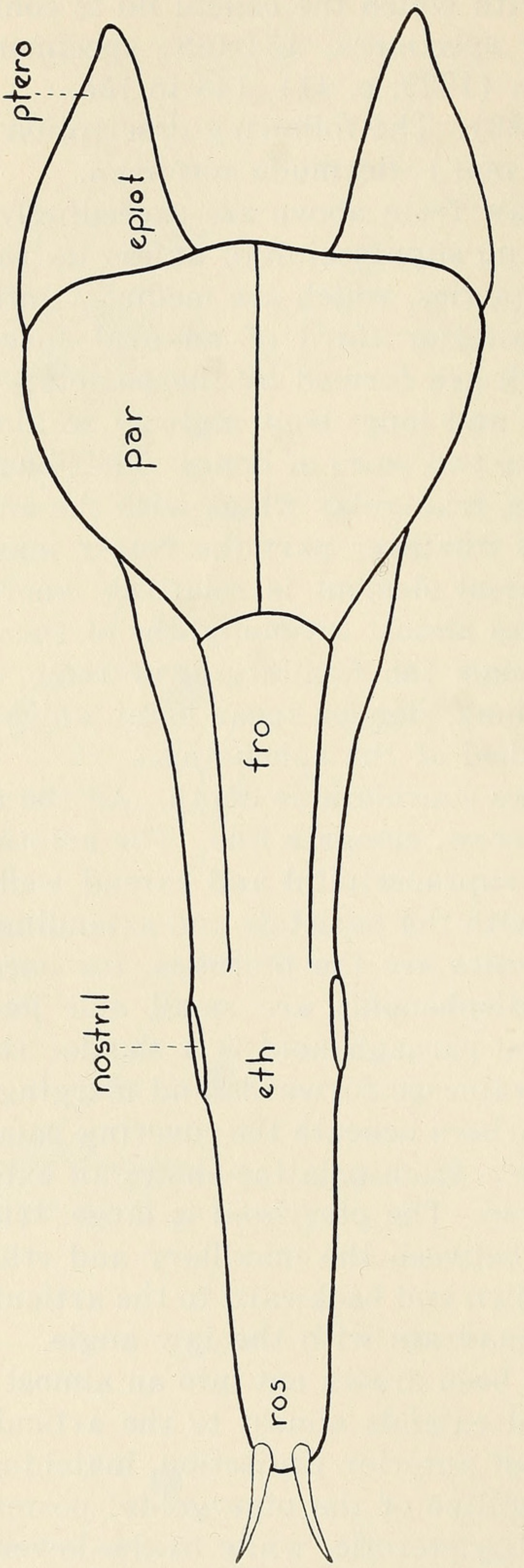


Fig. 26. *Serrivomer beanii.* Cartilaginous elements of larval skull, dorsal view. Standard length 36 mm. (x 44).

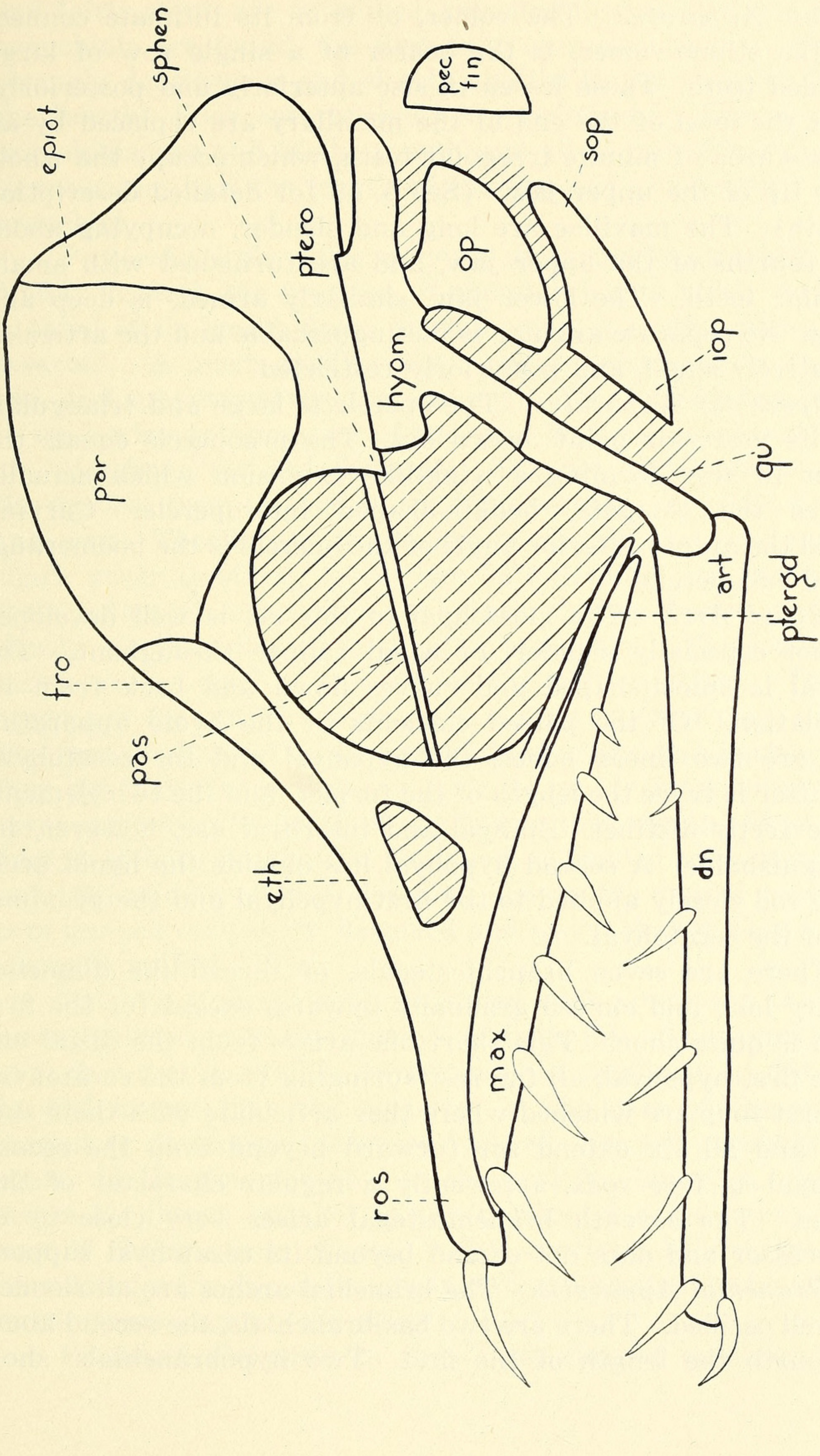


Fig. 27. *Serrivomer beanii.* Cartilaginous elements of larval head, lateral view. Standard length 36 mm. (x 44).

Jaw Apparatus: The vomer, or from its intimate connection, the ethmo-vomer, is the bearer of a single row of large palisaded teeth. These lessen in size anteriorly and posteriorly, and at the level of the end of the maxillary are replaced by an elongate area of minute irregular teeth, which occupy the whole of the tip of the upper jaw. (See p. 58 for detailed description of teeth). The maxillae are long and slender, occupying about three-fourths of the upper jaw, and are furnished with small, irregular teeth. The lower jaw, similarly armed, is deep and strong. No separate angular is distinguishable and the articular is relatively small, and posteriorly restricted.

Opercular Apparatus: The opercle is large and triangular, with its posterior point drawn out. The preopercle equals the former in size, forming a wing-like extension which actually overlies the elongate, bodkin-shaped interopercle. Curving around the antero-inferior angle of the opercle is the boomerang-shaped subopercle.

Hyoid Arch: The glossohyal in this eel is well developed and not especially slender, of equal calibre throughout. The urohyal is shield-shaped and curves down and back from its articulation. Of the paired elements of the hyoid apparatus, there are two linear bones, the hypohyal and the ceratohyal. The latter is twice the length of the former, and the two elements are perfectly distinct. Epihyal and interhyal are, however, indistinguishable. A second hypohyal lies outside the hyoid arch, a thin rod closely applied to the first hypohyal and the proximal half of the ceratohyal.

There are seven branchiostegals, of thread-like diameter, all very long and curved gradually upward, except for the first which is quite short. This short one arises from the distal end of the first hypohyal, all the rest springing from the ceratohyal. The first four are widened where they articulate with their supports and all six extend far forward beyond even the second hypohyal as free rods, apparently a regular character of this species. The seventh branchiostegal arises very close to its predecessor and does not extend beyond its ceratohyal support.

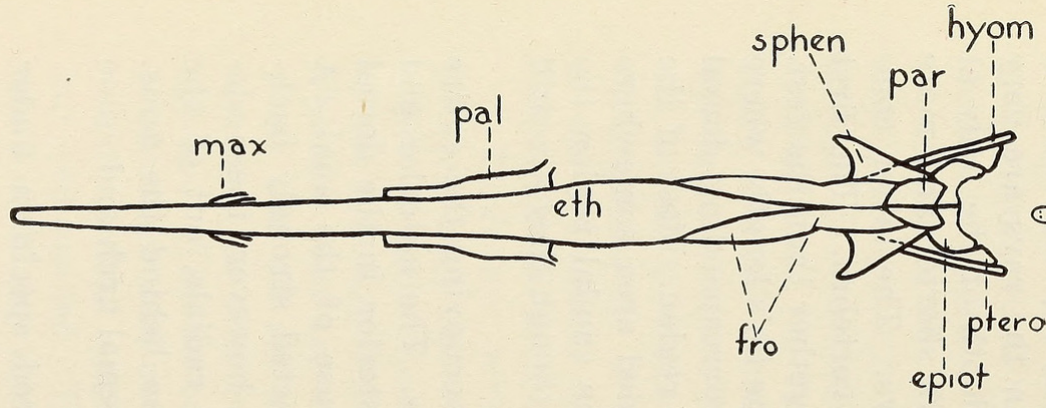
Branchial Apparatus: The branchial arches are all slender, but well ossified. There are two basibranchials, the second about one-fourth the length of the first. Two hypobranchials, short and fairly stout, are developed, subequal in size. All five cerato-branchials are found, the first four long and slender, the fifth strongly dentigerous and closely applied to the anterior face of the fourth. Four epibranchials are followed by five pharyngo-branchials, the end of the fourth and all of the fifth being dentigerous and half the length of the opposed and toothed cerato-branchial.

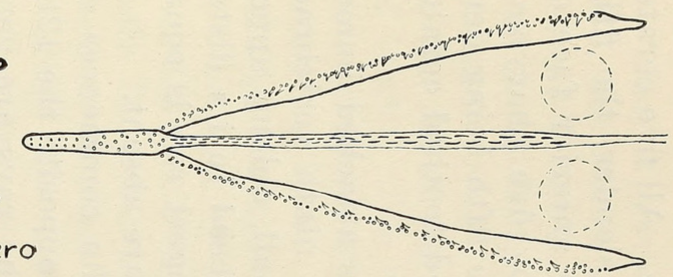
Pectoral Girdle: The curving cleithrum is attached immediately beneath the junction of the eighth and ninth vertebrae. A third of its length from the top arises a small, oblong upper coracoid. A much smaller lower one is ankylosed to its distal end, and supports seven pectoral rays. The longest ray is equal to the horizontal diameter of the eye. Radials are absent.

Vertical Fins and Supports: The dorsal fin commences at the vertical from the end of the 27th vertebra, opposite the 12th anal ray. Throughout the length of the fin the rays are very short, never equalling more than half the depth of the body at their points of attachment; they are always shorter and more closely set than the corresponding anal rays. The latter commence at the level of the end of the 21st vertebra. The first dozen and the last 50 are set more closely together than the rest. The rays are longest in the second third of the fin's length, where they are fully three times as long as the corresponding dorsal rays, and equal the depth of the fish in that region. Most of the finrays of both fins have a flattened, expanded area somewhere near the middle of their lengths, and in the caudal region the rays become very short, flattened and wavy, though they are still strongly ossified.

There is a radial with expanded ends occupying the entire space between each two finrays of both fins. The anterior end of each radial is slightly lower than the posterior in the dorsal fin and higher than the posterior in the case of the anal. A baseost is developed for every ray, all directed strongly backward. In the anterior part of the anal fin, however, these elements lie almost parallel to the horizontal radials, out of the way of the coelomic organs, which continue behind the anus. Correlated with this is the absence of the haemal arch and spine in the same region (see below).

Vertebral Column: In the large, cleared specimen under





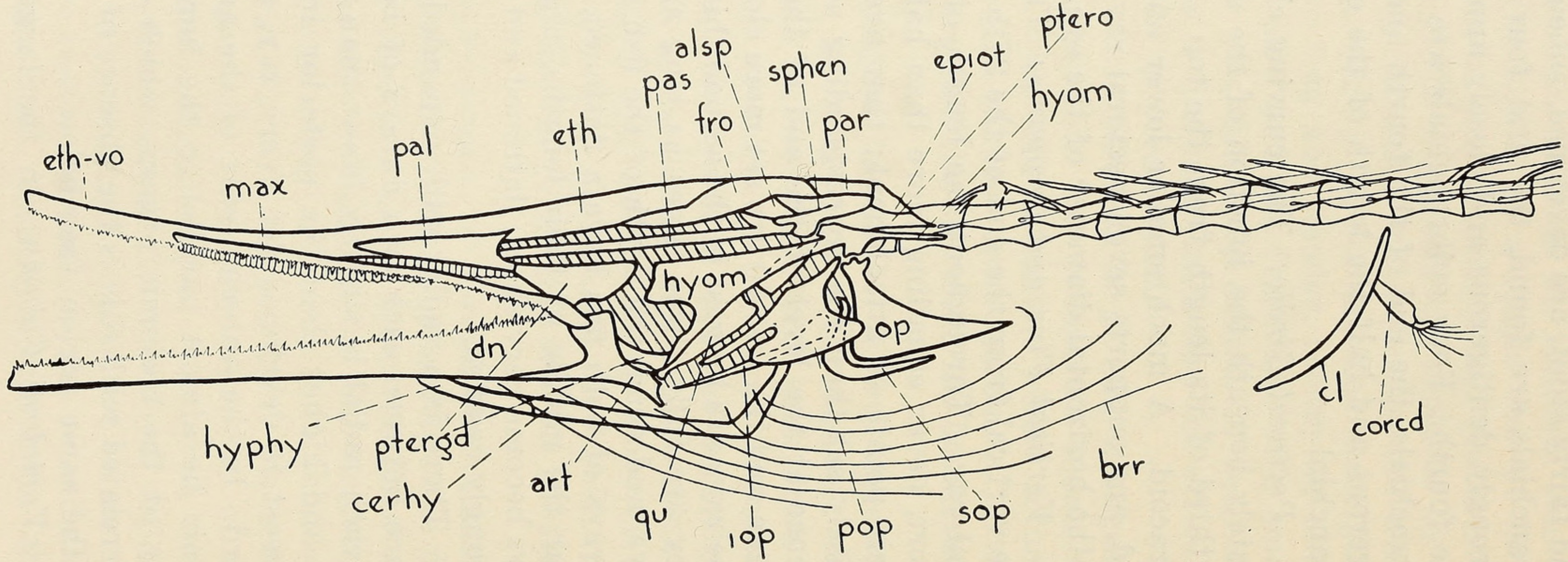


Fig. 28. (upper left). *Serrivomer beanii.* Skull of adult, dorsal view; standard length 440 mm. (x 10).
Fig. 29. (upper right). Same, teeth of upper jaw and vomer, ventral view. (x 10).
Fig. 30. (lower). Same, bones of head, pectoral girdle and anterior part of vertebral column, lateral view. (x 10).

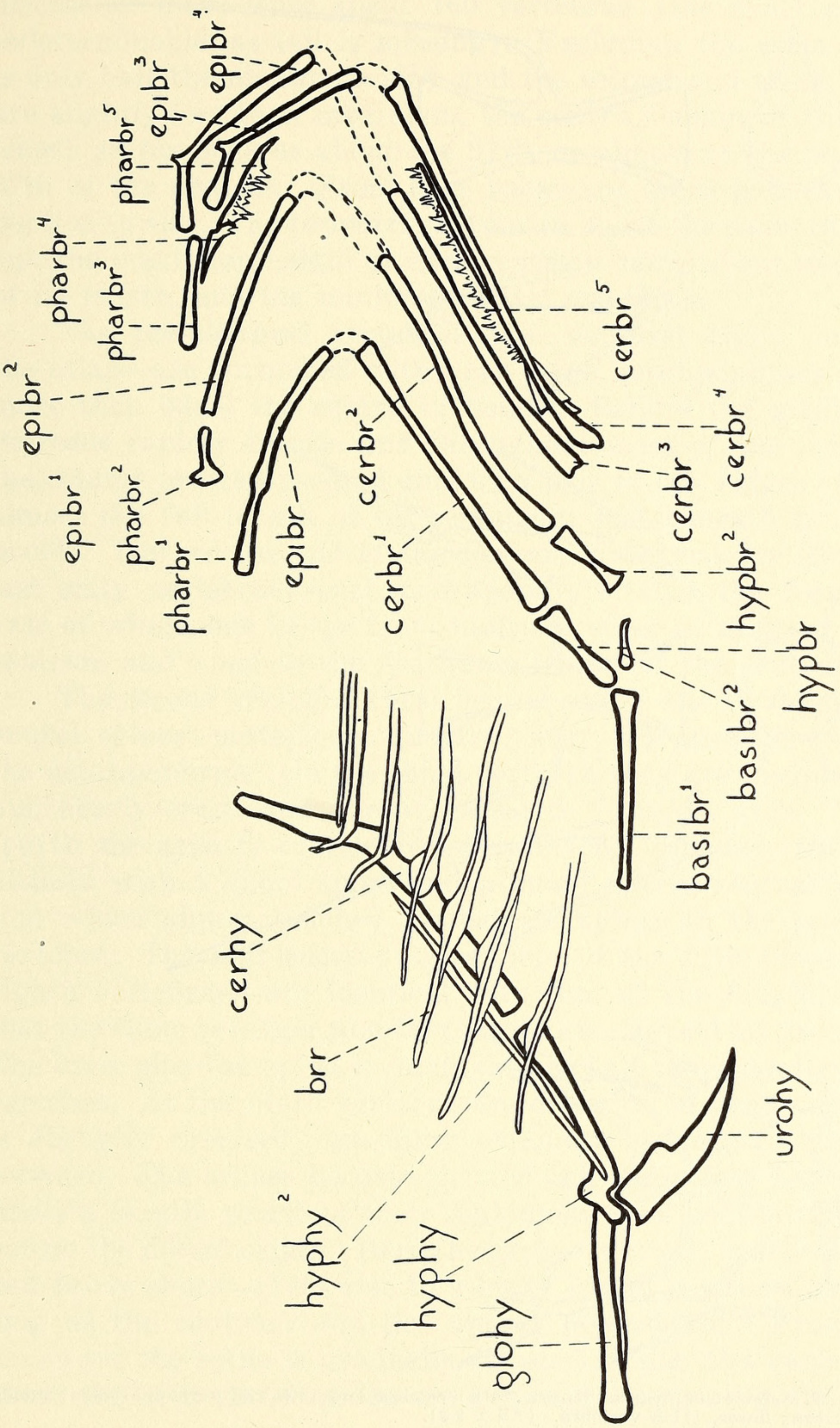


Fig. 31. *Serrivomer beanii.* Hyoid and branchial apparatus of adult, standard length 440 mm. (x 3.4).

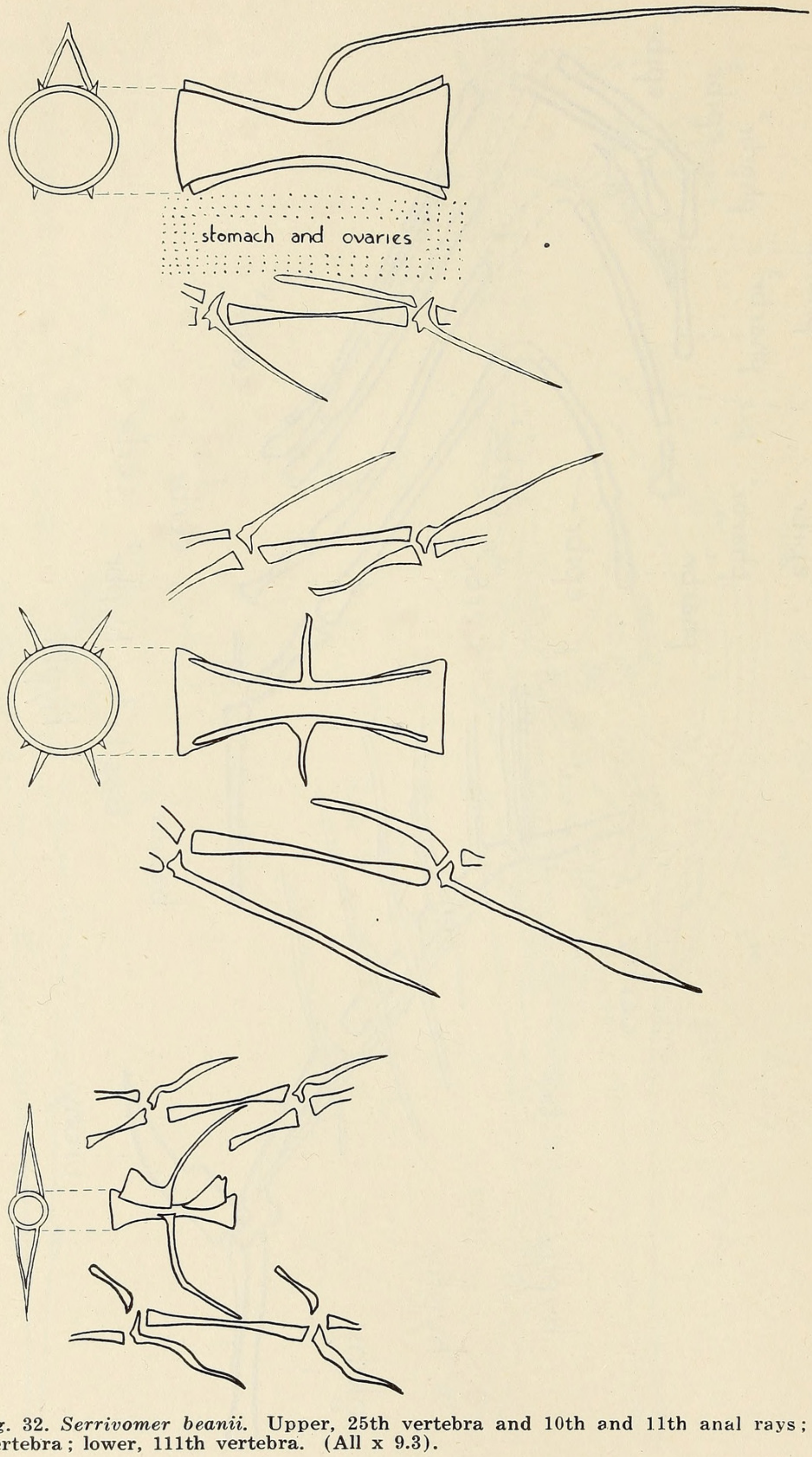


Fig. 32. *Serrivomer beanii.* Upper, 25th vertebra and 10th and 11th anal rays; middle, 97th vertebra; lower, 111th vertebra. (All x 9.3).

discussion there were about 160 vertebrae (the exact number indeterminable, as tail is missing). Excluding the atlas, which is only half the maximum size, and the second and third, which are slightly less than maximum, the centra remain of the same length as far back as about the 97th, or almost to the posterior fifth of the anal fin. From here backward there is a rapid reduction in size. The proportions remain about the same throughout, the maximum height of each centrum being about two-fifths of its length, and the minimum about one-tenth.

The pre-cleithral vertebrae—i.e. the first eight, counting the atlas—are furnished with very large neurapophyses, which more than equal the centra in height. Behind the girdle they decrease rapidly in size and throughout most of the length of the column are represented only by a pair of low ridges running almost the full length of each centrum just beneath its dorsal profile. Toward the end of the column, however—for about the last sixty vertebrae—each neurapophysis takes the form of a pair of wings, one in the front half, the other at the rear of the centrum and equal to the maximum height of the centrum.

The second vertebra (first behind atlas) has two dissimilar neural spines, posteriorly directed, near the posterior edge of the neurapophysis. On the third vertebra they are median, minute, nearly erect, and almost joined to form an arch. In the fourth the arch is complete and *anteriorly* directed, furnished distally with a short spine and a small antero-ventral projection which almost touches the pair of spines in the preceding vertebra. The four succeeding arches—of the fifth through the eighth vertebrae—are identical with that of the fourth, except that the spine is longer and there is no antero-ventral projection. The arch plus the spine in each case is half again as long as a vertebra. At the ninth vertebra the direction of arch and spine is abruptly reversed, extending obliquely backward instead of forward. The arches become shorter and the spines increase in relative length, reaching their maximum close behind the anus, before the dorsal origin. Here the arch—vertical, nearly median, and fairly short—gives rise to a spine which is almost twice as long as the centrum and lies almost horizontally. From here backward the spine is gradually reduced in size and vanishes at about the 38th vertebra, the arch once more opening at the top to form a pair of spines, as in the second and third vertebrae. In the most posterior part of the column, at about the 107th vertebra, the arch is again completed, its apex almost touching the dorsal baseost, and sends a short spine backward. Each of the first 17 neural arches is strengthened by a cross bar placed across the arch well below the apex.

Epineurals are distinguishable only on the first eleven vertebrae after the atlas. These are well ossified and there is no sign of epipleurals or of ribs anywhere along the column.

In the anterior part of the column haemapophyses correspond exactly to the neurapophyses, taking the form of narrow ridges close to the ventral profiles of the centra.

The first, incomplete, haemal arch—in the form of a pair of median, vertical spines—does not appear until the 91st vertebra, the 70th behind the anus. This is obviously connected with the post-anal extension of the coelomic organs. Similar structures are present on the 92nd, lacking on the 93rd and 94th, present on the 95th, lacking on the 96th, and present on all subsequent vertebrae. The first complete haemal arch appears on the 107th vertebra, the apex of the arch almost touching the anal baseost. Small, backwardly directed spines arise from the arches of subsequent vertebrae.

End of Vertebral Column and Caudal Fin: The caudalwards alteration of the vertebrae is so slow and gradual that it is difficult to say where it begins. The fourth from the urostyle is very spool-like in lateral view, and shows a large, rounded neural arch, topped with a short, irregularly backward directed spine. The haemal arch is smaller with a correspondingly larger and longer spine. The next three vertebrae are slightly smaller, but have actually larger arches. In the ultimate vertebrae the neural arch is slightly open, but the haemal is closed.

Although all the succeeding elements are fused, yet what we must call the proximal part of the urostyle is intrinsically a very distorted but entire vertebra. The widely separated arms of the neural element wave irregularly in midair, and what was a large, lateral foramen in the haemal arch of the preceding vertebra has become enlarged and has broken the haemal arch apart into two pairs of slender, bent processes. Posteriorly there is a short, ventral pair of spines and the dorsal aspect is drawn

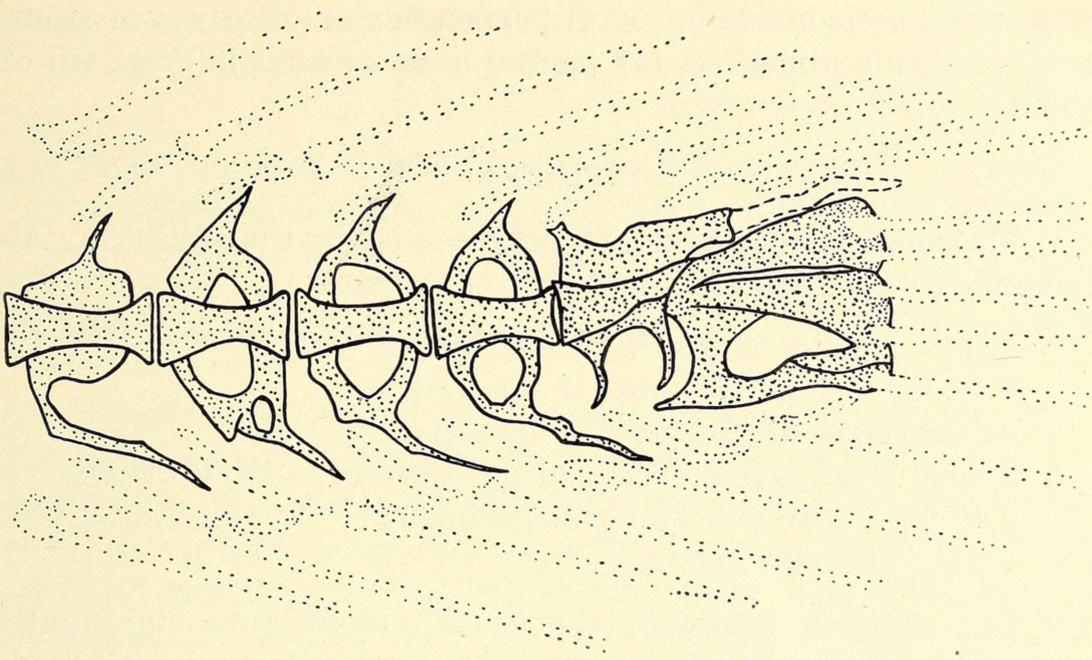


Fig. 33. *Serrivomer beanii.* Posterior part of vertebral column and base of caudal fin in adult female, standard length 405 mm. (x 43).

out into a long, slender projection, longer than the whole main body. This supports a well developed extension of neural arch, completely sheathing the spinal chord. About half way to the end of the vertebral spine, this arch ends, and the naked chord continues to the base of the caudal rays, then bends rather abruptly upward, over the dorsalmost ray and actually out some distance beyond the rounded homogeneous, cartilaginous caudal plate.

The most dorsal, or first, hypural arises at the posterior opening of the urostyle vertebra, extends backwards as a fairly stout rod, and supports two caudal rays. The second hypural at its base is indistinguishable from the first, but soon separates and parallels it to the caudal tip where it, too, supports two rays. The third hypural instead of as usual arising from the separate, antipenult vertebra, originates in the same cartilaginous mass as the two other hypurals. It extends downward and then backward, leaving a large, rounded foramen along its dorsal border. From its end arises the final or fifth caudal ray.

COELOMIC ORGANS: Stomach extending slightly behind anus, black; intestine straight; caeca absent; kidney spotted throughout, ending above anus, suspended below anterior part of gonads; gonads beginning at perpendicular of origin of stomach, extending almost as far behind anus as anus is from tip of snout.

Development

Material: All stages are represented in the collection, although transitional adolescents predominate:

Larvae, 17 to 63 mm.: 15 specimens.
Post-larvae, 54, 59 mm.: 2 specimens.
Adolescents, 61, 90 mm.: 2 specimens.
Transitional Adolescents, 90 to 318 mm.: 133 specimens.
Adults, 400 to 440 mm.: 3 specimens.
Total: 155 specimens.

The division between transitional adolescents and adults is unavoidably arbitrary, as none of our specimens is in breeding condition, and it is unknown whether or not these deep-sea eels breed more than once. In view of the fact that eggs when distinguishable, are all of a size, it seems probable that each individual spawns but a single time. Of the three specimens over 400 mm., it is not likely that any has eggs far enough developed to be deposited the same year. If this is the case, we have of course no fully adult specimens. Nevertheless, it has been found practicable to set off these three much larger and more fully ossified specimens from transitional adolescents. Sex is unquestionably determinable in about 18 specimens, all measuring over 200 mm.; these are without exception females.

Key to the Growth Stages:

A. Body more or less flattened laterally, its height much greater than its thickness and contained not more than 20 times in the length; translucent.
  B. Depth in length 7.8 to 10; vertical fins incomplete; no general pigment.
    C. Larval fangs present; anal origin between 89th and 97th myomere ....*Larva* ("Leptocephalus")
    CC. Larval fangs absent; anal origin between 80th and 25th myomere ....*Post-larva* ("Tilurid A")

BB. Depth in length 15 to 20; vertical fins complete (anal origin about 20th myomere) ; pigment appearing.
Adolescent ("Tilurid B")

AA. Body rounded; slender (depth in length 30 to 80) ; opaque.
D. Gonads developing; pigmentation, ossification and dentition immature in earlier half of stage........................
Transitional Adolescent
DD. Specimens ready for breeding..................................*Adult*

BRIEF SUMMARY OF CHANGES OCCURRING DURING GROWTH[2]: Although the larval stage of *Serrivomer*, as in all eels, is so exceedingly unlike the adult in appearance, and unlike the larvae of other fish both in appearance and in persistence of the stage, yet in all salient points the leptocephalus is a typical larva, with gut pendulous, finfolds present, eye vertically elongate, and the alimentary canal a simple tube. But in two particulars it contrasts strongly with the larvae of other fish: first, the body is compressed to more than flounder-like thinness and is correspondingly deep; and, second, the larval stage persists until the fish has reached a length of 55 or 65 mm. (in the present genus; much more in some other eels), instead of having this period confined to, say, a maximum of 10 mm. of length.

Following this unusual larval stage, however, development is typical of an elongate deep-sea fish, such as a stomiatoid. There is a hasty transformation, during which the most blatant larval characters are swiftly modified into the general appearance of those of the adult: the body becomes rounded and slender, the head is lengthened (contrary to stomiatoid development, where the head is reduced during this early stage), the eye is reduced in size and horizontally instead of vertically elongate, the jaws attenuated, and the fins assume their adult positions—the dorsal and anal actually moving forward along the profiles from their previous cramped location posteriorly, exactly as in the isospondylous *Idiacanthus*. Also the usual brief period of almost complete toothlessness is present, and pigment develops from adolescence onward. As in other fish, this transformation takes place during the post-larval period and that of early

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2 Detailed descriptions beginning on p. 82. See also table, p. 87.

adolescence. During this time growth almost ceases and an actual shrinkage of a few millimeters—not more in this species—probably takes place. Growth is resumed in late adolescence, when the body is losing the last traces of its leptocephalid compression. This period merges into the usual long, transitional adolescence of growth and osteological and gynecological development, commencing when the fish reaches about 90 mm. *Serrivomer,* with its slowly grown teeth and digestive organs, resembles the isospondylous stomiatoids much more closely than it does the digestively precocious *Omosudis* of the Iniomi. The extreme forward development of the snout is, of course, unique, as is the tardily appearing vomerine ridge, which is practically indistinguishable until transitional adolescence, and yet is the distinguishing mark of the genus.

Diagnostic Description of Growth Stages:

Larva: (Figs. 24, A to E incl.; 25, A to E incl.)—Pigment: This is found in two or three areas, the first two present throughout the larval stage, the third tending to disappear in older larvae: 1. An irregular series immediately below the midline, outlining the myomeres, usually several chromatophores to each myomere where they occur, but they are not present on every myomere. Pigment is especially scanty anteriorly; it may even be completely lacking in the anterior two-fifths of the fish. 2. A series of fine dots along the base of the anal fin. 3. A series of 6 larger spots, 3 above and 3 below the tip of the caudal. These usually vanish when the fish reaches a length of 35 or 45 mm..

Proportions: Depth (measured to exclude intestine and fin-folds) moderate, 7.1 to 9.6 in length (10.4% to 13%). Head in length 8.5 to 4.2 (7% to 11.7%), largest in youngest specimens. Eye 38 to 84 in length (2.6% to 1.2%), decreasing in relative size with growth, vertically elongate in young specimens, becoming rounded in the older ones. Snout long, slender, almost or more than equal to distance from posterior margin of eye to pectoral origin; outline at first extremely concave while supraorbital distance is greater than the horizontal diameter of the eye; with growth, the snout loses most of its concavity and the supraorbital distance becomes much reduced, the highest point of the head eventually falling well behind the eye; lower jaw slightly projecting; jaw angle under posterior margin of eye in young specimens, distinctly behind it in old; this is due, however, to the relatively decreased size of the eye, not to a relative increase in the length of the jaw.

Teeth: A pair of long, curved, fang-like larval teeth at tip of both jaws, each tooth followed by from five to eleven slightly smaller, less curved teeth. All of the teeth arise from the outer sides of the jaw cartilages, not from their margins; in the oldest fish, due perhaps to consolidation of the jaw margins, the teeth are closer to the rim than in the younger specimens. In these larger ones, too, the upper teeth are in two groups, the posterior three to five being much smaller than the others. The teeth increase in number until the fish reaches a length of about 35 mm.; just before transformation commences they drop out, until only several are left in each jaw in a transitional specimen of 57 mm.

Fins: Pectoral large, fan-like, without true rays, base enlarged, typically larvoid, becoming reduced in size with growth of fish; anal short, occupying last one-sixth to one-fourth of fish; dorsal considerably longer (up to half again as long) ; rays of both fins undeveloped in smallest specimen; tail and surrounding fin distinctly pointed even in smallest; dorsal finfold persisting throughout the larval stage, from the nape backwards, the finrays elevated upon it; anal finfold similar but starting considerably behind pectoral fin.

Osteology: Figs. 26 and 27 depict the cartilaginous structure of the larval head. At this time, remark will only be made of the complete absence of a supraoccipital, its lack being an important family character.

Coelomic Organs: The alimentary canal bends sharply downward immediately behind the heart and from there backwards is depended from the myomeral body only by delicate membranes and ligaments. Anlagen of the stomach and other digestive organs are distinguishable in the older larvae. The kidney is clearly visible and ends at about the 30th myomere, the urethra proceeding from here to the anus. Gonad rudiments indistinguishable.

Myomeral Count: 154 to 165 myomeres, 89 to 97 in front of anus (89 in smallest specimen; others with 93 to 97).

Shrinking: As the largest larva (63 mm.) has all its teeth intact, while one of only 57 mm. shows but several in each jaw, it is likely that a shrinkage of several millimetres takes place immediately preceding metamorphosis.

Post-larva: (Figs. 24 F, 25 F). During the post-larval and adolescent stages the actual transformation from leptocephalous to anguilliform takes place: the post-larva differs from the larva most obviously in the loss of larval teeth and in the forward migration of the vertical fins, with a corresponding shortening of the intestine and urethra; the depth gradually decreases to almost half that of the larva, while the body becomes slightly but noticeably thickened. The only traces of larval pigment are a few dots scattered along the anal fin; otherwise the fish is completely colorless. The head is in form midway between that of larva and adult: it is relatively longer; all of its parts are lower and the eye smaller than in the larva, the jaws having partially assumed their characteristic slenderness; the larval teeth have entirely disappeared, but very rudimentary permanent teeth are appearing as minute nodules in several rows on maxillary, mandible and vomer. The pectoral has become further reduced and true rays are forming. The dorsal and anal fins move forward very rapidly although actual growth has practically ceased, and in the most advanced post-larvae these vertical fins occupy almost their final positions. In the younger of our two post-larvae (54 mm.) the anus is at the eighty-third myomere, a forward migration of about 14 myomeres since the larval stage; in the older (59 mm.) the anus falls still farther forward, at the seventy-first. Traces only of finfold remain, but the dorsal and anal are still noticeably elevated. The end of the caudal peduncle is abruptly attenuated. The gut is still pendulous, but lies close against the myomeral body. There is no trace of ossification. The post-larval skull differs from that of the larva principally in the reduction in its height and in the extension of the postorbital and opercular regions. Except for the change in dentition, the jaws show relatively little modification.

Adolescent: (Figs. 24 G, H and 25 G, H). In the adolescent the form is semi-leptocephaloid, i.e. there is no mistaking the identity of the fish at a glance, but the body is distinctly flattened and though more slender than in the post-larva is still at least twice as deep as in the adult. Pigment is developing, spreading from the ventral portion of the fish upward, but the end of the tail portion is quite colorless; traces of several larval pigment spots may remain at the base of the anal. The head is almost of adult aspect, relatively larger and lower, the eye decreased nearly to adult proportional size and laterally elongate. The teeth are developing, but those of the vomer are still in several rows throughout, with the future vomerine ridge practically indistinguishable. All five nostrils are evident. The fins are complete, the anus falling at about the twenty-second myomere. Neither dorsal nor anal is any longer elevated on finfolds, but arises directly from the myomeral body. All trace of finfolds is absent. The intestine is completely enclosed. The viscera of the adult are all plain—stomach, pylorus, intestine, liver (very rudimentary), kidney, urethra and thread-like gonads—and all are in their final positions. The stomach barely reaches the level of the anus, however, and is scarcely pigmented. There is no ossification.

Transitional Adolescent: (Figs. 24 I, 25 I). As in most fishes the transitional adolescence is a long period of growth previous to arrival at full breeding condition. As in all eels, however, the changes remaining to be made following adolescence are greater than usual, probably because of the great extent of the metamorphosis, though they differ only in degree from the majority, not in kind. In the early part of the stage the body is at its roundest —even more so than in the full adult, where it becomes secondarily comparatively flattened in the caudal region; pigment develops steadily as well as a characteristic, iridescent, silver, outer coat (fragile and almost absent in a number of specimens). The head remains of the same proportions as in the adolescent, although the body cavity becomes relatively shorter due to the increased length of the caudal peduncle, and the postorbital region develops at the expense of the snout. The teeth attain their full development very late. This is especially true of those on the vomer, as this bone retains extra, small, irregular teeth on each side of the vomerine ridge until the fish has reached a length of about 150 mm. The extra teeth disappear from the posterior part of the vomer forward, the vomerine ridge becoming correspondingly pronounced and high.

In a specimen of 132 mm. the teeth, jaws, ethmo-vomer, hyomandibular and hyoid arch show moderate ossification; the brain-case, first dozen vertebrae, opercles and pectoral girdle a slight amount; and the remainder of the vertebral column, the branchial apparatus, finrays and their supports, and the tail none whatever. In a 250 mm. specimen all of the ossification is much stronger, and only the vertical fins, their supports and the end of the vertebral column are feebly or not at all stained.

The stomach becomes gradually black during this stage and is extended slightly beyond the anus. Sex can be determined in fishes of 200 mm. and over, but the gonads are minute.

RELATIVE PROPORTIONS DURING GROWTH: The table on page 87 shows the change of proportions and appearance of teeth during the development of *Serrivomer beanii.*

ECOLOGY

SEASONAL DISTRIBUTION: Both actually and theoretically *Serrivomer beanii* is most numerous during mid-summer, although it is fairly common throughout the trawling season. The youngest larvae—i.e., several under 30 mm. in length—were taken in June and July, making it probable that at least some spawning takes place in late spring or early summer. Larger larvae, however, were caught straight through from May to September. Successive stages show no correlation with the seasons. (See Table A and B, page 88).

VERTICAL DISTRIBUTION: *Serrivomer beanii* was taken between 50 and 1,000 fathoms, at a mean depth of 606 fathoms. When this average is computed on the theoretical basis of an equal number of nets drawn at each level, however, the mean is brought up to 485 fathoms, as *Serrivomer* was very common in the comparatively few nets drawn above 500 fathoms. Only two specimens, both larvae, were captured above 200 fathoms, but the average depth (727 fathoms) at which all larvae were caught is deeper even than the mean of the transitional adolescents and adults (594 fathoms). The question of the number of these leptocephali which entered the nets on their way to the surface

Growth Stage	Length (mm.)	Pre-anal Myomeres	Post-anal Myomeres	Maximum Depth: Length %	Head: Length %	Eye: Length %	Snout: Length %	Snout-to-Dorsal: Length %	Snout-to-Anal: Length %	Maxillary Teeth	Mandibular Teeth
Larva.....	17	89	69	12.5	11.7	2.6	5.1	-	83	4	5
Larva.....	25	96	60	13						9	7
Larva.....	34	95	?	12.8						8	7
Larva.....	34	93	61	12.6	9	2	4	73	83	11	9
Larva.....	36	97	63	12						10	8
Larva.....	42	95	70	11.6						9	9
Larva.....	43	96	64	11.2	7.8	1.7	3.5	76	83	11	9
Larva.....	46	97	65	10.9						12	10
Larva.....	46	97	62	10.4						12	9
Larva.....	49	96	69	13	7.2	1.4	3.3	76	76	13	11
Larva.....	52	94?	?	12						10	9
Larva.....	56	94	62	11.8						10	8
Larva.....	63	94	69	12.6	7	1.2	2.5	72	79	12	11
Transitional Larva.....	57	97	66	10.6	8	1.2	3.2	69	78	4	1
Post-larva.	59	71	97	11.4	7.4	1.3	3	57	60	True teeth appearing	
Adolescent.	90	22	?	2.4	16	.7	7.8	29	23	True teeth appearing	
Transitional Adolescent.	214	22	?	1.4	15.5	.6	6.7	29	23	Teeth almost complete	
Adult......	440	22	?	3.2	16.6	.8	6.5	31	26	Teeth complete	

is in this case especially important: according to the probability averages, not more than a third of those caught in deep-level nets were caught on the way up. Both small and large larvae were taken at high and low levels. (See Table C). No correlation is shown between depth and season.

Table A. Relation of Growth Stage to Season

	April	May	June	July	Aug.	Sept.	Oct.	Total
Larvae	..	1	5	2	2	5	..	15
Post-larvae	..	..	..	1	..	1	..	2
Adolescent	1	..	1	..	..	..	..	2
Trans. Adolescent	9	30	34	30	13	16	1	133
Adult	..	..	1	..	..	2	..	3
Total	10	31	41	33	15	24	1	155
Theoretical total[3]	68	58	57	49	27	24	26	

Table B. Length of Larvae in Relation to Season

Length	May	June	July	Aug.	Sept.	Total
17-25 mm.	..	..	2	..	..	2
26-35 mm.	1	1	..	..	1	3
36-45 mm.	..	1	..	1	1	3
46-55 mm.	..	1	..	1	2	4
56-63 mm.	..	2	..	..	1	3
Total	1	5	2	2	5	15

Table C.

Growth Stage	*Average Depth*
Larvae	727 F.
Post-larvae	600 F.
Adolescents	550 F.
Transitional Adolescents	589 F.
Adults	800 F.

If the two-foot *Serrivomer*-like fish observed from the Bathysphere between 125 and 250 fathoms actually belonged to this most abundant species, it is evident that the upper level of the swimming range of the adults lies far above that at which they are caught in the nets. In the latter only one small transitional adolescent (140 mm.) was taken as high as 200 fathoms; no specimen of 400 mm. and over was taken above 700 fathoms.

ABUNDANCE: *Serrivomer beanii* is fairly common among the deep-sea fishes of Bermuda, and is taken only slightly more

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[3] Computed on basis of the same number of nets being drawn every month as during September. See ZOOLOGICA, Vol. XVI, No. 1, p. 7.

often than other numerically comparable forms, such as *Idiacanthus fasciola, Bathytroctes rostratus, Bathylagus glacialis* and *Omosudis lowii.* It is far and away the most successful of the deep-sea eels in this locality, its nearest numerical rival in the collection being *Gastrostomus,* of which about 85 specimens have been taken by the Bermuda expeditions (*Serrivomer beanii:* 155 specimens).

SOCIABILITY: Judging from the evidence of both Bathysphere observations and trawling records, *Serrivomer* swims both alone and in company with several other fish of about the same stage of development. In the great majority of nets in which it was taken, *Serrivomer* was solitary, but in 12 per cent. (sixteen) from two to five specimens came up together. In all but two of these cases the fish were transitional adolescents. One of these exceptional nets held two larvae, the other a larva and a transitional adolescent.

FOOD: *Serrivomer* is primarily an eater of fairly large shrimps and euphausiids, although fish of equal size and small crustaceans are occasionally found in the stomachs.

Roule (1934) has developed in detail the theory that deep-sea fishes which seek relatively large prey undergo long resting periods between meals, as the majority of his specimens have proved to have empty stomachs. If this supposition is correct, *Serrivomer* would doubtless be included in the group: The stomachs and intestines of more than 135 transitional adolescents and adults of the present collection were examined, but only 23 or about 16 per cent contained more than the faintest trace of food. Roule draws his principal analogy, however, from the habits of the great snakes on land—reptiles which actually remain quiescent during the "resting period." Judging both from the Bathysphere observations and from rationalization, however, quiescence is impossible in the mid-depths of the ocean, where it seems that the fish must maintain a certain degree of activity all of the time. Judging again from Bathysphere observations, "game" is plentiful, so that in the case of active fish at least, long abstinence is unnecessary. Still again, some fish with the greatest stomach capacity (e.g., *Omosudis* and *Chiasmodon*) are very rarely taken *without* abundant food. And finally, plankton feeders, such as *Cyclothone* and most young fish—which, as Roule says, have a continuous supply of nourishment—are taken with empty stomachs almost as often as are the large predaceous forms. Therefore Roule's conclusion seems very questionable; the answer to the puzzle is probably that digestion takes place with extreme rapidity, at least immediately before and after death, the process being perhaps stimulated by capture.

The food was distributed among the 23 Bermuda specimens as follows:

Stomachs with shrimps or euphausiids	19
Stomach with copepods and *Phronima*-like hyperid	1
Stomach with 70-mm. myctophid	1
Stomach with *Cyclothone signata*	1
Stomach with *Cyclothone microdon*	1

Those of the shrimps which were fairly well preserved were all *Pasiphaea*-like; it is likely that all were either of the same kind or very closely related. None of the remains was definitely euphausian, but it was impossible to refer the poorly preserved material definitely to shrimps. The fish and shrimps were all large compared with the *Serrivomer*, each completely filling, but not greatly distending, a stomach.

In the larval intestines remains of radiolarians were found.

ENEMIES: *Serrivomer* has not been found inside of any animal.

VIABILITY: No Bermuda *Serrivomer* has been brought up alive. The only record I know of one of these eels being seen alive is a *Serrivomer sector* which was caught at 500 fathoms well up in the Gulf of California halfway between Guaymas and Santa Inez Bay. This was on April 8, 1936, at Station 139 T-4 of the Zoological Society's Templeton Crocker Expedition. The eel was a large one, measuring 580 mm. (22 in.) in length. It was very active and lived for more than an hour, snapping at my fingers and swimming with equal ease backward and forward in its aquarium. The iridescent, silvery epidermis was very noticeable.

HABITAT OBSERVATIONS: (See p. 54).

Study Material

The following list gives the catalogue number, net, depth in fathoms, date, length and growth stage of each specimen of *Serrivomer beanii* taken by the Bermuda Oceanographic Expeditions. All were caught in the cylinder of water off the Bermuda coast described in Zoologica, Vol. XVI, No. 1, p. 5, and Vol. XX, No. 1, p. 1. "Trans. Adol." stands for "Transitional Adolescent."

No. 9,548; Net 32; 600 F.; April 24, 1929; 138 mm.; Trans. Adol.
No. 9,567; Net 34; 700 F.; April 24, 1929; 96, 106, 134 mm.; Trans. Adol.
No. 9,705; Net 36; 900 F.; April 24, 1929; 318 mm.; Trans. Adol.
No. 9,597; Net 39; 600 F.; April 25, 1929; 114 mm.; Trans. Adol.
No. 9,652; Net 41; 600 F.; April 25, 1929; 90 mm.; Adolescent
No. 9,697; Net 45; 500 F.; April 25, 1929; 144 mm.; Trans. Adol.
No. 9,656; Net 46; 600 F.; April 29, 1929; 127 mm.; Trans. Adol.
No. 9,648; Net 47; 600 F.; April 29, 1929; 98 mm.; Trans. Adol.
No. 9,878; Net 89; 600 F.; May 10, 1929; 120 mm.; Trans. Adol.
No. 9,928; Net 98; 400 F.; May 14, 1929; 115, 115 mm.; Trans. Adol.
No. 9,954; Net 101; 700 F.; May 14, 1929; 119 mm.; Trans. Adol.
No. 9,955; Net 102; 800 F.; May 14, 1929; 115 mm.; Trans. Adol.
No. 9,985; Net 111; 700 F.; May 16, 1929; 133 mm.; Trans. Adol.
No. 10,123; Net 118; 900 F.; May 18, 1929; 102 mm.; Trans. Adol.
No. 10,138; Net 123; 800 F.; May 25, 1929; 110 mm.; Trans. Adol.
No. 10,152; Net 124; 900 F.; May 25, 1929; 34, 132 mm.; Larva, Trans. Adol
No. 10,175; Net 129; 400 F.; May 27, 1929; 105 mm.; Trans. Adol.
No. 10,183; Net 130; 500 F.; May 27, 1929; 142 mm.; Trans. Adol.
No. 10,319; Net 147; 600 F.; June 1, 1929; 135 mm.; Trans. Adol.
No. 10,350; Net 157; 1,000 F.; June 8, 1929; 120, 132 mm.; Trans. Adol.
No. 10,375; Net 158; 500 F.; June 12, 1929; 138, 141 mm.; Trans. Adol.
No. 10,420; Net 169; 1,000 F.; June 14, 1929; 115, 119 mm.; Trans. Adol.
No. 10,467; Net 170; 500 F.; June 15, 1929; 132 mm.; Trans. Adol.
No. 10,464; Net 174; 900 F.; June 15, 1929; 110 mm.; Trans. Adol.
No. 10,562; Net 184; 700 F.; June 18, 1929; 154 mm.; Trans. Adol.
No. 10,558; Net 185; 900 F.; June 18, 1929; 52, 56 mm.; Larvae
No. 10,559; Net 186; 1,000 F.; June 18, 1929; 42 mm.; Larva
No. 10,596; Net 187; 500 F.; June 19, 1929; 122, 136 mm.; Trans. Adol.
No. 10,683; Net 193; 500 F.; June 20, 1929; 125 mm.; Trans. Adol.
No. 10,753; Net 199; 500 F.; June 21, 1929; 110 mm.; Trans. Adol.
No. 10,754; Net 200; 600 F.; June 21, 1929; 160 mm.; Trans. Adol.
No. 10,757; Net 201; 700 F.; June 21, 1929; 123 mm.; Trans. Adol.
No. 10,755; Net 202; 800 F.; June 21, 1929; 142 mm.; Trans. Adol.
No. 10,875; Net 212; 600 F.; June 24, 1929; 144 mm.; Trans. Adol.
No. 10,876; Net 215; 900 F.; June 24, 1929; 63 mm.; Larva
No. 10,941; Net 217; 500 F.; June 25, 1929; 137 mm.; Trans. Adol.
No. 11,077; Net 233; 600 F.; June 28, 1929; 120 mm.; Trans. Adol.
No. 11,119; Net 240; 700 F.; June 29, 1929; 130 mm.; Trans. Adol.
No. 11,120; Net 241; 800 F.; June 29, 1929; 157 mm.; Trans. Adol.
No. 11,262; Net 254; 500 F.; July 5, 1929; 119 mm.; Trans. Adol.
No. 11,366; Net 271; 1,000 F.; July 8, 1929; 146 mm.; Trans. Adol.
No. 11,444; Net 279; 600 F.; July 10, 1929; 59 mm.; Post-larva
No. 11,705; Net 312; 700 F.; July 22, 1929; 154 mm.; Trans. Adol.
No. 11,913; Net 335; 700 F.; July 29, 1929; 140 mm.; Trans. Adol.
No. 11,984; Net 345; 500 F.; July 31, 1929; 25 mm.; Larva
No. 12,107; Net 355; 600 F.; Aug. 8, 1929; 123, 152, 162 mm.; Trans. Adol.

No. 12,167; Net 361; 500 F.; Aug. 10, 1929; 128, 129 mm.; Trans. Adol.
No. 12,174; Net 363; 1,000 F.; Aug. 10, 1929; 43 mm.; Larva
No. 12,284; Net 368; 700 F.; Aug. 14, 1929; 150 mm.; Trans. Adol.
No. 12,283; Net 371; 1,000 F.; Aug. 14, 1929; 200 mm.; Trans. Adol.
No. 12,500; Net 388; 900 F.; Aug. 17, 1929; 228 mm.; Trans. Adol.
No. 12,827; Net 399; 900 F.; Aug. 31, 1929; 49 mm.; Larva
No. 13,036; Net 416; 500 F.; Sept. 4, 1929; 138 mm.; Trans. Adol.
No. 13,073; Net 420; 900 F.; Sept. 4, 1929; 46 mm.; Larva
No. 13,134; Net 428; 1,000 F.; Sept. 5, 1929; 405 mm.; Adult
No. 13,163; Net 431; 600 F.; Sept. 6, 1929; 54 mm.; Post-larva
No. 13,237; Net 442; 1,000 F.; Sept. 7, 1929; 151 mm.; Trans. Adol.
No. 13,380; Net 453; 600 F.; Sept. 10, 1929; 123 mm.; Trans. Adol.
No. 14,418; Net 459; 400 F.; Sept. 12, 1929; 149 mm.; Trans. Adol.
No. 14,741; Net 539; 600 F.; May 6, 1930; 111, 133 mm.; Trans. Adol.
No. 14,779; Net 546; 1,000 F.; May 7 1930; 119 mm.; Trans. Adol.
No. 14,871; Net 562; 500 F.; May 10, 1930; 122 mm.; Trans. Adol.
No. 14,844; Net 563; 600 F.; May 10, 1930; 117 mm.; Trans. Adol.
No. 14,886; Net 567; 700 F.; May 12, 1930; 126 mm.; Trans. Adol.
No. 14,967; Net 573; 400 F.; May 14, 1930; 182 mm.; Trans. Adol.
No. 15,030; Net 580; 400 F.; May 15, 1930; 150 mm.; Trans. Adol.
No. 15,002; Net 583; 700 F.; May 15, 1930; 167 mm.; Trans. Adol.
No. 15,040; Net 587; 500 F.; May 17, 1930; 127 mm.; Trans. Adol.
No. 15,056; Net 588; 600 F.; May 17, 1930; 132 mm.; Trans. Adol.
No. 15,101; Net 594; 400 F.; May 19, 1930; 125 mm.; Trans. Adol.
No. 15,132; Net 595; 500 F.; May 19, 1930; 130 mm.; Trans. Adol.
No. 15,160; Net 604; 400 F.; May 20, 1930; 140 mm.; Trans. Adol.
No. 15,283; Net 619; 500 F.; May 22, 1930; 126 mm.; Trans. Adol.
No. 15,341; Net 626; 500 F.; May 23, 1930; 115 mm.; Trans. Adol.
No. 15,403; Net 631; 400 F.; May 26, 1930; 132 mm.; Trans. Adol.
No. 15,470; Net 637; 500 F.; May 28, 1930; 119 mm.; Trans. Adol.
No. 15,458; Net 639; 700 F.; May 28, 1930; 250 mm.; Trans. Adol.
No. 15,618; Net 657; 700 F.; June 2, 1930; 120 mm.; Trans. Adol.
No. 15,773; Net 684;1,000 F.; June 7, 1930; 130 mm.; Trans. Adol.
No. 15,823; Net 685; 700 F.; June 9, 1930; 125 mm.; Trans. Adol.
No. 16,101; Net 713; 700 F.; June 17, 1930; 400 mm.; Adult
No. 16,536; Net 762; 1,000 F.; July 2, 1930; 146 mm.; Trans. Adol.
No. 16,593; Net 765; 500 F.; July 3, 1930; 200 mm.; Trans. Adol.
No. 16,727; Net 776; 500 F.; July 5, 1930; 110, 140, 150 mm.; Trans. Adol.
No. 16,779; Net 784; 500 F.; July 7, 1930; 185 mm.; Trans. Adol.
No. 16,954; Net 796; 1,000 F.; July 9, 1930; 270 mm.; Trans. Adol.
No. 17,518; Net 823; 700 F.; Sept. 1, 1930; 440 mm.; Adult.
No. 17,760; Net 835; 500 F.; Sept. 3, 1930; 140 mm.; Trans. Adol.
No. 17,818; Net 842; 600 F.; Sept. 4, 1930; 148 mm.; Trans. Adol.
No. 19,246; Net 933; 600 F.; Sept. 23, 1930; 126 mm.; Trans. Adol.
No. 19,352; Net 944; 400 F.; Sept. 25, 1930; 135 mm.; Trans. Adol.
No. 19,566; Net 966; 400 F.; Sept. 30, 1930; 144 mm.; Trans. Adol.
No. 19,974; Net 967; 500 F.; Sept. 30, 1930; 202 mm.; Trans. Adol.
No. 20,515; Net 983; 500 F.; June 2, 1931; 61 mm.; Adolescent
No. 20,637; Net 994; 900 F.; June 4, 1931; 110 mm.; Trans. Adol.
No. 20,647; Net 996; 400 F.; June 5, 1931; 110 mm.; Trans. Adol.
No. 20,746; Net 1,005; 700 F.; June 6, 1931; 130 mm.; Trans. Adol.
No. 20,747; Net 1,006; 800 F.; June 6, 1931; 160 mm.; Trans. Adol.
No. 20,857; Net 1,014; 500 F.; June 13, 1931; 128 mm.; Trans. Adol.
No. 20,935; Net 1,030; 200 F.; June 22, 1931; 140 mm.; Trans. Adol.
No. 20,976; Net 1,037; 300 F.; June 25, 1931; 120 mm.; Trans. Adol.
No. 21,021; Net 1,042; 100 F.; June 26, 1931; 27 mm,; Larva
No. 21,018; Net 1,043; 300 F.; June 26, 1931; 115 mm.; Trans. Adol.
No. 21,115; Net 1,048; 300 F.; June 27, 1931; 214 mm.; Trans. Adol.

No. 21,116; Net 1,052; 300 F.; July 6, 1931; 120, 135, 135 mm.; Trans. Adol.
No. 21,153; Net 1,058; 300 F.; July 7, 1931; 110 mm.; Trans. Adol.
No. 21,222; Net 1,067; 300 F.; July 9, 1931; 120, 125 mm.; Trans. Adol.
No. 21,269; Net 1,072; 300 F.; July 10, 1931; 206 mm.; Trans. Adol.
No. 21,270; Net 1,073; 300 F.; July 10, 1931; 110, 120, 125, 130, 147 mm.; Trans. Adol.
No. 21,325; Net 1,078; 300 F.; July 11, 1931; 120 mm.; Trans. Adol.
No. 22,114; Net 1,097; 700 F.; July 24, 1931; 17 mm.; Larva
No. 21,539; Net 1,101; 400 F.; July 25, 1931; 130, 136 mm.; Trans. Adol.
No. 21,549; Net 1,103; 600 F.; July 25, 1931; 147 mm.; Trans. Adol.
No. 21,625; Net 1,110; 600 F.; July 27, 1931; 216 mm.; Trans. Adol.
No. 21,634; Net 1,112; 900 F.; July 27, 1931; 136 mm.; Trans. Adol.
No. 21,693; Net 1,114; 400 F.; July 29, 1931; 150 mm.; Trans. Adol.
No. 21,983; Net 1,137; 600 F.; Aug. 6, 1931; 245 mm.; Trans. Adol.
No. 21,952; Net 1,139; 700 F.; Aug. 6, 1931; 125 mm.; Trans. Adol.
No. 22,498; Net 1,189; 700 F.; Aug. 17, 1931; 142 mm.; Trans. Adol.
No. 22,962; Net 1,241; 500 F.; Aug. 31, 1931; 127 mm.; Trans. Adol.
No. 23,038; Net 1,243; 700 F.; Aug. 31, 1931; 150 mm.; Trans. Adol.
No. 23,044; Net 1,248; 600 F.; Sept. 1, 1931; 195 mm.; Trans. Adol.
No. 23,079; Net 1,258; 900 F.; Sept. 3, 1931; 34 mm.; Larva
No. 23,140; Net 1,265; 1,000 F.; Sept. 4, 1931; 36 mm.; Larva
No. 23,209; Net 1,276; 500 F.; Sept. 9, 1931; 150 mm.; Trans. Adol.
No. 23,308; Net 1,291; 600 F.; Sept. 12, 1931; 125 mm.; Trans. Adol.
No. 23,397; Net 1,296; 600 F.; Sept. 14, 1931; 110 mm.; Trans. Adol.
No. 23,377; Net 1,300; 1,000 F.; Sept. 14, 1931; 155 mm.; Trans. Adol.
No. 23,455; Net 1,301; 50 F.; Sept. 15, 1931; 46 mm.; Larva
No. 23,549; Net 1,311; 300 F.; Sept. 16, 1931; 57 mm.; Larva
No. 23,577; Net 1,316; 800 F.; Sept. 17, 1931; 130 mm.; Trans. Adol.
No. 23,955; Net 1,339; 700 F.; Oct. 29, 1931; 177 mm.; Trans. Adol.

Serrivomer brevidentatus Roule and Bertin 1929

Specimens Taken by the Bermuda Oceanographic Expeditions

7 specimens: May to October, 1930 and 1931; 500 to 800 fathoms; from a cylinder of water 8 miles in diameter (5 to 13 miles south of Nonsuch Island, Bermuda), the center of which is at 32° 12′ N. Lat., 64° 36′ W. Long.; Standard lengths from 73 to 512 mm.

Description of Adult
(Figs. 34, 35 C, 36 C).

Color: Black, with a fragile coating of silver skin, which, when fresh, gives off a high bronzy iridescence.

Proportions (from the 512 mm. Bermuda specimen): Depth in length 30; head in length 5.8; eye (horizontal) in head 17; eye is horizontally elongate; maxillary reaching well beyond vertical from posterior margin of eye; snout in head 2.9; snout to dorsal in length 3; snout to anal in length 3.6.

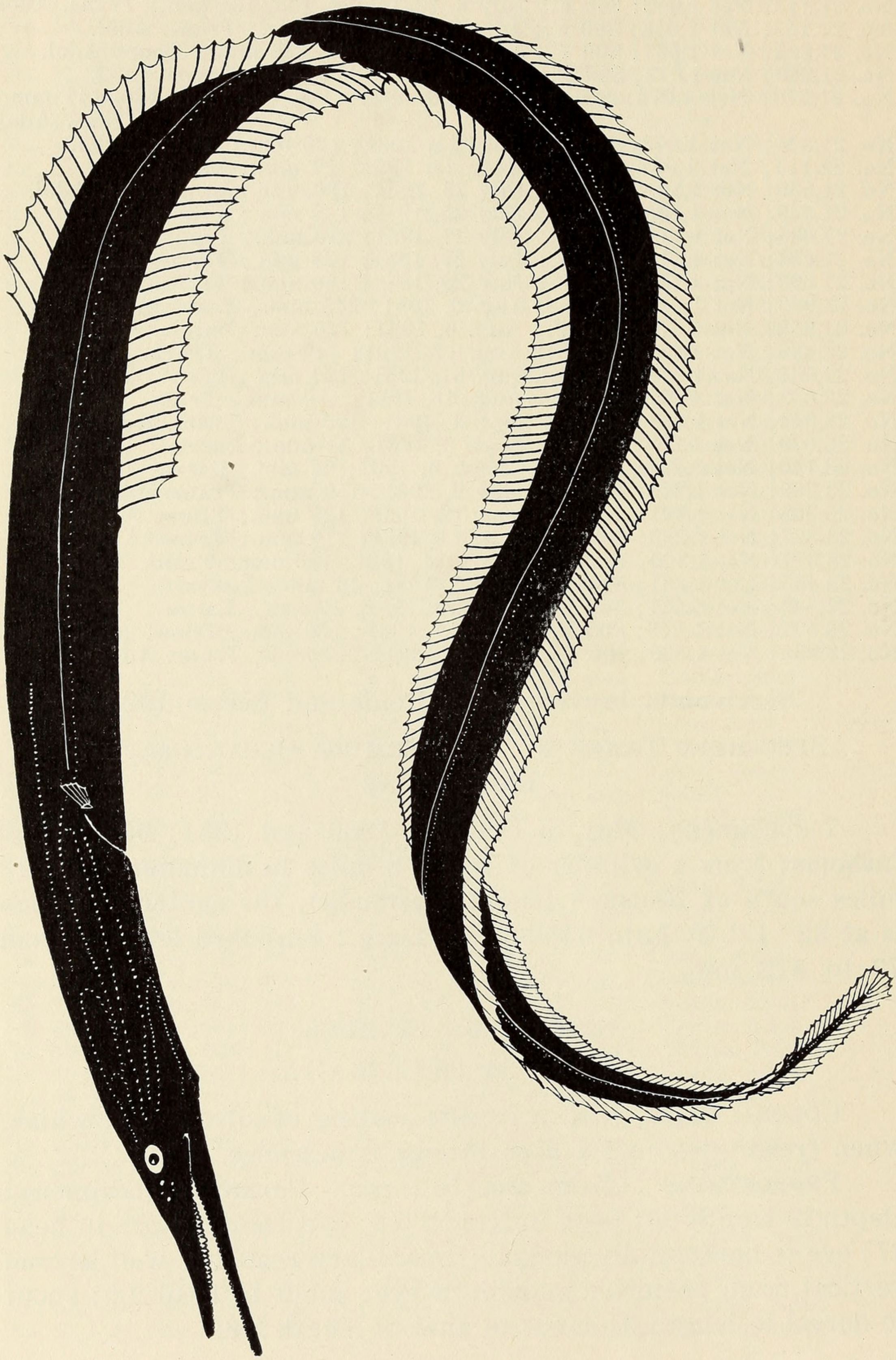


Fig. 34. *Serrivomer brevidentatus.* (x .7). *The pores indicated by the tiny white dots were visible only in the fresh, adult specimen.*

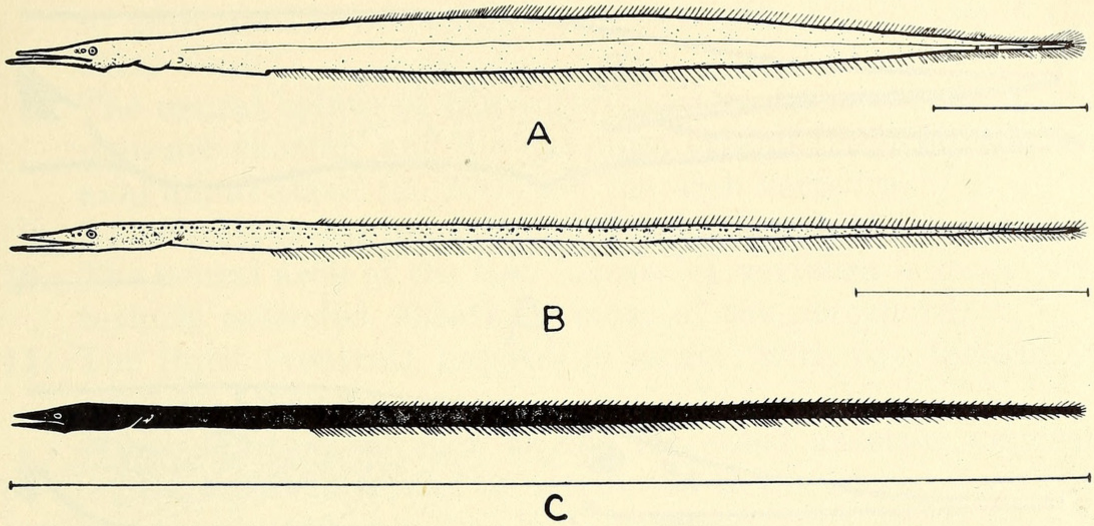


Fig. 35. *Serrivomer brevidentatus.* A, adolescent, 73 mm.; B, transitional adolescent, 110 mm.; C, adult, 512 mm.

TEETH: The dentition has been described in detail on p. 58.

FINS: Pectoral rays 6 or 7, very delicate, equal in length to horizontal diameter of eye, inserted at upper angle of branchial cleft. Dorsal rays 160 to 181, commencing well behind the anal origin, above 13th anal rays, at a distance 1.3 times the post-orbital length of the head. Anal rays 159 to 173, longer than those of dorsal. The rays of both fins are longest, and the spaces between successive rays greatest, in the anterior halves, behind the first 10 or 15 rays. Caudal rays 5 or 6, scarcely distinguishable from those of dorsal and anal, with which the caudal fin is confluent.

VERTEBRAE: Largest Bermuda specimen, 151; figures given by Roule & Bertin, 1929, 143-155; figure given by Trewavas, 1932, 171.

BRANCHIOSTEGALS: 7 to 8.

OSTEOLOGY: (Figs. 37-40). The skeleton of *S. brevidentatus* is exactly similar to that of *S. beanii* except for the following characteristics:

1. The ethmo-vomer is shorter and more slender.
2. The preopercle is less extensive.
3. The opercle is quadrilateral, with rounded corners, not triangular, and the closely applied subopercle consequently does not elbow sharply.
4. The proximal ends of the first five branchiostegal rays do

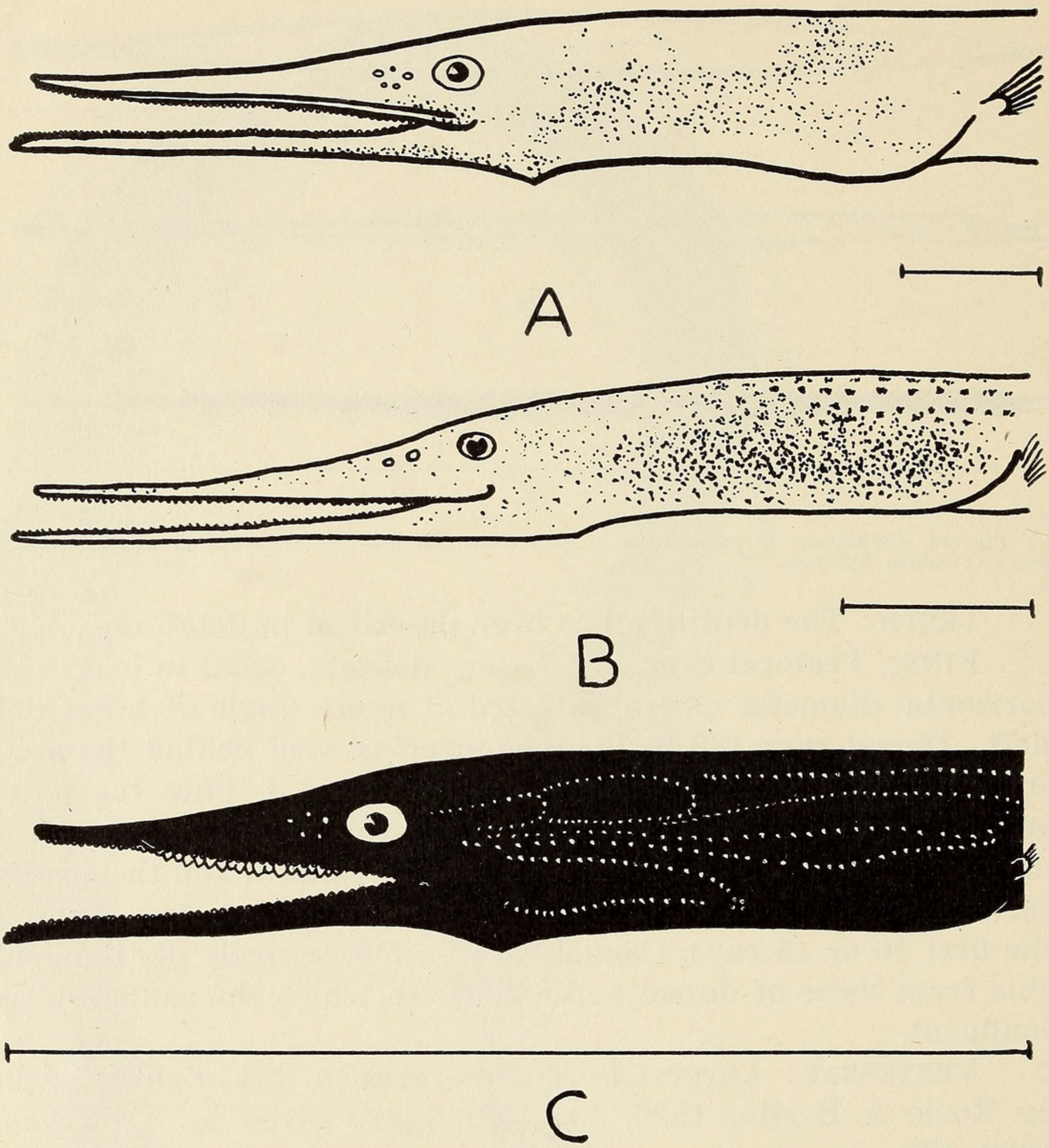


Fig. 36. *Serrivomer brevidentatus.* A, adolescent, standard length 73 mm.; B, transitional adolescent, 110 mm.; C, adult, 512 mm.

not project beyond the antero-dorsal margin of the hyoid arch.

5. There is only one basibranchial, not two.
6. The coracoids are more rudimentary, showing no connection with either cleithrum or finrays.
7. The dorsal origin is at the level of the 32nd to 34th (the latter figure according to Trewavas, *loc. cit.*, p. 651) vertebra, not at about the 27th, and that of the anal at the 25th

to 26th (latter according to Trewavas), not at about the 21st.

8. The neural spines of the anterior part of the vertebral column are shorter, and die out close behind the origin of the anal fin, at about the 29th, not the 38th vertebra.
9. Epineurals are present on 14 vertebrae, not 11.
10. The neural arch of the last (urostyle) vertebra is more posteriorly extended, sheathing more of the notochord.
11. The third (ventral) hypural is larger, with two instead of only one foramina.

Minor differences, such as the increased anterior expanse of the hyomandibular, may be attributed to the larger size (512 mm.) of the stained specimen of *S. brevidentatus*; as the largest *S. beanii* measures only 440 mm. To the same cause is probably due the relatively larger ethmovomer and sphenotic of the Bermuda *S. brevidentatus* when compared with Trewavas's 160 mm. stained specimen of the same species (*loc. cit.*, Pl. III).

DIGESTIVE and REPRODUCTIVE SYSTEMS: (Figs. 41, 42). These seem identical with those of *S. beanii.* The 512 mm. stained specimen was a female with the eggs poorly developed.

DEVELOPMENT

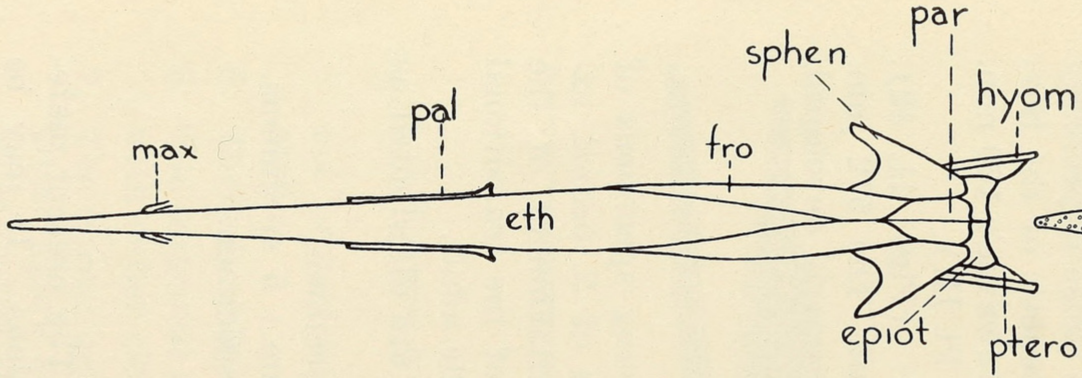
No differences are apparent between young specimens of *S. brevidentatus* and corresponding examples of *S. beanii,* except for the diagnostic character of the attachment of the branchiostegal rays. (p. 58). At least three of the transitional adolescents were females, as well as the single adult.

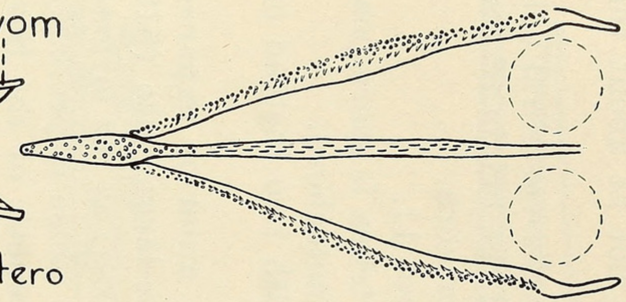
The seven specimens of *S. brevidentatus* are distributed as follows among the growth stages:

Adolescent, 73 mm.: 1 specimen.
Transitional Adolescents, 110 to 280 mm.: 5 specimens.
Adult, 512 mm.: 1 specimen.

ECOLOGY

SEASONAL and VERTICAL DISTRIBUTION: The present material is too scanty for any general conclusions. It may be





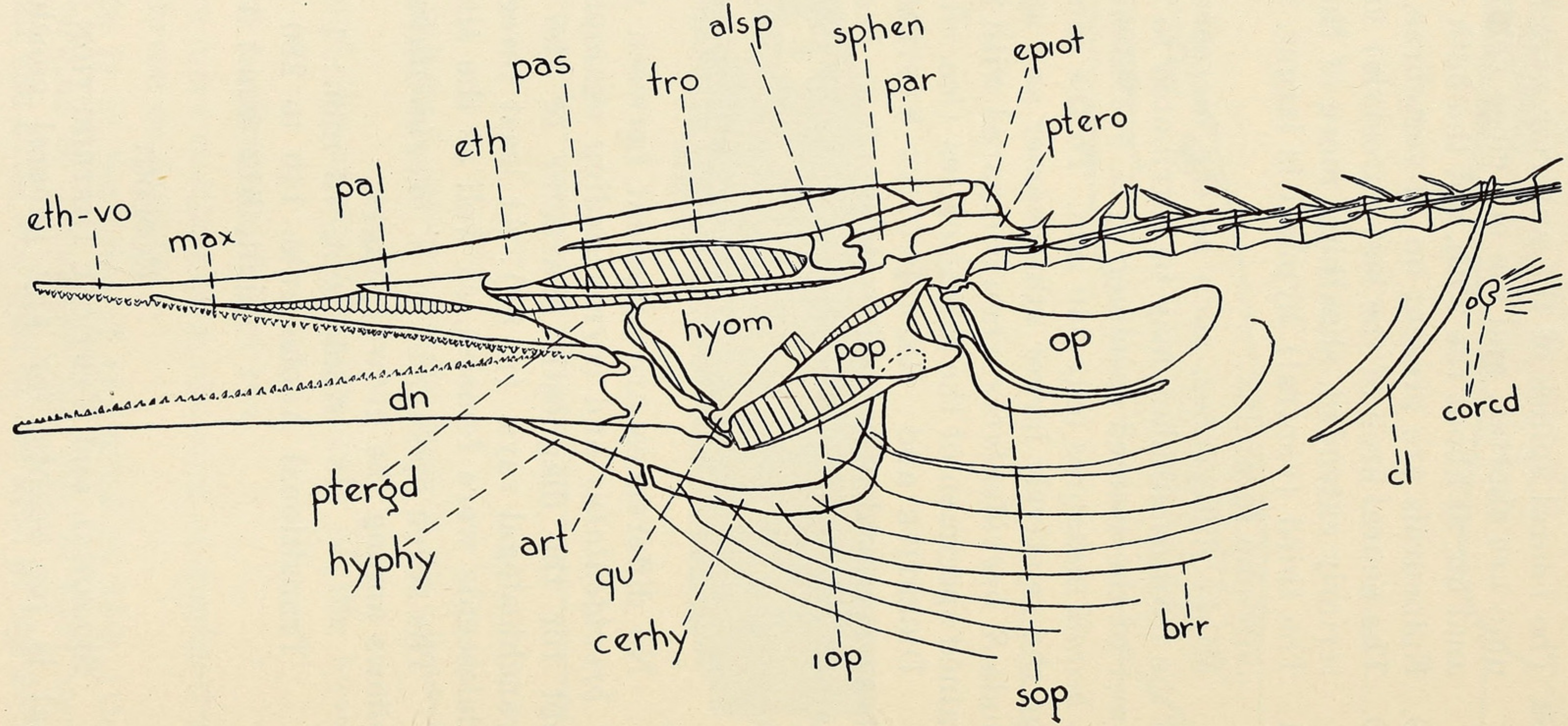


Fig. 37. (upper left). *Serrivomer brevidentatus.* Skull of adult, dorsal view; standard length 512 mm. (x 1.7).
Fig. 38. (upper right). Same, teeth of upper jaw and vomer, ventral view. (x 1.7).
Fig. 39. (lower). Same, bones of head, pectoral girdle and anterior part of vertebral column, lateral view. (x 1.7).

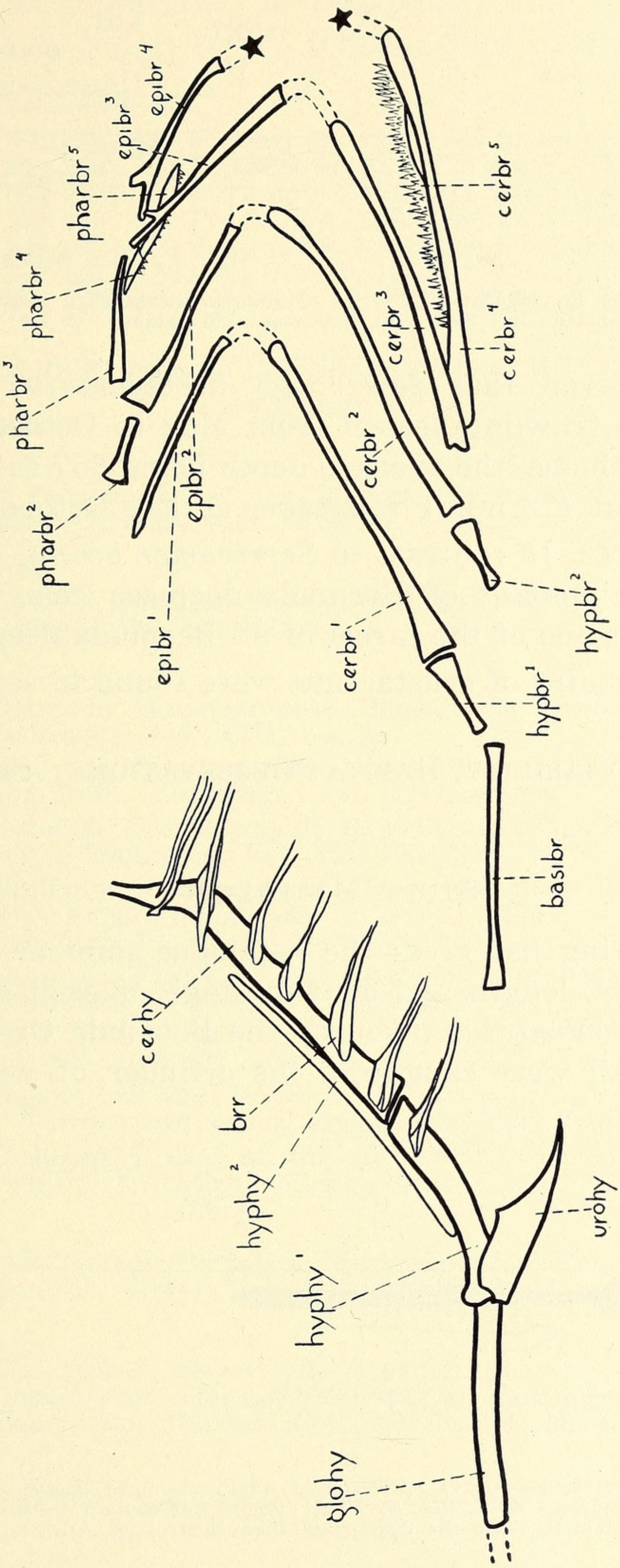


Fig. 40. ***Serrivomer brevidentatus.*** **Hyoid and branchial apparatus of adult, standard length 512 mm. (x 2.3).**

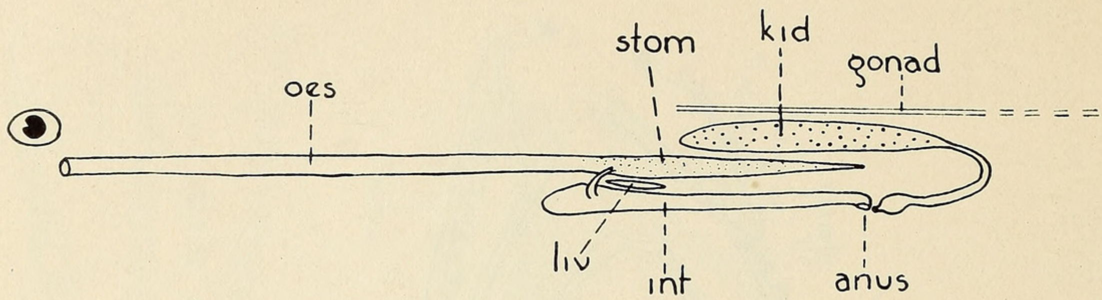


Fig. 41. *Serrivomer brevidentatus.* Viscera of adolescent, standard length 73 mm.; oes: oesophagus; stom: stomach; liv: liver; int. intestine; kid: kidney. (x 8.6).

remarked, however, that *Serrivomer brevidentatus* was taken throughout the trawling season from May to October, between 500 and 800 fathoms, the average depth being 657 fathoms. The single adolescent (73 mm.) was taken in late October.

ABUNDANCE: In contrast to *Serrivomer beanii,* which is by far the most abundant of Bermuda deep-sea eels, *Serrivomer brevidentatus* is one of the rarest of all Bermuda deep-sea fishes.

FOOD: Remains of crustaceans were found in several of the stomachs.

ENEMIES, VIABILITY, HABITAT OBSERVATIONS: See *S. beanii,* p. 90.

STUDY MATERIAL

The following list gives the catalogue number, net, depth in fathoms, date, length and growth stage of each specimen of *Serrivomer brevidentatus* taken by the Bermuda Oceanographic Expeditions. All were caught in the cylinder of water off the

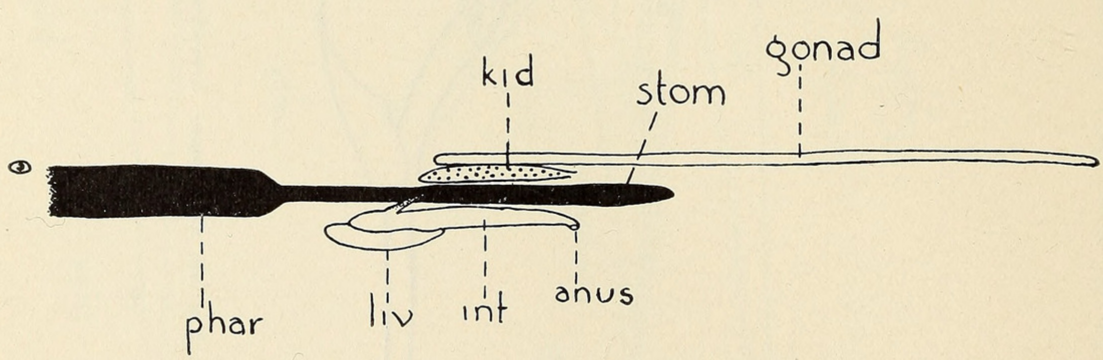


Fig. 42. *Serrivomer brevidentatus.* Viscera of adult, standard length 512 mm.; phar: pharynx; other abbreviations as in Fig. 41. The kidneys and gonads were slightly damaged so that it was impossible to trace the courses of their ducts. (x .5).

Bermuda coast described in ZOOLOGICA, Vol. XVI, No. 1, p. 5., and Vol. XX, No. 1, p. 1. "Trans. Adol." stands for "Transitional Adolescent."

No. 15,211; Net 612; 600 F.; May 21, 1930; 157 mm.; Trans. Adol.
No. 16,956; Net 778; 700 F.; July 5, 1930; 220 mm.; Trans. Adol.
No. 16,962; Net 793; 700 F.; July 9, 1930; 512 mm.; Adult
No. 18,071; Net 860; 600 F.; Sept. 8, 1930; 280 mm.; Trans. Adol.
No. 20,605; Net 992; 700 F.; June 4, 1931; 265 mm.; Trans. Adol.
No. 23,930; Net 1,336; 500 F.; Oct. 29, 1931; 110 mm.; Trans. Adol.
No. 23,962; Net 1,340; 800 F.; Oct. 29, 1931; 73 mm.; Adolescent.

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