Bijdragen tot de Dierkunde, 57 (1): 53-58 — 1987

SERRIVOMER BEANI GILL & RYDER, 1884 (PISCES, ANGUILLIFORMES, SERRIVOMERIDAE): SOME ASPECTS OF SEASONAL VARIATION IN NUMBERS AND DISTRIBUTION IN THE MID NORTH ATLANTIC*

by

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ABSTRACT

In Rectangular Midwater Trawl samples taken along the 30°W meridian in the mid North Atlantic, *Serrivomer beani* reaches its greatest density in April-June between 25° and 34°N. In this period the larvae of this species are caught here as well.

There is a significant increase in size of the individuals from 24° to 55°N. In October samples along the same meridian, *S. beani* was caught from 24° to 40°N only. Because the net used is not effective in collecting size classes above about 300 mm, it is presumed that north of 40°N *S. beani* is present, but consists of larger individuals.

No evidence is found that *S. beani* undertakes diurnal vertical migration.

RÉSUMÉ

Dans des échantillons prélevés le long du méridien de 30°O dans l'Atlantique Nord central avec le RMT (Rectangular Midwater Trawl), la densité maximum est enregistrée par *Serrivomer beani* en avril-juin entre 25° et 34°N. Au cours de cette période les larves de cette espèce sont aussi capturées.

De 24° à 55°N on enregistre une augmentation significative de la taille des individus. Dans des échantillons prélevés en octobre le long du même méridien, *S. beani* a été capturé seulement de 24° à 40°N. Le filet utilisé n'étant pas efficace pour la capture des classes de tailles supérieures à environ 300 m, on peut supposer que *S. beani* est bien présent au nord de 40°N, mais qu'il y est représenté par des individus plus grands.

Une migration verticale diurne n'a pas pu être démontrée pour *S. beani*.

* Amsterdam Mid North Atlantic Plankton Expeditions (AMNAPE), Project 101A. Report no. 29, supported by a grant of the Netherlands Ministry of Education and Sciences, N.Z.R. (Report no. 28 is published in the same issue of this journal).

INTRODUCTION

Serrivomer is caught in tropical to temperate regions in all oceans (Castle, 1969). The Serrivomeridae are pelagic (Castle, 1983). In the Atlantic two genera with six species are known.

Bauchot & Saldanha (1973) noted that in the eastern Atlantic the adult animals are meso- and bathypelagic and that the larvae live higher, between 100 and 300 m, with a vertical rise during night. Bauchot (1959) found that the larvae of *S. beani*** during daytime are mostly caught at depths between 70 and 130 m, whereas at night the main catches were made between 50 and 100 m. Beebe & Crane (1936) found that *Serrivomer* was caught between ca. 100 and 1800 m in the Bermuda area in various seasons. According to them the larvae grow to about 63 mm in length before metamorphosis, which takes place very rapidly.

This has been confirmed by Van Utrecht (1982), correlating the growth features in the otoliths with larval development, metamorphosis and growth. However, the larvae caught in the mid North Atlantic grow to about 90 mm when metamorphosis is completed. The specimens of *S. beani* from April, larvae and metamorphosed, are nearly all caught at depths between 500 and 1000 m, without any indications for diurnal vertical migration, contrary to the findings of Bauchot (1959) and Bauchot & Saldanha (1973).

** *Serrivomer parabeani* Bertin, 1940 is a common synonym of *S. beani* Gill & Ryder, 1884 (cf. Bauchot, 1986: 549).

TABLE I

Geographical and bathymetrical data for *Serrivomer beani*. Animals marked * were not measured, due to damage. Animals of stations marked ! are not taken into consideration.

Station	Haul	Position	Date	D(ay) N(ight)	Depth in m	Temp. at depth (°C)	Number of specimens	Length in mm
13	9	49°00.8'N 29°18.5'W	17-IV-'80	D	480-1005	6.70°	1	293
!17	2	41°10.6'N 35°30.9'W	21-IV-'80	N	330-505	12.75°	1	123
18	10	39°53.9'N 35°58.9'W	22-IV-'80	D	440-910	10.40°	1	191
19	22	37°48.5'N 35°17.4'W	24-IV-'80	D	500-1000	10.25°	3	123-269
21	6	33°40.5'N 30°40.6'W	27-IV-'80	N	510-1000	10.60°	2	112, 180
22	1	32°19.0'N 30°03.1'W	27-IV-'80	D	500-1000	10.50°	5, 2*	166-223
23	2	30°39.9'N 29°59.5'W	28-IV-'80	D	505-960	11.00°	15, 3*	76-118
24	1	29°53.7'N 29°57.1'W	29-IV-'80	N	45-100	19.50°	2*	
24	3	29°44.0'N 29°57.7'W	29-IV-'80	N/D	200-300	16.25°	1	110
25	1	28°42.0'N 29°59.1'W	29-IV-'80	D	490-1000	10.50°	28	62.5-255
26	1	24°58.9'N 29°59.1'W	1-V-'80	D	200-450	16.10°	1	115
26	4	24°52.0'N 29°59.5'W	1-V-'80	D	510-1090	9.80°	9	93-128
27	10	24°48.6'N 28°47.2'W	2-V-'80	D	475-1000	10.35°	59, 8*	52-215
!38	11	50°53.8'N 29°43.9'W	6-X-'81	D/N	0-520	9.65°	4, 1*	264-534
38	14	50°48.4'N 29°35.3'W	6-X-'81	N	0-315	11.25°	1	296
45	10	37°08.6'N 35°01.0'W	27-IX-'81	D/N	505-1010	9.80°	1	138
47	3	35°07.7'N 31°29.0'W	23-IX-'81	N	425-855	10.70°	1	213
47	12	35°07.4'N 31°07.3'W	24-IX-'81	D	750-1170	8.65°	1	151
48	8	34°12.9'N 31°11.9'W	23-IX-'81	N	500-1150	9.90°	1	159
49	3	31°43.1'N 29°42.6'W	21-IX-'81	N	515-1000	10.60°	6	152-368
49	8	31°45.6'N 29°32.9'W	22-IX-'81	N	105-230	17.45°	1	142
49	9	31°47.4'N 29°30.0'W	22-IX-'81	N	200-325	16.27°	1	172
50	2	30°05.3'N 29°46.7'W	20-IX-'81	N	730-1200	9.15°	11, 4*	125-157 357, 363
50	5	29°58.4'N 29°48.2'W	20-IX-'81	D	490-745	11.75°	30, 1*	131-224
51	12	28°07.0'N 29°52.9'W	19-IX-'81	N	500-1050	10.45°	5	131-152

TABLE I (continuation)

Station	Haul	Position	Date	D(ay) N(ight)	Depth in m	Temp. at depth (°C)	Number of specimens	Length in mm
52	5	24°57.5'N 30°01.2'W	18-IX-'81	D	490-1005	9.85°	17, 5*	115-147
52	14	25°04.1'N 29°55.1'W	18-IX-'81	N	400-510	13.50°	5	125-150
55	4	27°02.5'N 20°17.7'W	15-IX-'81	D	570-1000	9.15°	3	137-225
65	13	29°59.8'N 29°42.9'W	19-II-'82	N	285-445	14.80°	1	114
65	20	29°59.4'N 29°34.8'W	20-II-'82	N	490-1010	10.30°	3, 1*	100, 166
66	3	30°00.4'N 29°24.7'W	20-II-'82	N	395-505	12.65°	1*	
68	1	30°02.4'N 28°10.8'W	21-II-'82	N	400-505	13.60°	1	146
76	26	50°21.3'N 29°29.7'W	17-VI-'83	D	500-995	5.95°	1	297
81	6	40°56.2'N 35°31.6'W	11-VI-'83	N	500-1000	8.75°	1	202
81	17	40°58.5'N 35°27.5'W	12-VI-'83	N	505-1000	8.55°	1	207
84	36	35°11.0'N 31°30.9'W	6-VI-'83	N	300-400	12.65°	1	244
84	37	35°11.8'N 31°31.4'W	6-VI-'83	N/D	505-1000	9.95°	2	218, 252
84	77	35°09.6'N 31°31.7'W	7-VI-'83	N	1000-1760	6.15°	1	504
!85	14	33°30.9'N 30°12.0'W	4-VI-'83	N	50-102	17.65°	1	118
87	2	30°00.1'N 29°47.0'W	1-VI-'83	N	500-1000	10.45°	11, 2*	91-207
87	6	29°57.9'N 29°36.8'W	2-VI-'83	N	200-305	16.80°	2, 1*	122
87	35	30°00.9'N 29°04.0'W	2-VI-'83	D/N	500-1000	10.57°	15, 1*	84-199
89	8	24°49.5'N 30°01.6'W	30-V-'83	D	510-1000	9.30°	27, 8*	57-221
89	29	24°52.8'N 30°03.5'W	30-V-'83	N	515-1000	9.40°	40, 4*	54-211
89	34	24°54.3'N 30°00.6'W	30-V-'83	N	300-400	14.60°	1	109
89	39	24°54.5'N 29°58.8'W	31-V-'83	N	90-202	20.30°	2*	
987	6	29°59.1'N 28°06.0'W	3-VI-'83	N	55-105	19.20°	2	103, 114
987	8	29°59.8'N 27°55.3'W	3-VI-'83	N	85-193	18.10°	11, 1*	108-129
987	9	29°59.5'N 27°51.0'W	3-VI-'83	N/D	180-295	16.30°	9, 1*	113-134
987	25	29°57.1'N 27°44.6'W	3-VI-'83	D	498-677	9.90°	7, 1*	105-125
987	29	29°59.8'N 27°45.7'W	3-VI-'83	D	752-1005	9.65°	3, 1*	102, 103

Bauchot (1959) found, based on the catches of small larvae, that the area where hatching takes place is between 25° and 34°N and 46° and 61°W. Most of the small larvae were caught in the months of April to July. Beebe & Crane (1936) found that off Bermuda the main hatching season is in late spring and early summer. They did not find a relation between depth and developmental stage.

The aim of the present study is to verify this on samples from the Amsterdam Mid North Atlantic Plankton Expeditions held in different months in 1980, 1981, 1982 and 1983 along the same transect and made in nearly the same positions each year. This offers the possibility to study seasonal variations in abundance and distribution.

MATERIAL AND METHODS

During the Amsterdam Mid North Atlantic Plankton Expeditions, held each year from 1980-1983, samples were taken with the acoustically monitored Rectangular Midwater Trawl (RMT 1+8) with opening and closing device (Baker et al., 1973) at depths between 30 and 1760 m. The samples were taken between 55° and 24°N along approximately 30°W.

For the complete station lists, including technical and hydrological data, one is referred to Van der Spoel (1981, 1985) and Van der Spoel & Meerding (1983). All animals recorded in this paper were caught in the RMT 8 net, and preserved in the collections of the Zoölogisch Museum, University of Amsterdam (ZMA).

After landing the nets on deck the contents of the cod ends were transferred into cool boxes with filtered seawater of ambient temperature. As soon as possible all the leptocephalus-like larvae were removed from the sample and preserved in alcohol 70%. All metamorphosed specimens were first fixed with formalin 4% for a short time and then transferred to alcohol 70%.

Table I lists the data about *S. beani* caught during the successive expeditions. The specimens caught during the expedition held in February 1982 are not incorporated in the present study. This expedition was greatly hampered by adverse weather conditions, so sampling was completely inadequate and not comparable to the results of the other expeditions.

As the actual numbers of *S. beani* caught per station and per haul are in general relatively small and highly variable and, moreover, the duration of the hauls varies, they are converted to the density per 1000 l water filtered. This makes the results more easily comparable. For this purpose the numbers of specimens in a haul are divided by 8 times the distance fished, according to the formula $C_{1000} = \frac{N}{8 \times D}$ (in which C_{1000} means the concentration per 1000 l of water, N is the number of animals caught, and D is the distance fished multiplied by 8 as the opening of the net covers 8 m²).

RESULTS AND CONCLUSIONS

In the present material specimens up to a length of about 89 mm still show larval characters. Longer animals have already the shape of the adult *S. beani*, and show a gradual development of the pigmentation (Van Utrecht, 1982).

Larvae of this species are only found in the samples taken in April and June between 34° and 31°N, all in depths between 500 and 1000 m, with the greatest numbers in April. This agrees with the results of Bauchot (1959) for the area around 30°W.

Concerning the depths at which the metamorphosed animals are caught in the mid North Atlantic, the present results do neither agree with those of Beebe & Crane (1936) for the Bermuda area, nor with those of Bauchot (1959). The larvae in the mid North Atlantic hardly show signs of diurnal migration. Most of them are caught at depths below 400 m, just like the metamorphosed animals. Only in June and October small numbers of specimens are caught at depths of less than 400 m. They comprise 8.6% of the animals caught (361 from which 31 are caught above 400 m). So it can safely be concluded from the present material that *S. beani* does not migrate diurnally.

S. beani is caught in water layers with temperatures varying between about 6° and 22°C.

Though the Rectangular Midwater Trawl was primarily designed for sampling larval and young stages of fishes, specimens up to a total length of about 300 mm are present in the catches along the whole transect, including the southern part. So these catches are representative of the presence of *S. beani* up to that length. Only a few animals over 300 mm in length are present, the longest being 534 mm. The longest *S. beani* ever found was 594 mm

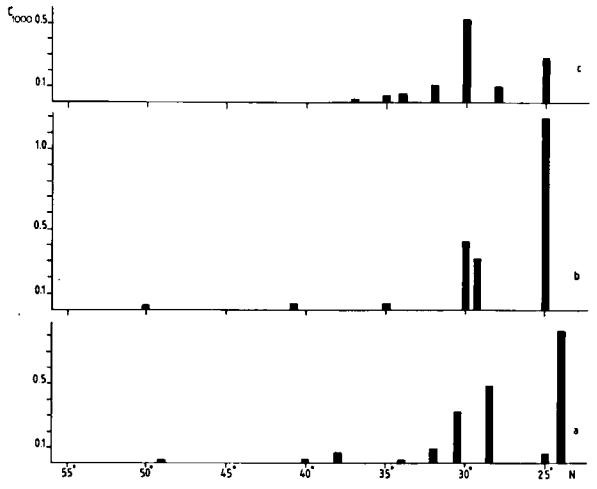

Fig. 1. Horizontal distribution and seasonal variations in density, expressed in numbers of animals per 1000 l water filtered, of *Serrivomer beani* along 30°W longitude: a, in spring (April 1980); b, in summer (June 1983); c, in autumn (October 1981).

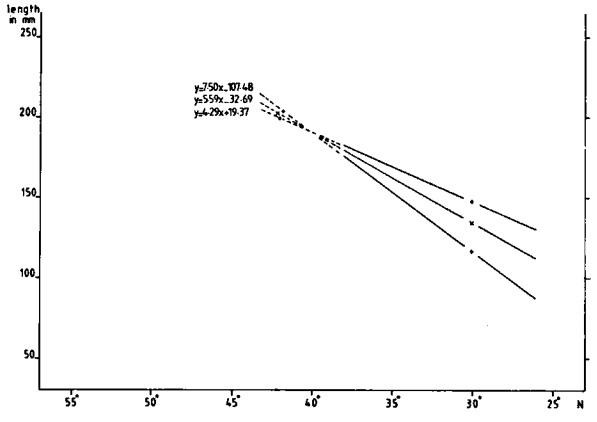

Fig. 2. Regression lines for the growth in length of *Serrivomer beani* in successive seasons (+ = April 1980; x = June 1983; o = October 1981).

(Beebe & Crane, 1936). Lengths of 293 and 297 mm are considered to be regularly present in the samples.

Due to sampling differences the number of specimens caught varies considerably. Therefore, the number of animals per 1000 l water filtered gives a better picture of their distribution and seasonal variations along the 30°W meridian (fig. 1). From this it is clear that the greatest concentrations of *S. beani* are caught in April and particularly in June at about 25°N. Their concentration gradually diminishes towards 40°N. Together with this decrease in density the specimens increase in length. The longer animals in the available samples are found north of 40°N (see table I and fig. 2). However, these larger specimens are actually underrepresented. In October no specimens are caught north of 40°N. It seems that *S. beani* of relatively short length then are only present south of 40°N.

Since specimens between 100 and 200 mm in length are caught in all three seasons along the whole north-south transect, it can be concluded that north of 40°N in October, the population is either at very low density or, more probable, consists mainly of individuals longer than 300 mm, the size at which they hardly can be captured with the Rectangular Midwater Trawl. The density of *S. beani* south of 40°N is in October considerably lower than it is in April and June (fig. 1).

In order to analyse the presumed increase in length of the animals when moving from south to north along the transect, regression lines are calculated for all animals caught in each season. These regression lines are calculated between latitude and size (fig. 2). From this figure and the results of the calculations it is evident that there is a significant increase in length in April, June and October. The greatest increase is found in April (fig. 2). In this month the percentage of young small animals is high and these rapidly increase in length. In the course of the year the numbers of small animals rapidly decrease as is demonstrated by the higher level at which the regression lines in June and October start. The decreasing slope of the regression lines for June and October demonstrates the gradual decrease of growth in *S. beani* (fig. 2).

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Revised draft received: 9 June 1986