

On the Biology of *Sagitta*. II. The Breeding and Growth of *Sagitta setosa* J. Müller in the Plymouth Area, 1930-31, with a Comparison with that of *S. elegans* Verrill.

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With 2 Figures in the Text and Plate II.

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In a previous paper (6) an account was given of the breeding and growth of *Sagitta elegans* Verrill in the waters off Plymouth throughout a whole year. Similar data are now available for *Sagitta setosa* J. Müller\* which also occurs commonly in the Plymouth area. The material has been treated in exactly the same way as was that of *S. elegans*. Measurements were made to the nearest half-millimetre in body-length and the *Sagitta* were divided into the three stages of development after examination of material stained in Alum Carmine, as described in the previous publication (p. 133 and Text-Fig. 1).

*Sagitta setosa* were rare in the ring-trawl catches in 1930 until September when they became fairly abundant; so that, whereas the data for *S. elegans* already published covered the period May, 1930, to May, 1931, it has been necessary to take the period September, 1930, to September, 1931, for *S. setosa*. But in order that a fair comparison may be made between the two species the observations on *S. elegans* have been continued to September, 1931, as shown in Text-Figure 1, which is supplementary to Plate I of 6, and in Tables IV-VI.

#### GENERAL RESULTS.

The results of measurements and examinations of *S. setosa* have been set out in Tables I to III, pp. 156-159. These results have been reproduced in a complete form in Plate II, in which the length distribution on each day has been reduced to a percentage basis and the data regarding state of maturity have been incorporated. The diagram which covers the period September, 1930, to September, 1931, appears to give the following information.

\* I am indebted to Professor Alexander Meek for kindly confirming the identification of this species.

There was a population of adults spawning in September, 1930, which gave rise to a brood which matured and spawned during October. The offspring of this October spawning population did not fully mature until the following February; in the middle of December the male organs were ripening, and the ovaries had started to develop by the middle of January. The spawning adults in February gave rise to a brood which matured at and grew to a large size in April and May. The April and May spawners gave rise to a spawning population in June, followed by others in July and August.

The evidence obtained for *S. setosa* is not quite so clear-cut as was that for *S. elegans*. This is no doubt due to the smaller numbers of *S. setosa* available in the catches, and also to the smaller differences in the sizes attained by the adults of the different broods than in *S. elegans*. It is not, for instance, quite certain that there is a definite spawning in February; there are no indications of young coming on in the small catches which ensue. It is however noticeable that when the catches are small the smaller individuals tend to be absent, which is probably due to the selective action of the stramin net, the small Sagitta whose proportion is very low only appearing in large catches. There is however evidence that the *S. setosa* in March and April are maturing at a considerably larger size than they were in January and February, and this is taken as an indication of a different population. Throughout the summer also the catches were often not rich enough to show the full story; there is evidence, however, from the size variation that there are at least two distinct broods between June and September. But the observations with adequate numbers are not quite closely enough spaced to make it clear what has actually happened between June 9th, 1931, and August 14th. One would imagine that there might have been time for the production of two broods. On the other hand the gradual increase in the size of the adults from an average of  $11\frac{1}{2}$  mm. at the beginning of July to  $13\frac{1}{2}$  mm. on August 5th points to the fact that here we have perhaps one brood which has probably arisen from a spawning in June and has continued to grow in size after attaining maturity. There is indirect evidence available that this may be so, in that the larger Sagitta on August 14th have a high proportion parasitized by Nematodes. In Table III, in the last column, are

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#### EXPLANATION OF PLATE II.

PLATE II.—The percentage size distribution of *Sagitta setosa* caught in the ring-trawl on the days given. The black, cross-hatched and shaded areas represent the various stages of development (see top of diagram for key). In this diagram the lines of demarcation between different stages must not be taken as being exact, as possible shrinkage has not been taken into account. It must also be realised that the Stage III includes both ripening and mature females, and they must not be regarded as all fully mature, though, usually, probably the majority are so.

given the number of *S. setosa* seen to contain Nematode parasites among those that have been measured. The comparatively high number in August is obvious, and it seems possible that this may indicate that the large adults on the dates given have lived on from July, since one would expect parasites to be more prevalent in a population of old individuals. The beginning of a new brood on August 14th that grows to a spawning population in September is indicated, but spawning also appears to be taking place throughout August.

On the above assumptions then it would appear that from the period September, 1930, to August, 1931, inclusive, there were at least six breeding populations of *S. setosa*, i.e. in September, October, February, April-May, June and July-August.

Plate II also shows that there was a definite difference in the lengths attained by the adults in each successive brood. The approximate average lengths of the adults of the different broods as determined by inspection of the graphs in Plate II without calculation were as follows:—

September, 1930 . . . . .	11½–12½ mm.
October, 1930 . . . . .	9½–10 mm.
February, 1931 . . . . .	11½–12 mm.
April–May, 1931 . . . . .	14–14½ mm.
June–1st half July, 1931 . . . . .	11½ mm.
2nd half July–1st half August, 1931 . . . . .	12½–13½ mm.
2nd half August–September, 1931 . . . . .	12–11 mm.

#### OBSERVATIONS ON *S. ELEGANS* FROM JUNE TO SEPTEMBER, 1931.

As stated above, the observations on *S. elegans* were continued until September, 1931, and the results obtained are given in Tables IV, V, and VI, and represented graphically in Text-Figure 1. The broods in the summer of 1931 followed the same general trend as did those for 1930. The approximate average lengths for the adults were in June *ca.* 12½–13½ mm., July 12–12½ mm., and end of August and beginning of September 11 mm. It was noticeable that in 1931 the brood developing during August reached maturity slightly earlier than did the corresponding brood in 1930. There are slight differences in the sizes attained by the adults at corresponding times in the two years; Text-Figure 2 shows that there are also slight temperature differences between the two years. Until similar data are obtained over a period of a number of years and in different localities, it is however premature to attempt to correlate slight variations with environmental conditions.

COMPARISON BETWEEN *S. ELEGANS* AND *S. SETOSA*.

Comparing the results for the two species of *Sagitta* shows that there is a similarity in the behaviour of the two species in that neither of them breed during the months of November, December, and early January.

There were, however, certain definite differences.

1. *S. setosa* produced a brood maturing in October, while in *S. elegans* the last pronounced spawning took place in September.

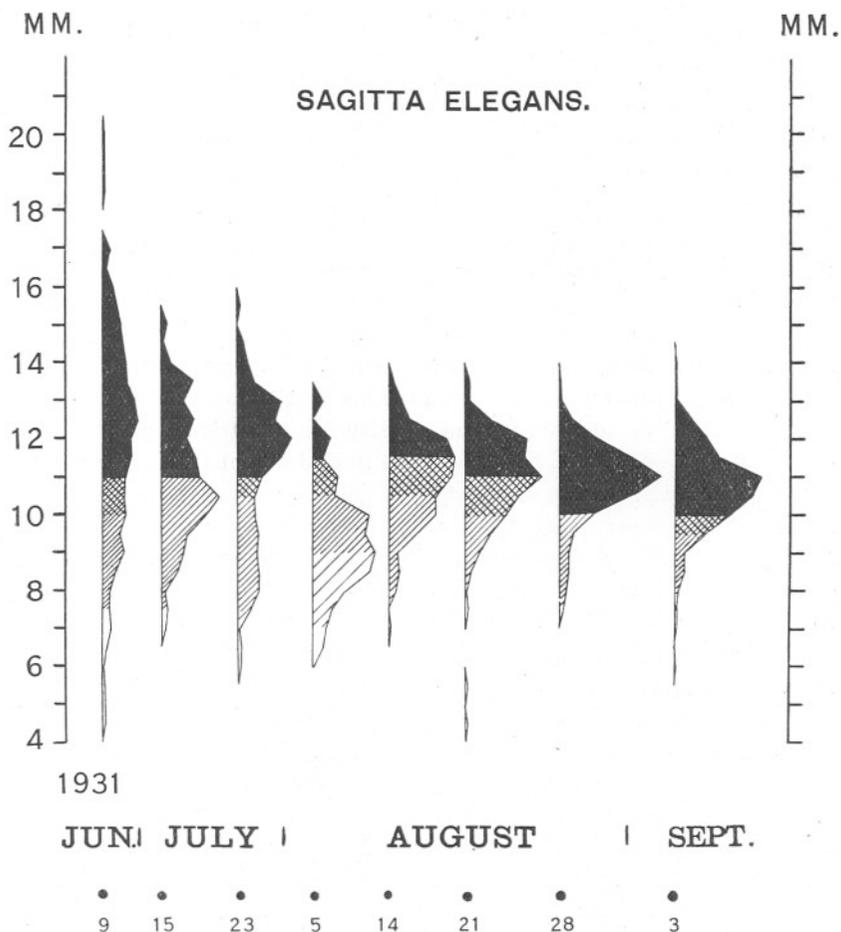
2. Of the broods that lived through the winter without spawning that of *S. elegans* started to mature the earlier; the male organs maturing earlier in December, and the female gonads earlier in January, than in *S. setosa*.

3. There was a distinct difference between the sizes to which the adults of the different species grew at different times of the year. In *S. elegans* the average size of adults between September, 1930, and September, 1931, varied from 10–10½ mm. in September, 1930, to ca. 16 mm. in April and May, 1931, and 11 mm. at the end of August and beginning of September, 1931. For *S. setosa* the average lengths for the adults at the corresponding times were 11½–12½ mm., 14–14½ mm., and 11–12 mm. respectively. The range of size variation over a comparable period is thus greater for *S. elegans* than for *S. setosa*. The brood of *S. setosa*, however, which matured in October, 1930, had the low average size for the adults of 9½–10 mm., but there was no mature brood of *S. elegans* during that month to compare it with.

The summarised results are set out in Text-Figure 2 together with the temperature conditions prevailing at the time.

In addition to the above differences between the species a comparison of their actual abundance in the catches is of interest. These figures are given in Tables I and V, and in Table I of 6. Up to September, 1930, *S. elegans* definitely predominated over *S. setosa*. From that date until August, 1931, the two species are of about the same abundance, but towards the end of August and beginning of September in 1931, *S. setosa* became the predominating species, when the very large catches of 19,725 and 31,666 were recorded on September 3rd and 10th respectively.

The occurrence of two very large individuals among the 31,666 caught on September 10th is of interest. During the sorting of the material almost all the individuals over 13 mm. in length were picked out: the measurements of these including some ranging down to 11 mm. are given in the last line in Table III. There were in all 126 specimens, but as these only amounted to 0.4% of the whole catch their presence has only been



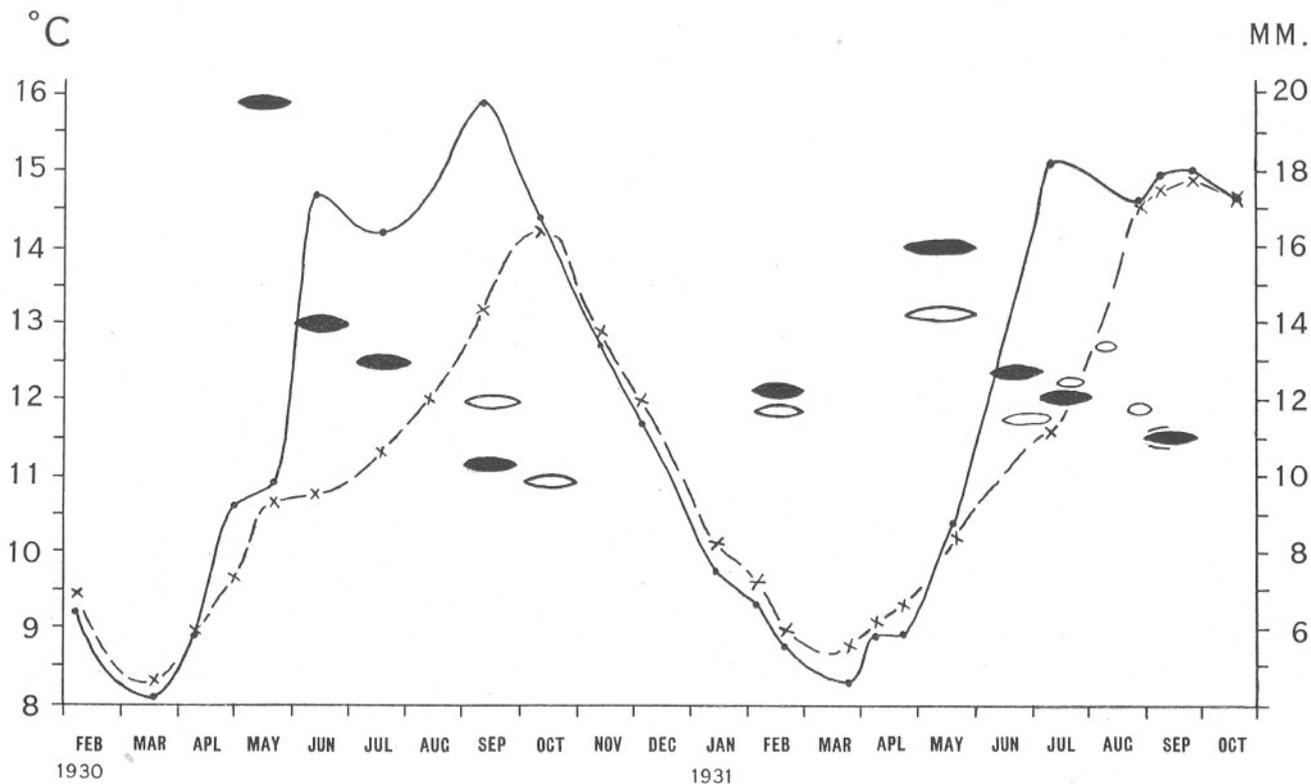
TEXT-FIG. 1.—The percentage size distribution of *Sagitta elegans* caught in the ring-trawl on the days given, June to September, 1931. (For further description see explanation of Plate II.) This figure is supplementary to Plate I of 6.

indicated in Plate II by a dotted line. Two individuals measuring respectively  $19\frac{1}{2}$  mm. and  $22\frac{1}{2}$  mm. in length were the largest taken in the whole year and they can probably be regarded as abnormal; both had the appearance of being spent.

The significance of the differences between the two species is not clear and cannot be discussed until more data are obtained and the exact geographical range for each is mapped out together with information of the environmental conditions they can withstand in different localities.

In marine animals the existence of so-called "geographical races" has been known for many years, and attention has especially been turned to their study in such fishes of commercial value as the herring. In marine invertebrates differences in the form of the individuals of a single species from place to place are continually being reported and have been indicated from time to time for most groups of plankton animals. But it is desirable that these observations should be continued over periods of time in different localities as has here been done for *Sagitta*. While much attention has been given to so-called "temporal variation" in plankton crustacea of fresh waters, little work has been done in this line on marine plankton animals. To my knowledge the only detailed observations covering a long period are those of Adler and Jespersen (1) on the size attained by certain species of Copepods, while I myself have carried out similar observations on the adults of *Calanus finmarchicus* during a period April to September inclusive (5). In certain localities where hydrographic conditions are complicated it will be difficult to sift "geographic races" from seasonal broods. But a number of observations in many localities may help to throw light on the effects of the environmental conditions on the growth and form of marine animals. A recent paper by Steuer (7) brings together a certain amount of information on geographical races of copepods brought about apparently by hydrographic conditions, individuals of a species tending to grow to larger sizes in cold southern waters as compared with the warmer regions, and also when living in the deeper colder layers as opposed to surface-living forms. Slight structural modifications are also indicated. A perusal of his paper emphasizes the need for more detailed seasonal observations in all localities.

It seems unnecessary to say that a species cannot be regarded as a series of standard organisms, but that their reactions to their environment must depend to a great extent upon the conditions under which they live and grow. The formation of geographical and seasonal broods must therefore be taken into consideration in a study of the animals' behaviour and has an obvious bearing on such studies as that of vertical distribution (see Russell, 5).



TEXT-FIG. 2.—Curves of Temperature at surface at international station L5 (—) and at 25 metres at E1 (---). Superimposed on these are the periods of spawning of the different broods of *S. elegans* (black areas) and *S. setosa* (white areas) plotted against the average length of the adults of each brood. (Left coordinate, temperature in °C.; right coordinate, length in millimetres.)

ON THE OVARY LENGTH OF *S. SETOSA*.

The results of a number of ovary measurements have shown that on an average the lengths of the ovaries of *S. setosa* are shorter in proportion to the body-length than are those of *S. elegans*. The following figures give the results of averaging a number of measurements, but it must be realised that there is considerable variation in ovary length among individuals.

Length of adults (mm.).	Average length of ovary (mm.).	Ovary-length Body-length.
11	0.96	0.088
11.5	0.96	0.084
12	0.99	0.083
12.5	1.10	0.088
13	1.143	0.088
13.5	1.19	0.088
14	1.32	0.094
14.5	1.63	0.112
15	1.60	0.107
15.5	1.82	0.117

If these figures are compared with those given in 6, p. 138, for *S. elegans*, it will be seen that the ovaries of *S. elegans* are always proportionally longer than those of *S. setosa* except for those of 14½ mm. length which are equal.

These figures also indicate that as with *S. elegans* there is a tendency for the larger individuals to have relatively larger ovaries in *S. setosa*. From about 10 to 14 mm. the proportion ovary-length/body-length is about constant, but above this length there was a sudden increase. These latter large individuals will have been the adults of the April-May population.

In comparison with the eggs of *S. elegans* those of *S. setosa* as measured *in situ* in stained and mounted specimens are much smaller, being about .13 to .19 mm. in diameter.

PREVIOUS OBSERVATIONS ON *SAGITTA SETOSA*.

Few records are to be found on the occurrence of *S. setosa*. Ritter-Záhony (3) gives its distribution as only English Channel, North Sea, Skagerak and Kattegat. He notes that there are three types which differ in fin proportions, especially in the length of the front fin. The specimens that I have examined at Plymouth agree very closely in fin-outline and proportions with the Helgoland type shown in Fig. 1, A, on p. 8 of 4. Meek (2), however, has recorded *S. setosa* in the Northumbrian

plankton agreeing with the Kattegat type in appearance. Ritter-Záhony (4, p. 9) gives the largest observed size as 14 mm. total length. Apart from the two large individuals of 19½ mm. and 22½ mm. on September 10th, 1931, my records in Table III show that 16 to 17 mm. seems to be about the limit of size in this area (to which ½ mm. should be added to allow for the tail fin).

#### SUMMARY.

1. A study of the adult population of *Sagitta setosa* J. Müller has been made in the waters off Plymouth by weekly collections with the 2-metre stramin ring-trawl hauled obliquely in the daylight.

2. Measurements of samples and a study of the state of development of the gonads has shown that there were apparently at least six broods of *S. setosa* during the period September, 1930, to August, 1931, inclusive.

3. The successive broods were apparently spawning in September and October, 1930, and February, April-May, June, and July-August, 1931.

4. In the offspring of the October spawning population no gonads were developed during November. The male organs started to ripen in the middle of December, and the ovaries in the middle of January.

5. There was a difference in the size to which the adults of the different broods grew. The approximate average lengths of the adult of the spawning populations were in 1930 for September, 11-12½ mm. ; and October, 9½-10 mm. ; and in 1931, February, 11½-12 mm. ; April-May, 14-14½ mm. ; June-1st half July, 11½ mm. ; 2nd half July-1st half August, 12½-13½ mm. ; and 2nd half August-September, 12-11 mm.

6. A comparison is made between these data for *S. setosa* and the data previously published (6) for *S. elegans*.

7. The need for similar observations in these and other plankton animals in different localities is stressed.

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TABLE I.

TOTAL NUMBERS OF *SAGITTA SETOSA* IN RING-TRAWL COLLECTIONS.

Sept.	11th, 1930	760	Jan.	15th, 1931	339	June	9th, 1931	530
"	16th "	46	"	22nd "	270	"	16th "	18
"	24th "	87	"	26th "	101	July	8th "	1
Oct.	1st "	45	Feb.	6th "	2	"	15th "	106
"	7th "	369	"	12th "	17	"	23rd "	120
"	14th "	683	"	20th "	239	"	30th "	10
"	16th "	258	"	23rd "	134	Aug.	5th "	7
Nov.	6th "	300	March	17th "	221	"	14th "	325
"	13th "	120	"	26th "	333	"	21st "	2545
"	20th "	73	April	1st "	1048	"	28th "	7893
"	26th "	84	"	9th "	1872	Sept.	3rd "	19,725
Dec.	3rd "	1080	"	16th "	385	"	10th "	31,666
"	10th "	162	"	22nd "	27			
"	17th "	376	"	30th "	18			
"	22nd "	78	May	6th "	42			
Jan.	1st, 1931	249	"	13th "	8			
"	5th "	59	"	28th "	175			

TABLE II.

RESULTS OF EXAMINATION OF STAINED SPECIMENS OF *S. SETOSA*  
FOR STATE OF MATURITY: LENGTHS IN MILLIMETRES.

Date.		St. I.	St. II.	St. III.	Date.		St. I.	St. II.	St. III.		
1930		Upper limit.	Lower limit.	Upper limit.	Lower limit.	1931		Upper limit.	Lower limit.		
Sept.	11th	—	—	—	9½	Feb.	23rd	9	7	11	10
„	16th	6½	7	9	8½	March	17th	9	9	12½	11½
„	24th	6	6	9½	10	„	26th	—	9½	13	11½
Oct.	1st	6½	—	9	9	April	1st	10½	7½	13	12
„	7th	8½*	7½	9†	9	„	9th	6	—	13	11½
„	14th	8½	—	8½	8½	„	16th	—	9	13½	12
„	16th	8½	7	8½	8½	„	22nd	—	—	11	12
Nov.	6th	11	—	9½	9½	„	30th	—	—	—	12½
„	13th	9½	—	9	9	May	6th	—	—	—††	11
„	20th	9½	—	—	—	„	13th	—	—	—	12
„	26th	10	—	—††	—	„	28th	—	6½	12	9½
Dec.	3rd	10	—	—	—**	June	9th	—	6½	9	9½
„	10th	11½	—	—	—	July	15th	—	—	—	10
„	17th	11	10	11½	—	„	23rd	—	8½	9½	10
„	22nd	11½	9½	—	—§	„	30th	—	—	—	10
Jan.	1st, 1931	10½	9½	—	—	Aug.	5th	—	—	—	10
„	5th	10	8½	10	—	„	14th	5½	6	10	9½
„	15th	10½	10	12	—	„	21st	6½	7	10	9
„	22nd	11	10½	11½	11	„	28th	9	8	11	10½
„	26th	11	9	11	10½	Sept.	3rd	6½	7½	11	10½
Feb.	12th	9	9	10	9½	„	10th	9	8½	10	10
„	20th	8½	7½	11½†	10						

\* 1 at 12 mm.

† 1 at 13 mm.

§ 1 at 10½ mm.

†† 1 at 9½ mm.

\*\* 1 at 11 mm.

|| 2 at 10½ and 9½ mm.

‡ 2 at 13½ and 12½ mm.

‡‡ 2 at 12½ and 11 mm.

TABLE III.  
MEASUREMENTS OF BODY-LENGTH OF *SAGITTA SETOSA* IN MILLIMETRES.

	1930	Length in mm.																			Total measured.	Number with Nematodes.											
		4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	10½	11	11½	12	12½	13			13½	14	14½	15	15½	16	16½	17			
Sept.	11	-	-	-	-	-	-	-	-	-	1	1	2	3	7	25	54	51	14	10	2	-	1	-	-	-	-	-	-	-	-	171	2
"	16	-	-	-	-	1	2	1	1	4	2	5	1	1	2	6	8	6	6	1	-	-	-	-	-	-	-	-	-	-	-	47	1
"	24	-	2	-	3	7	16	12	14	8	6	2	1	3	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	77	-	
Oct.	1	-	-	-	-	-	1	4	1	1	1	4	6	6	7	3	4	5	1	1	1	1	-	-	-	-	-	-	-	-	46	-	
"	7	-	-	-	-	4	2	2	10	13	16	20	49	51	39	19	24	24	11	6	2	-	-	-	-	-	-	-	-	-	292	1	
"	14	-	-	1	3	4	11	12	21	23	24	37	47	38	19	13	7	6	2	-	-	-	-	-	-	-	-	-	-	-	268	2	
"	16	1	4	7	11	11	16	19	22	17	21	30	36	24	17	5	6	3	-	-	-	-	-	-	-	-	-	-	-	-	250	2	
Nov.	6	-	-	1	5	12	17	31	54	45	44	35	24	15	15	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	301	-	
"	13	1	3	5	11	8	14	11	16	20	8	12	3	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	117	-	
"	20	-	-	3	3	12	2	11	9	16	10	4	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73	-	
"	25	1	2	4	5	14	11	13	6	11	6	5	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	82	-	
Dec.	3	-	-	1	7	7	13	18	25	25	21	20	19	9	4	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	170	-	
"	10	-	2	2	2	7	15	26	20	22	9	21	17	4	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	152	-	
"	17	-	-	-	2	5	5	9	17	28	18	26	26	20	7	2	3	-	1	-	-	-	-	-	-	-	-	-	-	-	169	-	
"	22	-	-	1	3	2	-	3	6	8	11	9	13	5	3	7	2	2	1	-	-	-	-	-	-	-	-	-	-	-	74	-	
1931																																	
Jan.	1	-	1	1	5	7	28	20	32	35	36	28	17	13	6	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	234	-	
"	5	-	-	-	-	2	4	-	3	4	13	10	9	6	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56	-
"	15	-	-	-	-	1	4	3	9	11	13	16	30	24	28	20	17	5	4	-	-	-	-	-	-	-	-	-	-	-	-	185	1
"	22	-	-	2	1	-	10	11	11	15	30	30	19	36	34	24	12	11	-	-	-	-	-	-	-	-	-	-	-	-	-	246	-
"	26	-	-	-	-	-	1	4	6	4	8	12	16	11	19	12	5	3	-	-	-	-	-	-	-	-	-	-	-	-	-	101	1
Feb.	6	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
"	12	-	-	-	-	-	-	1	-	1	-	3	2	3	2	1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	17	-
"	20	-	-	-	-	-	2	2	1	5	7	8	8	7	18	16	27	18	19	4	2	2	1	-	-	-	-	-	-	-	-	147	-
"	23	-	-	-	-	-	2	3	3	2	7	7	9	4	16	14	21	11	7	1	-	-	-	-	-	-	-	-	-	-	-	107	-
March	17	-	-	-	-	-	-	-	-	-	-	1	3	1	4	3	5	9	13	8	3	1	-	-	-	-	-	-	-	-	51	-	
"	26	-	-	-	-	-	-	-	-	-	1	2	4	3	9	15	25	36	55	42	18	5	1	-	-	-	-	-	-	-	-	216	1
April	1	-	-	-	-	-	-	-	1	1	1	6	6	6	19	23	23	15	33	19	10	3	-	-	-	-	-	-	-	-	-	166	1
"	9	-	-	-	-	-	-	-	-	-	-	2	-	3	1	8	17	35	32	41	15	7	1	-	-	-	-	-	-	-	-	162	2
"	16	-	-	-	-	-	-	-	-	-	-	1	2	3	4	8	9	12	32	31	29	17	8	3	-	-	-	-	-	-	-	159	2
"	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	3	6	8	3	5	-	-	-	-	-	-	27	-	
"	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3	2	4	5	-	1	-	-	-	-	-	18	1	
May	6	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	1	4	4	10	10	5	1	4	-	-	-	-	42	1	
"	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	3	1	2	-	-	-	-	-	-	-	8	-	
"	28	-	-	-	2	2	1	4	7	6	15	13	7	14	6	8	4	5	5	2	6	6	21	19	13	3	5	1	175	3	-		

June	9	-	-	2	-	-	3	5	3	3	12	16	23	33	27	42	53	31	30	11	8	13	9	7	11	1	-	-	343	-
"	16	-	-	1	-	-	-	1	-	-	-	1	1	1	3	3	-	2	2	-	-	1	-	1	-	-	1	-	18	-
July	15	-	-	-	-	-	-	-	-	-	-	-	3	4	16	19	27	17	12	4	1	2	1	-	-	-	-	-	106	-
"	23	-	-	-	-	-	-	-	-	1	1	1	3	3	6	10	15	26	24	23	4	2	1	-	-	-	-	-	120	2
"	30	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	1	2	5	-	-	-	-	-	-	-	10	-	
Aug.	5	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	1	1	-	-	2	-	-	-	-	7	1	
"	14	-	1	-	-	1	8	8	4	8	4	6	6	10	14	13	11	20	39	48	51	21	6	6	-	1	-	286	20	
"	21	-	1	5	2	8	9	16	14	21	23	28	28	44	37	39	34	29	31	29	22	10	-	1	-	-	-	431	14	
"	28	-	-	-	-	-	-	2	2	10	10	9	23	32	41	44	46	39	23	14	8	1	2	-	-	-	-	306	6	
Sept.	3	-	-	1	2	1	4	6	5	6	9	13	27	20	27	31	40	33	19	15	3	2	1	-	-	-	-	265	1	
"	10	-	-	-	-	-	1	-	3	8	9	13	24	34	63	64	62	24	16	2	1	-	-	-	-	-	-	324	-	
"	10*	-	-	-	-	-	-	-	-	-	-	-	-	-	4	5	15	21	16	17	18	12	13	2	1	-	-	126	8	

\* 0.4% of whole catch: also 1 of 19½ mm. and 1 of 22½ mm.

TABLE IV.  
MEASUREMENTS OF BODY-LENGTH OF *S. ELEGANS* IN MILLIMETRES.

		Length in mm.																				Total measured.													
1930		4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	10½	11	11½	12	12½	13	13½		14	14½	15	15½	16	16½	17	17½	18	18½	19	19½	20
June.	9	-	1	2	1	-	4	9	6	9	15	25	21	27	26	27	36	34	44	39	31	29	26	23	17	12	4	7	-	-	2	2	1	1	481
"	16	-	-	-	1	1	1	2	-	1	3	1	1	1	-	-	-	-	1	-	-	-	-	2	-	-	-	-	1	-	-	-	-	16	
July	8	-	-	-	-	1	-	1	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	
"	15	-	-	-	-	-	2	3	2	9	13	15	25	33	22	20	15	19	13	18	5	2	3	-	-	-	-	-	-	-	-	-	-	219	
"	23	-	-	-	-	1	3	1	10	18	18	16	18	15	15	21	36	45	32	36	15	9	6	-	1	-	-	-	-	-	-	-	-	316	
"	30	-	-	-	-	-	4	1	2	2	3	3	2	-	1	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23		
Aug.	5	-	-	-	-	-	2	3	4	7	13	14	12	13	5	6	2	4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	87		
"	14	-	-	-	-	-	1	-	6	9	7	25	42	41	55	57	50	18	11	5	-	-	-	-	1	-	-	-	-	-	-	-	328		
"	21	-	1	-	1	-	-	2	1	3	9	16	26	33	49	38	39	16	3	3	-	-	-	-	-	-	-	-	-	-	-	-	240		
"	28	-	-	-	-	-	-	3	6	7	8	12	28	63	84	62	30	10	2	1	-	-	-	-	-	-	-	-	-	-	-	-	316		
Sept.	3	-	-	-	-	1	-	2	1	3	9	8	27	50	70	77	40	28	15	3	2	2	-	-	-	-	-	-	-	-	-	-	338		
"	10	-	-	-	-	-	-	-	-	2	-	1	2	4	7	4	4	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	28		

TABLE V.

TOTAL NUMBERS OF *S. ELEGANS* IN RING-TRAWL COLLECTIONS.

June 9th, 1931	434	Aug. 5th, 1931	88
„ 16th „	16	„ 14th „	824
July 8th „	5	„ 21st „	1058
„ 15th „	219	„ 28th „	2570
„ 23rd „	544	Sept. 3rd „	5152
„ 30th „	22	„ 10th „	256

TABLE VI.

RESULTS OF EXAMINATION OF STAINED SPECIMENS OF *S. ELEGANS*  
FOR STATE OF MATURITY: LENGTHS IN MILLIMETRES.

Date.	St. I.		St. II.		St. III.		Date.	St. I.		St. II.		St. III.	
	Upper limit.	Lower limit.	Upper limit.	Lower limit.	Upper limit.	Lower limit.		Upper limit.	Lower limit.	Upper limit.	Lower limit.		
June 9th	—	7½	11	10	Aug. 14th	8	7	11½	10½				
„ 16th	7	8	9½	?	„ 21st	—	7½	11	10				
July 15th	—	7½	11	11	„ 28th	—	7	10	10				
„ 23rd	7½	7	11	10½	Sept. 3rd	6½	7½	10	9½				
„ 30th	7	7½	11½	11½	„ 10th	—	8½	11	10½				
Aug. 5th	9	7	11½	10½									