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Herbert Boschung
University of Alabama

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A NEW SPECIES OF LANCELET, *Branchiostoma longirostrum* (ORDER Amphioxii), FROM THE WESTERN NORTH ATLANTIC

Herbert Boschung
Department of Biology
The University of Alabama
University, AL 35486

Abstract: *Branchiostoma longirostrum* n.sp. (order Amphioxii) is described from specimens in the northern and eastern Gulf of Mexico, and the east coast of Florida. The new species is distinct in having the combination of few dorsal fin-ray chambers ($\bar{x} = 237$), high total myotome count ($\bar{x} = 61.3$), and a relatively large rostrum (percent of TL, $\bar{x} = 2.91$). It is compared with *B. virginiae* and *B. bennetti*, its probable nearest relatives, as well as with *B. floridae* and *B. bermudae*.

The lancelet described herein was first noticed as unusual by Mike Howell and myself from specimens collected independently by the Pan American Petroleum Company and Everett Brett (The University of Alabama) off the coast of Alabama. Subsequently, additional specimens from other parts of the Gulf of Mexico and the east coast of Florida have become available. This new species brings to five the number of described species of *Branchiostoma* from the western Atlantic north of the tropic of Cancer; the others being, *B. virginiae*, *floridae*, *bermudae* described by Hubbs (1922), and *B. bennetti* described by Boschung and Gunter (1966).

METHODS

Thirteen characters were selected for the various statistical analyses. The number corresponding to each character is consistent throughout the paper: 0 - Total length (mm); 1 - Number of preatriopore myotomes; 2 - Number of myotomes between atriopore and anus; 3 - Number of postanal myotomes; 4 - Number of postatriopore myotomes; 5 - Position of anus by myotome number; 6 - Total number of myotomes; 7 - Body depth as percent of total length; 8 - Preatriopore length as percent of total length; 9 - Postanal length as percent of

total length; 10 - Caudal fin length as percent of total length; 11 - Postanal length as percent of caudal length; 12 - Number of dorsal fin-ray chambers (DFR); 13 - Number of ventral fin-ray chambers (VFR).

The number of preatriopore myotomes, myotomes between the atriopore and anus, and postanal myotomes constitute the myotome formula (e.g., modally $35 + 14 + 6 = 55$ in *B. bermudae*). The atriopore and anus are also reference points for measurements, such as preatriopore length, postanal length, etc., and most measurements are expressed as a percent of total length. The caudal fin is measured from the anterior margin of the lower lobe to the posteriormost tip. The body depth is the greatest vertical distance. Measurements were made to the nearest 0.1 mm using a stereomicroscope equipped with a mechanical stage and a vernier scale, and a cross-hair in an ocular for the reference point. All fin-ray chambers were counted, regardless of size and shape. All myotomes were counted, including the last one which is button-like rather than the typical V-shape. The length of the snout was measured from the tip to the apex of the first myotome with an ocular micrometer to the nearest 0.02 mm.

Statistical procedures were ac-

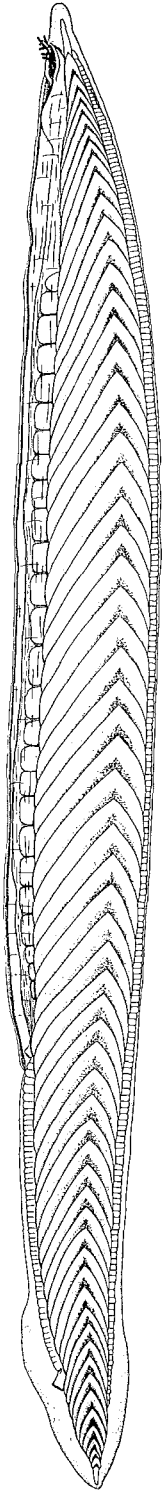


Figure 1. *Branchiostoma longirostrum*, holotype USNM 257774. Drawn by W.M. Howell.

completed with the UNIVAC 1100/60 computer. The discriminant analysis program (Klecka, 1975) was from the Statistical Package for the Social Science (SPSS).

Holotype

U.S. National Museum (USNM) 257774, 42.7 mm TL, approximately 24 km S Mobile Bay, AL, 30°03' N lat, 88°03' W long; collected in sand from 18 m depth, in 1963 (exact date unknown).

Paratype

USNM 257772 (6 specimens, 15.4-46.9 TL) and University of Alabama Ichthyological Collection (UAIC) 3740.01 (5, 24.7-40.0), same locality and data as holotype. USNM 257773 (4, 29.7-37.8), approximately 30 km SSW Mobile Bay, AL, 29°58' N lat, 88°11' W long, 30 m, 15 August 1969 (formerly part of UAIC 6276.01). UAIC 4248.01 (32, 21.8-46.8), 29°59' N lat, 88°03' W long, 27 m, November 1976. University of West Florida (UWF) 1467 (5, 28.9-36.5), 29°50' N lat, 86°05' W long, 37 m, 19 October 1975. University of South Alabama (USA) 05007 (4, 21.9-40.1) and USA 05008 (4, 27.2-29.0), 30°00' N lat, 86°18' W long, 37 m, 6 September 1977. UAIC 6737.01 (17, 25.7-49.2), approximately 16 km E of Jacksonville, FL, 15 m, 5 October 1976. UAIC 3721.01 (12, 12.0-49.1), 24°56' N lat, 82°19' W long, approximately 30 m, 21 May 1967.

Other Study Material

UAIC 3729.02 (1, 22.7), 29°06' N lat, 94°10' W long, 13 m, silty sand, 5 January 1966. UWF uncatalogued (7, 29.3-47.2), 28°15' to 28°45' N lat, 84°00' to 84°25' W long, approximately 37 m, 3 November 1971. USA 02221 (1, 22.7), 27°50' N lat, 83°31' W long, approximately 35 m, 23 July 1975. UWF 2888 (3, 30.2-36.0) 25°50' N lat, 83°31' W long, approximately 35 m, 13 July 1976. Florida State Board of Con-

ervation (FSBC) 3873 (1. 25.6), 27°37' N lat, 83°28' W long, 37 m 19 January 1964. UAIC 3706.01 (1, 28.1), 9.7 km W of Anna Maria Island, FL, 13 m, 7 July 1966. UAIC 3220.01 (2, 41.3-43.5), 25°15' N lat, 82°23' W long, approximately 30 m, 19 May 1967. UAIC 6738.02 (34), 28°00' N lat, 8°18' W long, R/V Silver Bay Station 5252, 30 m, 10 November 1963. UAIC 6276.1 (13, 25.1-41.8), same as USNM 257773, data extant, specimens are lost.

The following diagnosis and descriptions are based on the holotype, paratypes and study material listed above. Localities are shown in Fig. 2.

Diagnosis

A species of *Branchiostoma* with large rostrum (\bar{x} = 2.91 percent of TL) relatively low dorsal fin-ray chamber count (\bar{x} = 237), and modal myotome formula of 36 + 16 + 9 = 61. The combination of these characters, and those given in Table 1 are unknown for any other lancelet.

Description

Table 2 compares *Branchiostoma longirostrum* with three other species of western North Atlantic lancelets, using the 13 characters listed above. It is clear that *B. longirostrum* is distinct from the

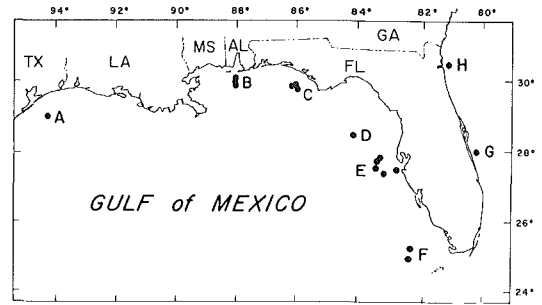


Figure 2. The dots represent localities where *Branchiostoma longirostrum* were collected.

four species with which it is compared. It is morphologically more similar to *B. bennetti* and *B. virginiae* (Table 3), sharing with these a similar myotome formula. An outstanding attribute of *B. longirostrum* is the exceptionally large and long rostrum (Table 4). The dorsal profile of the rostrum blends smoothly with the dorsal fin-ray chambers, lacking a conspicuous notch or depression characteristic of the other species. The oral cirri are without the lateral projections characteristic of *B. bennetti*.

The number of dorsal fin-ray chambers (\bar{x} = 237) is far fewer than that of *B. virginiae*, *B. bennetti* or *B. floridae* (\bar{x} = 317, 322, and 302, respectively), but more than that of *B. bermudae* (\bar{x} = 266); however, *B. bermudae* and *B. floridae*

Table 1. Descriptive statistics of 13 characters of *B. longirostrum* examined in the present study.

Character*	N	Minimum Maximum	Mean	S.D.	S.E.	C.V.
1	165	34-38	35.8	0.56	0.04	1.58
2	165	15-19	16.4	0.66	0.05	4.02
3	164	8-11	9.2	0.74	0.06	8.15
4	164	24-28	25.5	0.84	0.07	3.29
5	165	51-54	52.2	0.64	0.05	1.23
6	164	60-63	61.3	0.77	0.06	1.26
7	131	8.1-13.7	10.5	0.91	0.08	8.56
8	132	66.1-73.0	69.4	1.08	0.09	1.56
9	131	5.6-10.8	7.9	0.82	0.07	10.36
10	129	11.2-18.3	15.4	1.29	0.11	8.39
11	129	40.8-62.2	51.5	4.52	0.40	8.77
12	163	209-264	237.1	11.27	0.88	4.75
13	160	29-57	41.6	5.32	0.42	12.80

* See text for key to characters.

Table 2. Comparison of 13 Characters of *Branchiostoma longirostrum* with those of *B. virginiae*, *B. bennetti*, and *B. floridae*.

Character*	Comparison of <i>B. longirostrum</i> with <i>B. virginiae</i>		Comparison of <i>B. longirostrum</i> with <i>B. bennetti</i>		Comparison of <i>B. longirostrum</i> with <i>B. floridae</i>	
	"t"	P	"t"	P	"t"	P
1	7.0	<0.001	0.0	1.0	1.1	0.3
2	2.2	0.02	1.4	>0.1	5.7	<0.001
3	6.0	<0.001	6.6	<0.001	21.6	<0.001
4	7.2	<0.001	4.3	<0.001	23.3	<0.001
5	4.1	<0.001	1.6	0.1	6.5	<0.001
6	3.1	0.0002	4.7	<0.001	26.4	<0.001
7	13.3	<0.001	11.5	<0.001	16.6	<0.001
8	17.9	<0.001	0.1	>0.9	18.4	<0.001
9	0.1	>0.9	7.6	<0.001	12.3	<0.001
10	3.6	<0.001	0.2	>0.5	4.8	<0.001
11	2.5	0.01	8.0	<0.001	10.0	<0.001
12	54.2	<0.001	44.5	<0.001	34.7	<0.001
13	13.8	<0.001	22.4	<0.001	4.8	<0.001

* See text for key to characters.

(Table 3) have fewer myotomes (\bar{x} = 55.3 and 58.8 respectively). Other species of lancelets, *B. lanceolatum* (north Eastern Atlantic, Mediterranean Sea) and *B. haekelii* (Ceylon), have dorsal fin-ray chamber counts within the range of that of *B. longirostrum*, but differ in other meristic and morphometric ways so as to separate the species.

Fig. 3 shows the relationship of the group means displayed in discriminant space that resulted from the discrimi-

nant analysis. The standardized canonical discriminant function coefficients are presented in Table 5. The probability of correctly classifying the four species of lancelets treated herein is excellent (Table 6).

Etymology

longirostrum, from Latin *longus* = long, and *rostrum* = snout, a noun in apposition, calls attention to the long rostrum.

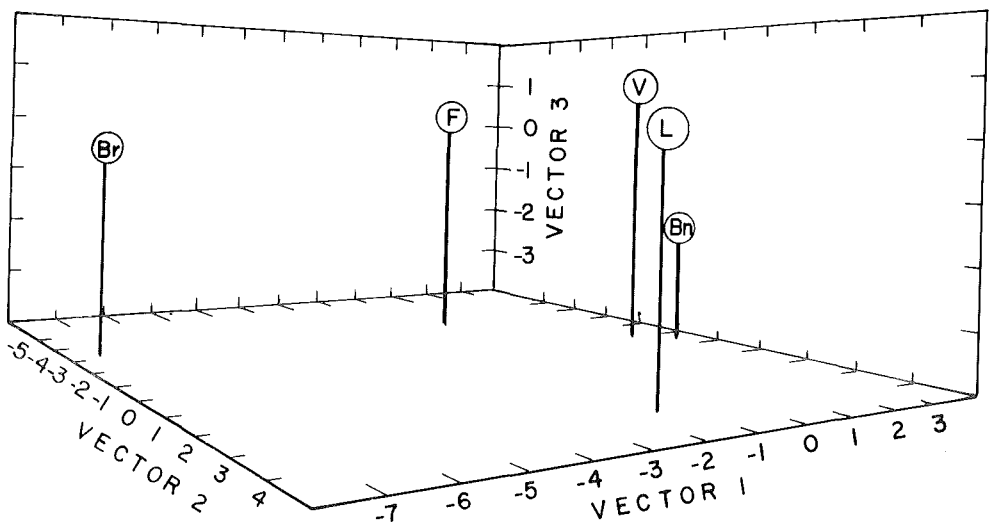


Figure 3. Projection of means of 13 characters of five species of *Branchiostoma* onto the first three discriminating functions. L = *B. longirostrum*; V = *B. virginiae*; Bn = *B. bennetti*; F = *B. floridae*; and Br = *B. bermudae*.

Table 3. Means and standard deviations (in parentheses) of 13 characters of *B. virginiae* (B.v.), *B. bennetti* (B.bn.), *B. floridae* (B.f.) and *B. bermudae* (b.br.). N = number of specimens.

Character	Species			
	B.v. N = 124	B.bn. N = 65	B.f. N = 84	B.br. N = 42
1	36.2 (0.48)	35.8 (0.62)	35.7 (0.56)	34.8 (0.62)
2	16.2 (0.59)	16.5 (0.66)	15.9 (0.72)	14.0 (1.06)
3	8.6 (0.74)	8.5 (0.61)	7.2 (0.48)	6.5 (0.74)
4	24.8 (0.76)	25.0 (0.80)	23.1 (0.63)	20.5 (0.94)
5	52.2 0.59	52.3 (0.77)	51.6 (0.73)	48.8 (0.96)
6	61.0 (0.65)	60.8 (0.74)	58.8 (0.66)	55.3 (0.87)
7	9.1 (0.74)	8.9 (1.00)	8.6 (0.60)	10.6 (1.23)
8	71.8 (0.98)	69.5 (0.96)	72.7 (1.52)	73.5 (1.43)
9	7.9 (0.68)	7.0 (0.76)	6.6 (0.67)	7.2 (1.08)
10	14.9 (0.99)	15.4 (1.10)	14.5 (1.37)	15.2 (1.30)
11	52.9 (4.42)	46.1 (4.26)	44.9 (4.69)	47.3 (7.18)
12	316.7 (13.57)	321.7 (16.27)	302.3 (18.31)	226.1 (15.04)
13	50.9 (5.97)	60.0 (6.10)	38.2 (5.00)	22.6 (3.84)

Ecology

In the Gulf of Mexico *B. floridae* occurs in shallower water than *B. longirostrum*. Specimens of *B. longirostrum* have been collected between 11 and 40 meters, usually in sand strewn with shell fragments. The large rostrum of *B. longirostrum* may be an adaptation to this kind of substrate. *B. longirostrum* were collected with *B. floridae* west of Anna Maria Island, Florida (UAIC 3706.01), and with *B. bennetti* in silty sand off Texas (UAIC 3729.02). On the east coast of Florida,

they were taken with *B. virginiae* at the two locations shown in Fig 2. *B. longirostrum* was not detected among hundreds of specimens of *B. virginiae* collected north of Florida. Salinities at five collections sites ranged from 35.4 to 36.4 ‰, except from off Texas where salinity was estimated from 25 to 30 ‰.

ACKNOWLEDGMENTS

I wish to acknowledge Dr. Gordon Gunter's aid, especially in obtaining specimens, during the early years of the lancelet studies. Others have contributed

Table 4. Comparison of rostrum length of *B. longirostrum* and *B. virginiae* from syntopic specimens. Rostrum length is expressed as percent of total length.

Species	Minimum Maximum	Mean	S.D.	S.E.	C.V.
<i>B. longirostrum</i> (N = 24)	2.25-3.68	2.91	0.47	.096	16.15
<i>B. virginiae</i> (N = 16)	1.53-2.22	1.80	0.22	.055	12.22

Table 5. Standardized canonical discriminant function coefficients.

Character*	Function 1	Function 2	Function 3
1	0.5256	0.4418	0.3904
2	1.5550	1.5324	0.3025
3	1.4734	1.6770	0.1550
4	- 1.2832	- 1.1981	0.2304
7	- 0.2084	0.0648	0.1063
8	0.0012	- 0.3269	0.6076
9	- 0.1712	- 0.2778	0.7442
10	0.1893	0.1929	- 0.4842
11	0.1682	0.3343	- 0.1608
12	0.5468	- 0.6794	0.1251
13	0.3940	0.1418	- 0.5147
% of variation accounted for	52.85	39.54	5.42

* See text for key to characters.

significantly to the study of western Atlantic lancelets. Mike Howell drew the figure of the holotype, compiled much of the data reported herein, and helped in numerous other ways. Hector Harima obtained the valuable series of specimens of the new species from off Jacksonville, Florida; gathered meristic data on other east Florida specimens; and unselfishly made the data available to me. I also wish to acknowledge the following friends for making available specimens of the new species that they collected or had in their care: Steve Bortone, Everett Brett, Charles Guice, Philip Hastings, Thomas S. Hopkins, Eric H. Livingston, Martin Moe, Douglas Nester, Robert Shipp, and John L. Taylor. This project was supported in part by the National Science Foundation, Grant G23627.

KEY TO THE SPECIES OF WESTERN ATLANTIC *Branchiostoma* NORTH OF THE TROPIC OF CANCER

1. Dorsal fin-ray chambers 180 to 264, usually between 216 and 248 2
Dorsal fin-ray chambers 260 to 359
. 3
2. Myotomes 53 to 57 (\bar{x} = 55.3), modal formula 35 + 14 + 6 = 55; dorsal fin-ray chambers 189 to 254 (\bar{x} = 226) relatively short rostrum. Bermuda
. *bermudae*
Myotomes 60 to 63 (\bar{x} = 61.3), modal formula 36 + 16 + 9 = 61; dorsal fin-ray chambers 209 to 264 (\bar{x} = 237) rostrum long and large. East and west coasts of Florida in northern Gulf of Mexico *longirostrum*

Table 6. Probability identification matrix for five species of *Branchiostoma*. N = number of specimens used in the discriminant analysis.

Species	N	Predicted Species Membership				
		1*	2	3	4	5
1. <i>B. longirostrum</i>	166	100.0%	0.0%	0.0%	0.0%	0.0%
2. <i>B. floridae</i>	84	0.0%	98.8%	1.2%	0.0%	0.0%
3. <i>B. virginiae</i>	125	0.0%	2.4%	94.4%	3.2%	0.0%
4. <i>B. bennetti</i>	65	1.5%	1.5%	4.6%	92.3%	0.0%
5. <i>B. bermudae</i>	42	0.0%	0.0%	0.0%	0.0%	100.0%

Percent of species correctly classified was 97.3%.

* Corresponds to the numbered species.

3. Myotomes 57 to 60 (\bar{x} = 58.8); dorsal fin-ray chambers 260 to 340 (\bar{x} = 302); modal formula $36 + 16 + 7 = 59$. West Florida and northern Gulf of Mexico *floridae*
Myotomes 59 to 63, usually 60 to 61; dorsal fin-ray chambers 286 to 358 4
4. Snout very short, upturned; cirri with lateral projections; modal myotome formula $36 + 17 + 9 = 61$ ventral fin-ray chambers 46-77 (\bar{x} = 60) Gulf Coast, west of the Mississippi delta *bennetti*
Snout short but not upturned; cirri without lateral projections modal myotome formula $36 + 16 + 9 + = 61$; ventral fin-ray chambers 38-68 (\bar{x} = 51) East Coast of the United States from Delaware to Florida *virginiae*.

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