

On the Occurrence of Pelagic Tunicates (Thaliacea) in the Waters of the English Channel off Plymouth.

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It is only occasionally that pelagic tunicates of the genera *Doliolum* and *Salpa* are recorded in numbers in the waters off Plymouth. In view of their possible use as indicators of the presence of Atlantic water (see Bowman, 1923; and Schmidt, 1909, p. 159), it is of value that their occurrence should be put on record. Regular weekly catches of plankton have been made since 1930 with half-hour oblique hauls with the two-metre stramin ring-trawl. During this period species of both genera have appeared in such numbers that it has seemed desirable to make a careful examination of the species occurring.

Doliolids.

PREVIOUS RECORDS.

*Doliolum** was found in considerable numbers in tow-nettings at Plymouth in August and the beginning of September, 1893, soon becoming scarce (Garstang, 1894, p. 222; Browne, 1896, p. 171). In 1895 *Doliolum* was exceedingly abundant at the beginning of September and there was a gradual decrease towards the end of the month (Browne, 1896, p. 171). In September, 1897, *Doliolum* was not found (Browne, 1898, p. 191). The only other record in the Plymouth Marine Fauna (1931) is of several specimens of *D. nationalis* taken in November, 1904.

Salps.

Large shoals of *Salpa democratica* visited the Sound from the middle of June to the end of the first week in July, 1893 (Garstang, 1894, p. 222, *Thalia democratica-mucronata*). In September, 1893 and 1897, none were taken and in September, 1895, a few on the 9th only (Browne, 1896, p. 171; 1898, p. 191).

Salpa fusiformis was taken in the region of the Eddystone in August, 1901, and July and September, 1925 (Plymouth Marine Fauna, 1931).

* Specimens of *D. nationalis* recorded as *D. tritonis*, see Fowler, 1898, p. 593.

It was also present in large numbers in the Sound in September, 1917, but no collections were available from offshore waters.

Salpa zonaria was taken in numbers by Professor J. H. Orton when on a cruise in s.s. *Oithona* in September, 1914, off Falmouth Bay. We are indebted to Professor Orton for allowing us to examine these specimens.

RECENT OBSERVATIONS.

In Table I are given records of the numbers of tunicates taken in the weekly oblique hauls in 1931 and 1932. Throughout the whole of 1930 none were seen, and in Table I only those months in which specimens were seen are included.

TABLE I.

NUMBERS OF DOLIOLIDS AND SALPS IN HALF-HOUR OBLIQUE HAULS WITH THE 2-METRE STRAMIN RING-TRAWL.

1931	<i>Doliolum.</i>	<i>S. mucronata.</i>	<i>S. fusiformis.</i>
Sept. 10th	-	3 solitary 2 aggregate	-
„ 24th	21	-	-
Oct. 1st	60	20 aggregate	-
„ 8th	798	-	-
„ 15th	1513	-	-
„ 22nd	515	-	-
„ 29th*	1412	-	-
1932			
Aug. 26th	-	-	18 aggregate.
Sept. 1st	-	-	{ 47 aggregate. 14 solitary.
„ 7th	-	-	{ 103 aggregate. 4 solitary.
„ 14th	32	-	{ 696 aggregate. 6 solitary.
„ 21st	199	-	{ 311 aggregate. 199 solitary.
„ 29th	213	-	116 aggregate.
Oct. 4th	164	-	{ 1330 aggregate. 120 solitary.
„ 11th	1722	-	-
„ 19th	3450	-	1 aggregate.
„ 26th	2357	-	-
Nov. 14th	331	-	-

* The next haul was on November 25th, when none were seen.

The Table shows that the autumn of 1931 was notable for the appearance of Doliolids and a few *S. mucronata*; and that 1932 is notable for the occurrence of Doliolids and also of *Salpa fusiformis* which has appeared in numbers greater than in living memory of any member of the Plymouth Laboratory staff, except perhaps for the year 1917 when it invaded the Sound and Hamoaze. Examinations were also made of ring-trawl catches during the following periods, but no Doliolids or Salps seen—May to July, 1924; April to August, 1925; April to September, 1926; April to December, 1927; January to April, 1928; April to October, 1929. (For dates of collections, see Russell, 1930, p. 714.)

Two species of Doliolum were taken in large numbers in 1931, namely *D. nationalis* and *D. gegenbauri*. In 1932, however, it is to be noted that only *D. nationalis* was seen. Table II shows the composition of samples of some of the catches.

TABLE II.

COMPOSITION OF SAMPLES OF DOLIOLUM CAUGHT ON THE DATES GIVEN.

		8.10.31.	15.10.31.	22.10.31.	29.10.31.
<i>D. nationalis</i>	{ (phoro-zooids)	84	103	7	51
	{ (gono-zooids)	5	—	—	—
<i>D. gegenbauri</i>	{ (phoro-zooids)	17	17	4	24
	{ (gono-zooids)	21	40	12	76
<i>D. sp.</i>	(old blasto-zooids)	64	15	11	49
<i>D. ? nationalis</i>	(blasto-zooids)	—	—	—	1

		14.9.32.	21.9.32.	26.9.32.	29.9.32.	11.10.32.	19.10.32.	26.10.32
<i>D. nationalis</i>	(phoro-zooids)	13	83	311	72	646	303	388

THE SPECIES OF THALIACEA OCCURRING IN THE ENGLISH CHANNEL OFF PLYMOUTH.

(1) *Salpa fusiformis* Cuvier, 1804, p. 382, Pl. LXVIII, Fig. 10.

The specimens of *S. fusiformis* obtained in 1932 have the smooth test of the typical form. The relationship of this form to *S. fusiformis aspera* (Cham.) (= *S. echinata* Herdman, see Ihle, 1912, p. 40) is still debatable. Ritter (1905, p. 69) maintained that the characters of *aspera* appeared in older specimens. Apstein (1906, p. 268) regarded it as the cold water form. Examination of the material in the British Museum has given no conclusive evidence.

- (2) *Salpa democratica* Forskål, 1775, p. 113.
- (3) *Salpa zonaria* (Pall.). *Holothurium zonarium* Pallas, 1774, p. 26. Pl. I, fig. 17 A, B, C. Only recorded off Falmouth Bay.
- (4) *Doliolum nationalis* Borgert, 1893, p. 406, text-fig.
- (5) *Doliolum gegenbauri* Ulianin, 1884, p. 134, Pl. VII, fig. 5.

No member of the group of species to which *D. gegenbauri* belongs had previously been recorded at Plymouth, for Garstang's record of *D. tritonis* was based on material of *D. nationalis* (see above). *D. gegenbauri* and *D. tritonis* are very closely allied and may yet prove to be synonymous. The gonozooids are distinguished by the stigmata, which end ventrally at the 5th muscle band in *D. gegenbauri* and in *D. tritonis* extend a little further forward to end between the 4th and 5th bands. Except in a few badly crushed specimens, where the position of the stigmata could not be made out at all, the Plymouth material was all clearly of the *gegenbauri* type.

6) Blastozooids of *Doliolum*.

The blastozooids obtained in 1931 are nearly all too old for identification. One, however, has the stigmata and gut complete, though the stigmata are a little crushed so that their exact shape cannot be determined. It agrees closely with the blastozooid of *D. denticulatum** (Grobber, 1882, Pl. I, figs. 3-5; for synonymy see Neumann, 1906, p. 222), no difference being apparent except that the endostyle extends a little further back, reaching the 5th muscle band. *D. denticulatum* does not occur at Plymouth, but its nearest ally, *D. nationalis*, together with *D. gegenbauri*, was in the haul in which this one blastozooid was taken. Fowler (1905, p. 93) had exactly similar blastozooids, some of which are in the British Museum (Nat. Hist.). He attributed them very tentatively to *D. tritonis*, recognising *D. nationalis* as the only alternative. Ritter (1905, p. 86) has shown reasons for connecting a different blastozooid with *D. tritonis*. In it the intestine is short and slightly twisted, the anus presumably being further forward than in Fowler's blastozooid, in which the intestine is straight and reaches the 8th band. The otocyst is in the third intermuscular space in both, but in Ritter's is nearer the 3rd, in Fowler's nearer the 4th band. Despite the fact that *D. gegenbauri* is the classical material for the study of the life-history of *Doliolum*, there appears to be no precise information about the characters of the intestine

* Ritter (1905, p. 93) gives no reasons for his conclusion that this blastozooid belongs, not to *D. denticulatum*, but to some unknown gonozooid. The name *D. ehrenbergii* Ulianin belongs to a gonozooid (which may not exist) with the stigmata reaching the first muscle band. Ritter's use of the name for his blastozooid would only be justified if he had proved that it developed from a gonozooid of that type. His references to *gegenbauri* in this paragraph must be read as *ehrenbergii*.

of the blastozoid, except that the anus lies between the 7th and 8th bands (Neumann, 1906, p. 219). There is thus some reason for distinguishing Fowler's blastozoid with its straight intestine and anus under the 8th band from both *D. tritonis* and *D. gegenbauri*, whether they are synonymous or not, and for concluding that it belongs to *D. nationalis*.

DISTRIBUTION.

All the five species of Thaliacea recorded above are widely distributed in the warmer seas of the world. The Salps are all found in the Atlantic, Indian, and Pacific Oceans. Apstein (1906, pp. 261-277) states that *S. democratica* is the commonest Salp in warm water, and that it is carried northwards in the Gulf Stream; that *S. fusiformis* is one of the most frequent Salps, above all at home in warm water but occurring in higher latitudes; and that *S. zonaria* is found above all in the warm parts of the oceans but is carried north in the Gulf Stream. Of all the warm-water species of Salps, these three especially appear to be able to withstand a considerable lowering of temperature, being carried north into temperatures of 10° C. in waters north of Scotland.

Neumann (1913, p. 230-231) states that *D. nationalis* and *D. gegenbauri* occur in the Atlantic and Indian Oceans and in the Mediterranean. They however appear to be more confined to the warm water than do the above species of Salps.

It is hoped that when future records are available it will be possible to indicate to what extent the presence of these tunicates in English Channel waters may be due either to movement of Atlantic water or to high temperatures allowing successful reproduction and survival in the area.

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