DISTRIBUTION AND VARIATION OF *BRANCHIOSTOMA CARIBAEUM* IN MISSISSIPPI SOUND

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Reprinted from
TULANE STUDIES IN ZOOLOGY
Vol. 9, No. 5, pp. 245-257
April 16, 1962

DISTRIBUTION AND VARIATION OF *BRANCHIOST OMA CARIBAEUM* IN MISSISSIPPI SOUND

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The only lancelet known from the Gulf of Mexico is *Branchiostoma caribaeum* Sundevall. The first account of *Branchiostoma* in the Gulf was made by Garman *(in* Kingsley, 1885, p. 64), who mentioned "Specimens at hand from the Gulf of Mexico . . ." but gave no precise location. The first account of a collection from a specific locality in the Gulf was that of Wright (1890), who took lancelets from Tampa Bay, Florida. Adams and Kendall (1891) reported several in dredges at two stations made by the schooner *Grampus* off Cape Romano and Sanibel, Florida. Andrews (1893) recorded additional material from Tampa Bay. Evermann and Kendall (1900) extended the distribution to the Snapper Banks off Pensacola. Large numbers of Gulf lancelets were unknown until Wells (1926) collected some 5,000 on the west coast of Florida. Fowler (1941, 1945) listed a total of 14 specimens in three collections from Sanibel, Florida, and Longley and Hildebrand (1941) reported three near Tortugas. Hutton *et al. (1956)* took 63 specimens in Boca Ciega Bay and Springer and Woodburn (1960) caught 3 in Tampa Bay at salinities ranging from 24.8 to 25.5. Baughman (1950) recorded lancelets from Texas collected by T. E. Pulley, the first known west of Pensacola, Florida. Subsequent small Texas collections were reported by Gunter and Knapp (1951) and by Hoese (1958). Hefley and Shoemaker (1952) took lancelets from Mississippi and Louisiana, and Boschung and Mallory (1956) found them in Alabama. Dawson (1961) also collected lancelets in Louisiana.

Up to the present, amphioxus has been reported in large numbers on the beaches of West Florida, but the literature indicates that its distribution on the northern Gulf is spotty and thin. Statements in the literature also generally indicate that this little animal is most abundant on pure sand bottom. However, it seems to be uncommon along that thousand miles of sand beach between Sabine Pass and Tampico, possibly because of the fine, packed sand.

DISTRIBUTION AND ABUNDANCE IN MISSISSIPPI WATERS

Investigations on amphioxus were begun at the Gulf Coast Research Laboratory several years ago (Cf. Hefley and Shoemaker, 1952), but were carried on in a more or less disorganized manner by class and student groups digging for the animals around the shores of the offshore islands, where they are taken every summer. In some cases a thousand and more specimens have been taken by a student group.

In the spring of 1960, the Pan American Petroleum Company sent a research team to Ocean Springs which worked out of the Laboratory and made several hundred corings of Mississippi Sound and adjacent Gulf bottoms. Samples were also taken with a modified Petersen grab. Samples covering one-eighth of a square meter were collected and it was soon noted that *Branchiostoma* was being taken. Figure 1 shows the map of these samplings with the *Branchiostoma* catches distinguished by the large closed circles. The Pan American data give some quantitative information on the numbers and abundance of lancelets which is of considerable interest because such information is lacking in the literature. The figures are minimal because the geologists were not searching for lancelets. They gathered what they could when the Petersen grab was

[1] The first author was enabled to work on this problem through a grant of the National Science Foundation to the Gulf Coast Research Laboratory.

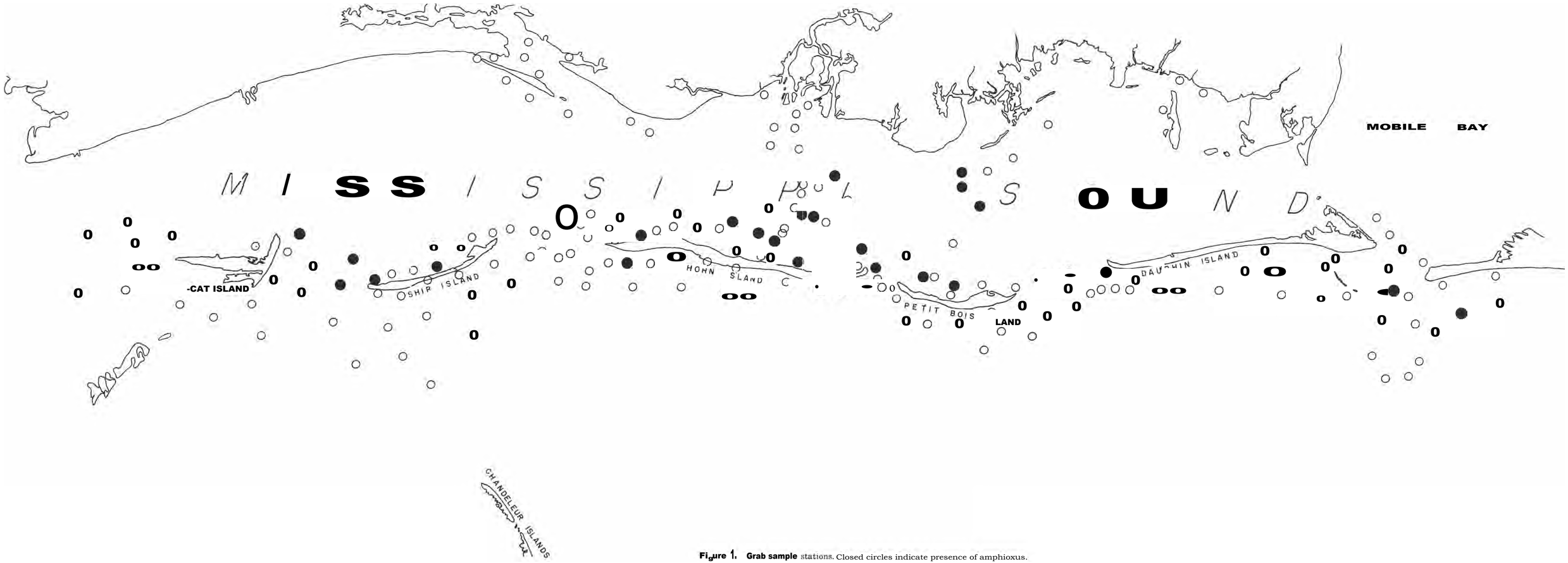
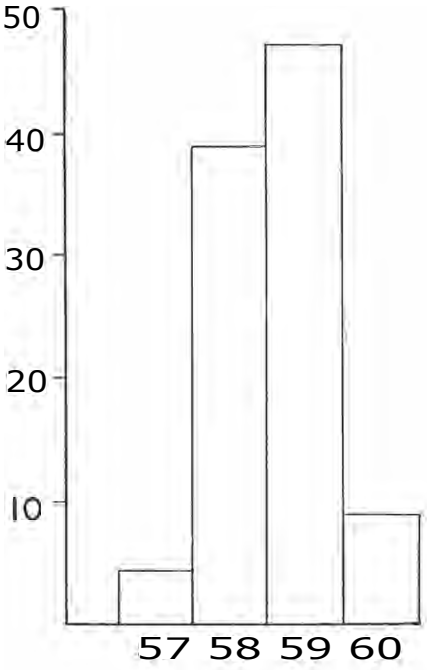
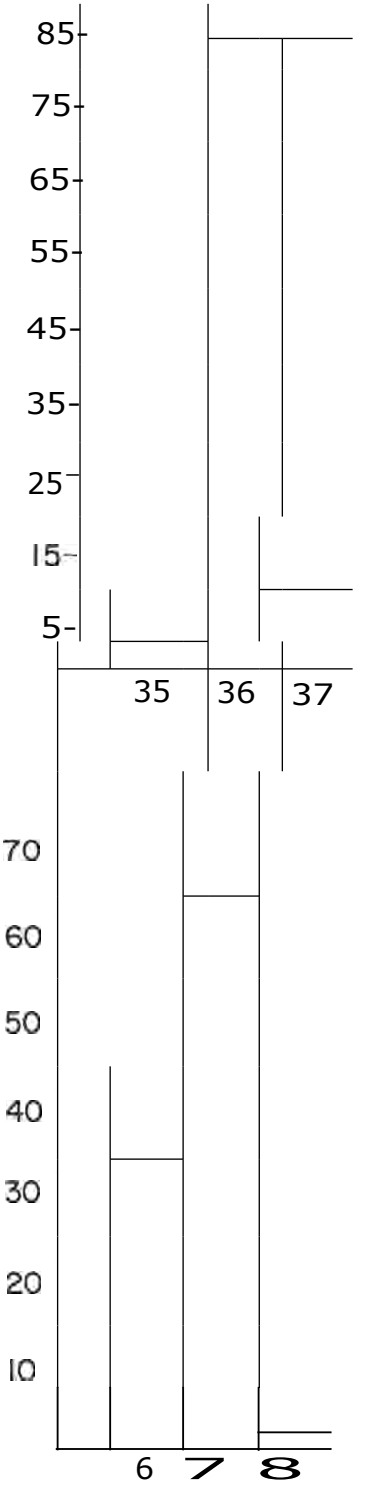
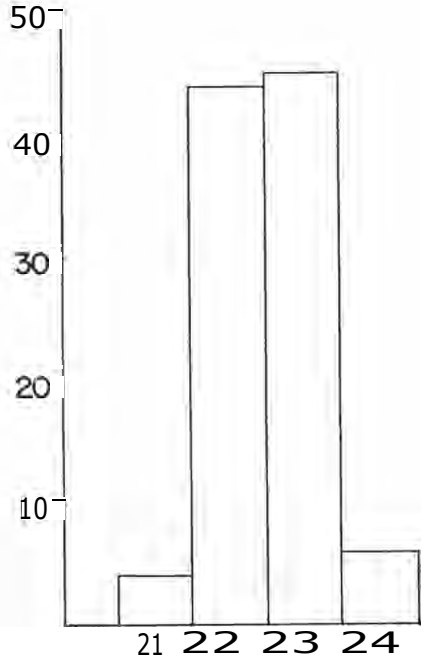


Figure 1. **Grab sample** stations. Closed circles indicate presence of amphioxus.







Figures 2-5. Mississippi lancelets. 2. (top left) Frequency distribution of total myotomes. 3. (top right) Frequency distribution of preatriopore myotomes. 4. (bottom left) Frequency distribution of postatriopore myotomes. 5. (bottom right) Frequency distribution of postanal myotomes.

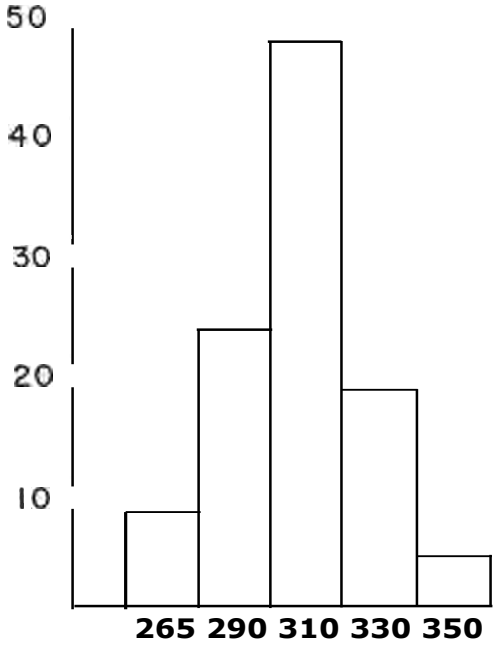


Figure 8. Frequency distribution of dorsal fin-ray chambers of Mississippi lancelets.

the known range of myotomes for *caribaeum* (including *floridae* and *virginiae)* is 57 to 64. The range of total myotomes of *platae* (55 to 65, Samaya and Carvalho, 1950) encompasses the range of *caribaeum* and broadly overlaps that of *bermudae (Fig. 7).* The myotome count of our study material as well as other *caribaeum* reported in the literature overlaps *bermudae* by only one; however, the variation of all *caribaeum* reported in the literature is great enough to encompass the range known for *haekelii* and *minucauda* and overlaps that of *bazarutense* and *belcher* as well as *bermudae.*

Fins,—The number of dorsal fin-ray chambers varied from 252-359, with 84 per cent of the specimens possessing 281-330 chambers (Fig. 8). Bigelow and Farfante (1948) gave a minimum count of 227 chambers for specimens from Puerto Rico and a maximum count of 330 for specimens from Florida. Thus, the now known range of dorsal fin-ray chambers in *caribaeum* is 227 to 359, giving a variation of 133 chambers for the species. However, the variation of 108 chambers in the Mississippi Sound lancelets is unparalleled by any known population of *Branchiostoma.* The dorsal fin-ray chamber variation of *caribaeum* narrowly overlaps that of *bermudae* and encompasses that of *platae* (Fig. 9).

The preanal (ventral) fin-ray chambers varied from 35 to 61, with 81 per cent of the specimens possessing 41 to 55 (Fig. 10). Previously reported low and high counts for *caribaeum* were 15 and 18 for specimens from Puerto Rico and Florida respectively to 42 for those from Virginia and North Carolina (Bigelow and Farfante, 1948). The number of preanal fin-ray chambers in *caribaeum* is now known to vary from 15 to 61, giving a variation of 47 chambers for the species. The preanal fin-ray chamber variation of *caribaeum* overlaps well that known of *bermudae* and encompasses that of *platae (Fig.* 11). The ventral fin-ray chambers become progressively smaller towards the anus and are difficult to see in opaque specimens.

The caudal fin varied in shape, and several selected from the study material are shown in Figure 12. No attempt to categorize shapes was made since there is no sharp line of demarcation between the types studied. Caudal fin A shows the upper lobe

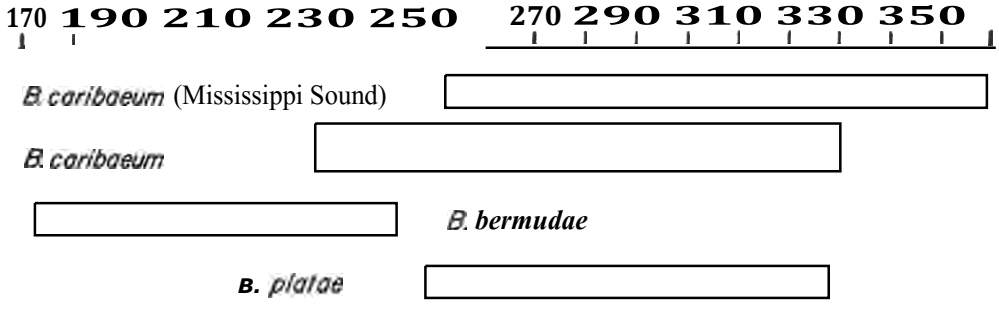
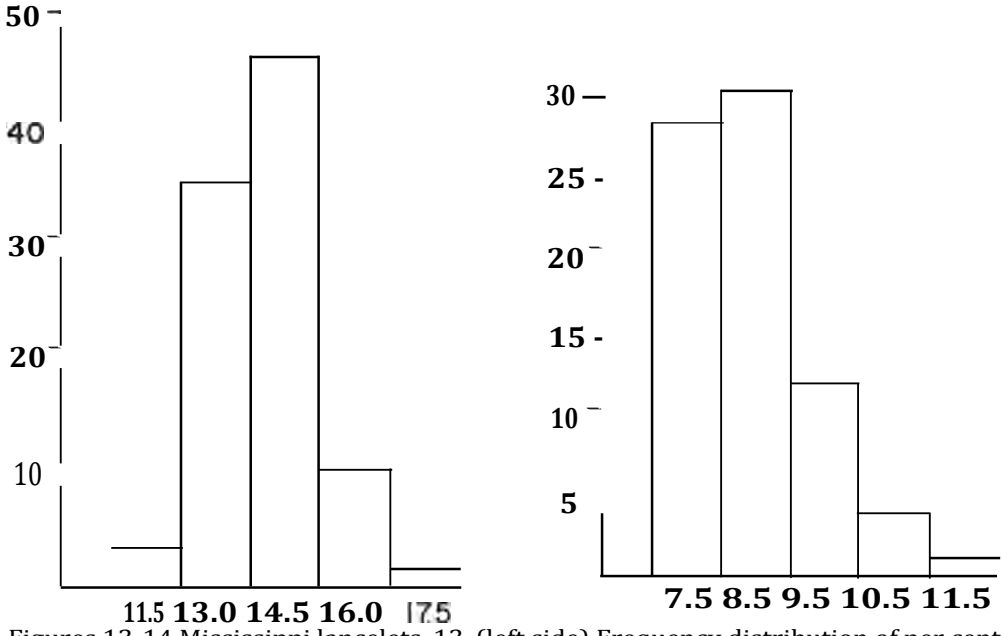


Figure 9. The range of numbers of dorsal fin-ray chambers of Mississippi specimens compared with other western Atlantic lancelets.



Figures 13-14 Mississippi lancelets. 13. (left side) Frequency distribution of per cent caudal fin length of total body length. 14. (right side) Frequency distribution of per cent body depth of total length.

(Fig. 14). The postatriopore length varied from 27.4 to 32.4 per cent of the total length, 61 per cent falling into the 29 to 30 per cent class (Fig. 15). Both the depth and postatriopore length are more or less directly proportional to total length (Figs. 16 and *17).*

The dorsal fin-ray chamber height-breadth ratio is quite variable, the height being from 3 to 5 times the breadth. These limits are equal to those of *bermudae* and overlap those of *platae.* The height of the dorsal fin is contained in the body depth (at deepest point) from 6 to 10 times. There is no correlation of number of dorsal fin-ray chambers and total length. In fact, two relatively small specimens measuring 19.4 and 20.8 mm. in total length possessed 252 and 359 dorsal chambers, respectively. Although the fin-ray chamber measurements were made with an ocular micrometer, we consider the measurements not too reliable since such measurements are affected by the opaqueness of the specimen. Other workers have used this characteristic but we feel that it is not of much value.

The position of the anus varies within the genus *Branchiostoma* from in advance of the center of the caudal lobe to far behind the center. Previous writers have stated that in *caribaeum* the anus is near the center

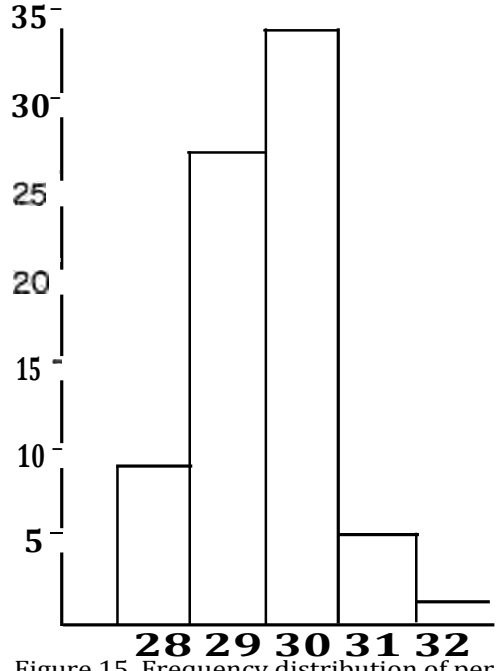


Figure 15. Frequency distribution of per cent postatriopore length of total length of Mississippi lancelets.

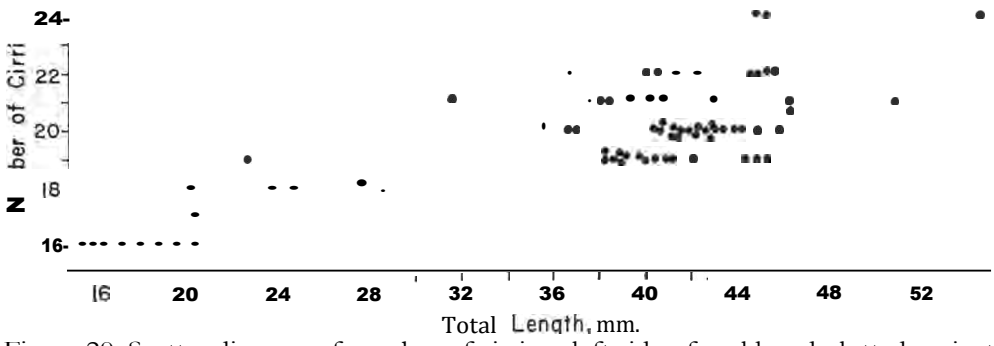


Figure 20. Scatter diagram of number of cirri on left side of oral hood plotted against total body length of Mississippi lancelets.

but have not placed it by actual measurements. We have found in the Mississippi Sound specimens that the anus is almost always behind the center of the lower caudal lobe, the postanal length varying from 30 to 53 per cent of the lower caudal lobe. The mean postanal length is 40 per cent of the lower caudal lobe (Fig. 18). The position of the anus by myotome number varies from myotome 50 to 53, with the mode 52 (Fig. 19).

Cirri.-Oral cirri were counted on the left side only. They varied from 16 to 24, the number increasing proportionally with body length (Fig. 20). The diameter of the cirri varied from 0.04 to 0.09 mm., this too having some correlation with total length of the lancelet. The cirri of the Mississippi Sound lancelets all have lateral knob-like projections, varying in number and position. They are best developed on larger specimens and are most dense on the longer, lateral cirri.

Gonads.-The position of the gonads relative to myotomes may have some taxonomic significance. The modal formula for this character is 9-25-1, where 9 is the number of myotomes anterior to the first gonad; 25, the number of myotomes within the gonadal region, and 1, the number of myotomes between the last gonad and the atriopore. Counts on 50 specimens, without regard to sex, varied as follows: 6 to 11 - 20 to 28 - 0 to 3. These figures were established from counts made on the left side of the animal.

Gonad counts were made on 100 mature specimens ranging in size from 32 to 52 mm. The total number of gonads varied from 46 to 57, with a mean of 51.4 and mode of 52. There was a slight difference between right and left sides. The left side

TABLE 1.
Statistical table of 12 characters in Branchiostoma caribaeum*

Character	Number	Range	Mean	Standard Deviation	Standard Error	Coefficient of Variation	Rank
1	100	57-60	58.6	0.76	0.07	1.3	2
2	100	35-37	36.1	0.14	0.01	0.39	1
3	100	21-24	22.5	0.45	0.04	2.0	4
4	100	14-17	15.8	0.69	0.07	4.4	6
5	100	6-8	6.7	0.50	0.05	7.5	9
6	100	252-359	306.9	18.84	1.88	6.2	7
7	84	35-61	47.2	5.75	0.63	12.2	12
8	95	11.6-17.5	14.1	0.99	0.10	7.1	8
9	100	30.2-53.2	39.8	4.62	0.46	11.7	11
10	74	7.3-11.7	8.4	0.85	0.99	10.1	10
11	100	50-53	51.95	0.70	0.07	1.4	3
12	100	27.4-32.4	29.4	1.0	0.1	3.4	5

* (1) Total myotomes; (2) Preatriopore myotomes; (3) Postatriopore myotomes; (4) myotomes between atriopore and anus; (5) Postanal myotomes; (6) Dorsal fin-ray chambers; (7) Preanal (ventral) fin-ray chambers; (8) Per cent caudal fin length of total body length; (9) Per cent postanal length of caudal fin length; (10) Per cent body depth of body length; (11) Position of anus, myotome number; (12) Per cent atriopore length of total length.

TABLE 3.
Comparison of the Mississippi Sound lancelets with the other species of the western Atlantic *

Species	Taxonomic Characters										
	1	2	3	4	5	6	7	8	9	10	11
B. caribaeum (Mississippi Sound)	57–60	35–37	14–17	6–8	252–359	35–61	6–10x	3–5x	.38—.48	22–30	Behind midpoint of lower caudal lobe
B. caribaeum** (Previously reported)	57–64	35–38	13–17	6–9	227–320	15–42	8x	5–8x		22–29	In advance of midpoint of lower caudal lobe
B. platae**	55–65	34–42	9–17	5–9	249–327	19–53	4–8x	4x	.28—.32	26–31	Near midpoint of lower caudal lobe
B. bermudae**	54–57	35–36	12–14	5–7	172–242	9–24	6–7x	3–4x	.31—.43	22–28	Little behind midpoint of lower caudal lobe

* The characters are numbered 1–11: (1) Total myotomes; (2) Preatriopore myotomes; (3) Myotomes between atriopore and anus; (4) Postanal myotomes; (5) Dorsal fin-ray chambers; (6) Preanal (ventral) fin-ray chambers; (7) Number of times height of dorsal fin is contained in depth of body; (8) Height of dorsal fin-ray chamber times its breadth; (9) Postatriopore region as a proportion of the length of the preatriopore region; (10) Gonads, one side; (11) Position of anus.

** Data based on works cited in text.

sippi Sound and a little way outside the barrier islands from Mobile Bay to Louisiana, an area of about 350 square miles. The total numbers in this region must be in the order of several billions. The lancelet is sometimes exposed by low tides, and the greatest depth at which it was taken was 15 fathoms, 20 miles south of Mobile Bay. In shallow water *B. caribaeum* was taken in greatest numbers where shell and plant debris was common on the bottom. Hundreds of sediment samples collected in Mississippi Sound and the adjacent Gulf show that about nine times out of ten amphioxus was taken in coarse or medium coarse sand, or coarse sand mixed with silt, and was taken rarely on fine sand and not at all on clay. The salinity at 32 stations where amphioxus was taken ranged from 15.4 to 33.1 *per mille* and the mean salinity was 24.3. (This does not include the outside stations, where the salinity was certainly up to 36.0). Lancelets were taken with *Saccoglossus,* the echinoid *Mellita,* and various nemertean and annelid worms, as well as several pelecypods. It was observed that lancelets lying on the bottom would wriggle their way into the sand, a manner of burial which has not been recorded before. Analysis of meristic characters confirms Webb's dictum that a character which varies widely in one species does not necessarily do so in another. Some meristic characters overlap those of the other species of the western Atlantic to a considerable extent, and even other species of lancelets of the world. In meristic characters *B. caribaeum* is more similar to *B. platae* than to *B. bermudae* but this generalization does not hold for all characters. Statistical analyses of populations of lancelets are necessary for their unequivocal separation as species.