

THE DISTRIBUTION OF *ARACHNACTIS* *ALBIDA* M. SARS IN THE CELTIC SEA

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(Text-fig. 1)

The present paper is an account of the distribution of *Arachnactis albida* (Fam. Arachnanthidae, Carlgren, 1924) in the area south of Ireland and in the western approach of the English Channel during 1937-9. This larval Cerianthid, the adult of which is at present unknown, is a North Atlantic planktonic species. It has been collected by numerous scientific expeditions, the records of which indicate a centre of distribution between the Faroes and the Hebrides with a range extending along the Atlantic seaboard of north-western Europe from the Barents Sea to south-west of Ireland, and as far west as long. 20° W. (Carlgren, 1906, 1924). It has been taken in the northern North Sea frequently, but in the southern North Sea the only record is of a solitary specimen found off the Norfolk coast (lat. 50° 02' N., long. 1° 40' E.) by Leloup (1929, 1931), who attributes its occurrence there to a south-going coastal current. There is no valid record of the species in the English Channel or the Irish Sea, but off the west coast of Ireland specimens have been taken from many points, especially towards the south-west in Valentia Harbour (Browne, 1900) and off Tearaght Light (Bourne, 1920). This is the southernmost point (lat. 51° 27' N., long. 11° 51' W.) at which it has been recorded by previous workers. According to Carlgren's investigations (1906), several of the records of *A. albida* in the International Bulletins refer to other species (Krampe, 1913), and the records in the *Bulletin Planktonique* are not reliable as *A. albida* has been confused with *Synarachnactis bournei*¹ (Ostenfeld, 1931, p. 632). The records show that the species occurs mainly in open oceanic seas and not in the relatively more enclosed waters of the English Channel, Irish Sea and the southern North Sea (excepting Leloup's single record). Bourne, who investigated the specimens collected off south-west Ireland, suggested a subcentre of distribution in that area (near lat. 51° N.), but he emphasized that 'the possibility must not be overlooked that the larvae and adult or quasi-adult forms taken off the south-west coast of Ireland belong to a species or sub-species distinct from *A. albida*' (Bourne, 1920, p. 45). His statement is

¹ This is the species of *Arachnactis* which occurs at Plymouth in spring and summer (vide *Plymouth Marine Fauna*, 1931, p. 87). *A. albida* has not been found at Plymouth. Bourne's record (1890, p. 321), cited by many authors, actually refers to *Synarachnactis bournei* which is the larva of *Cerianthus lloydi* (vide Bourne, 1920, p. 29). The statement in *Journ. Mar. Biol. Assoc.*, Vol. VII, p. 203, 1904, concerning the occurrence of *Arachnactis albida* in spring at Plymouth is a mistake, repeated by Pax (1934), who has overlooked the correction in the 1931 edition of the *Plymouth Marine Fauna*.

based on evidence of 'differences in size, colour(?), distribution and minute anatomy' between the specimens from the south-west coast of Ireland and examples from the Faroes. This problem is discussed in the present paper.

The specimens of *Arachnactis* taken during 1937-9 in the Celtic Sea¹ can be referred with certainty to the species *A. albida*. A careful analysis of distribution in the area was made not only in view of the new locality but also because there is no accurate information concerning its distribution towards the south. The present data extend the range of the species as far south as lat. 48° N. off the mouth of the English Channel and indicate the existence of a localized subcentre of distribution to the south of Ireland in the neighbourhood of lat. 50° N., long. 10° W. Its occurrence to the south and east of this new centre can probably be correlated with water movements.

The material for this study was obtained in 1937-9 during a series of spring and summer cruises undertaken in the course of the Plymouth mackerel investigations and covering the area of the south-western continental shelf. The plankton samples were collected by means of half-hour oblique hauls with the 2 m. stramin ring-trawl. A thorough examination was made of the material obtained in June 1939, for which year hydrographical data were also available. The larvae were picked out from each haul and their total numbers counted except at those stations where they occurred in swarms; in the latter the total was estimated by subsampling. The plankton collections of the other cruises were then examined in order to determine whether the centre of distri-

TABLE I. *Records of Arachnactis albida from the Celtic Sea, arranged according to months*

Cruise	Station no.	No. of <i>Arachnactis</i>	Cruise	Station no.	No. of <i>Arachnactis</i>
March 1939	5	0	June 1939 ²	2	1
	18	0		3	1
April 1938	19	0		6	44
	20	0		7	3
	21	0		8	4
				9	1
April 1939	23	0		10	1050
	24	1		11	600
				12	1
May-June 1937	5	0		14	2
	8	0	15	47	
	10	0	18	2	
	15	0	19	2	
			27	5	
June 1938	6	0	July 1937	5	0
	13	1		8	102
	18	3000		10	0
	28	0			
	30	0			

¹ 'Le terme de "mer Celtique" fut employé pour la première fois par E. W. L. Holt, pour désigner l'étendue marine qui recouvre le plateau continental au sud de l'Irlande et à l'Ouest de l'entrée de la Manche' (Le Danois, 1938). Though we have not been able to find it in any of Holt's published papers, this term is used here owing to its great convenience.

² See Fig. 1 for the fourteen stations at which no larvae were obtained in this cruise.

bution was similarly located in each year and also to ascertain the time of year at which the larvae begin to appear in the plankton. Owing to the large number of samples this examination was not made station by station: it was limited to certain hauls from the areas in which *A. albida* was abundant in June 1939 and to certain other hauls from areas barren of larvae in June 1939. This was considered fully sufficient, since all the samples had previously been examined minutely in the course of the mackerel work and the presence of

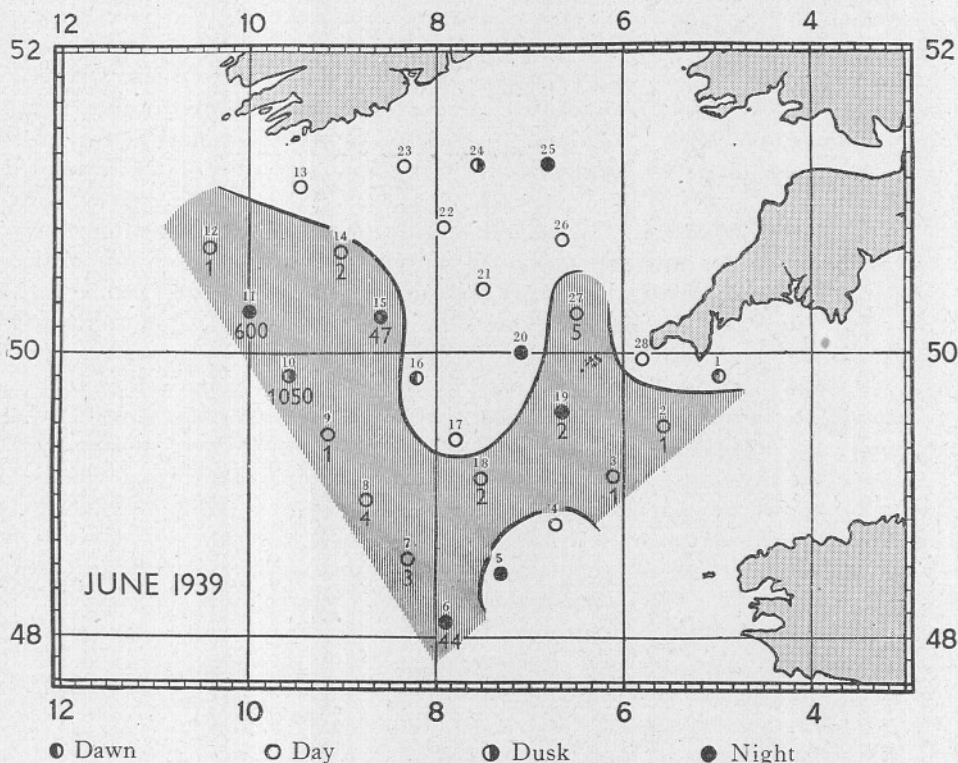


Fig. 1. Distribution of *Arachnactis albida* in the Celtic Sea in June 1939. Shaded area shows regions where larvae were obtained. Circles indicate station positions (differently shaded according to time of haul) with the station numbers above. The number of larvae obtained (if any) is shown below each circle.

Arachnactis larvae had been noted at the time. It is therefore unlikely that their occurrence in any numbers escaped notice. These results are summarized in Table I.

The numbers of *A. albida* obtained in June 1939 are shown in this table and in Fig. 1. The species was widely distributed over the western, southern and eastern margins of the area investigated—almost completely surrounding a region barren of larvae which extended southwards from the St George's and Bristol Channels (Sts. 13, 16, 17 and 20–26). The largest catches were taken

at Sts. 10 and 11, where 1050 and 600 specimens respectively were recorded. Elsewhere only small numbers occurred, but 44 larvae were taken at St. 6, which is noteworthy since it is the southernmost record of the species. The large hauls at Sts. 10 and 11 suggest the existence of a distribution centre in this region. Since, however, both day and night hauls were taken during the cruise, this indication cannot be established without first determining whether or not the observed horizontal distribution was affected by diurnal vertical migration of the larvae. This is especially important since Sts. 10 and 11 were worked at dusk and just before dawn. Sts. 6 and 15, where the next largest catches were made (44 and 47 specimens), were worked just before dawn and at midnight respectively. Unfortunately there is little information relating to the diurnal behaviour of *A. albida*, and the question can therefore only be further investigated by a critical examination of the data available in the present records.

In June 1939 *A. albida* was taken at fourteen stations. A total of twenty larvae were taken at nine day stations in contrast to over 1700 from one dusk and four night stations (Sts. 6, 10, 11, 15 and 19). The four largest catches of *A. albida* were all from night stations. This suggests that the large numbers taken in night hauls were probably due to migration of the larvae into the upper layers of water during darkness. Apart, however, from any temporary night-time increase in numbers of larvae near the surface, the existence of a distribution centre in June 1939 is indicated by the marked difference between the large total of 1650 larvae from Sts. 10 and 11 and the much smaller total of only 91 from the two next largest night catches at Sts. 6 and 15. Vanhoffen (1895) has noted the occurrence of *A. albida* in swarms at the surface in daytime. A daylight haul in July 1937 contained 102 specimens, and it is significant that about 3000 *A. albida* were taken in a daylight haul in June 1938 at a point less than 5 miles distant from St. 10 of June 1939. This recurrence in two consecutive years (1938 and 1939) of dense *Arachmactis* patches in the same locality and at the same time of year affords strong evidence of the existence of a breeding centre in the neighbourhood of lat. 50° N., long 10° W.

All the larvae taken in June 1939 were at fairly early stages of development. The youngest example had only five marginal and two oral tentacles, a stage very similar to that illustrated by Bourne (1920), which is the youngest larva recorded. The oldest individuals had eleven marginal and six oral tentacles. Of the 1050 specimens from St. 10, a critical examination of two subsamples showed that about 10% were early stages in which the directive tentacle had not appeared, about 2% possessed more than nine marginal tentacles, and the bulk of the material belonged to intervening stages in which the directive was recently formed and distinctly smaller than the other marginal tentacles. Larvae from Sts. 11 and 15 showed about the same percentages. Larvae from Sts. 6 and 27 were mostly earlier stages with less than eight marginal tentacles, and the single specimens obtained at Sts. 2, 3 and 9 were damaged, though certainly identifiable as *A. albida*. No *A. albida* were taken on

the June 1937 cruise. This may in some measure have been due to the fact that the area investigated did not extend farther west than long. $8^{\circ} 30' W$. But in July 1937, 102 specimens were taken at a point about 50 miles south-east of the June 1939 centre. Most of these larvae were older stages than those found in June 1939; they had more than six oral tentacles, and the marginals had begun to drop off prior to the settlement of the larvae.

On the whole the records of 1937-9 show considerable agreement in regard to the locality of the dense concentrations of *A. albida*—a fact which points to the existence of a localized centre of distribution in the area investigated. It is also evident that in this area early June is the period of abundance, whereas in the Faroe-Hebrides region, July and August are the months during which the species has been most commonly taken. The single larva taken in April 1939 (about 20 miles west of St. 10 of June 1939) is the earliest record from the Celtic Sea. It would appear that in the south adults of *A. albida* begin to breed earlier than in northern latitudes, an observation which is in accord with the breeding behaviour of many other species.

It is probable that the centre of distribution off the south-west of Ireland is not as localized as is indicated by either Bourne's or the present records. Further work in the area may reveal that it covers a very much wider region embracing both these sets of records; or that the position of the centre of distribution shifts with the changes in flow of the Atlantic Stream (Harvey, 1930) or with changes of other controlling factors not yet known.

The *Arachnactis* obtained in the Celtic Sea during 1937-9 all belong to the species *A. albida*. The external appearance of the larvae, the arrangement of tentacles, colouring and disposition of the mesenteries as revealed by dissection of older individuals agree completely with the descriptions of *A. albida* given by Carlgren, Vanhoffen and others. The earlier stages show the characteristic brown coloration at the tips of the tentacles and on the throat. Examination of *A. albida* from the Faroe Channel¹ and comparison of them with the Celtic Sea specimens showed complete agreement in regard to external features.

It has also been possible to examine and compare a large series of larvae collected from the west coast of Ireland² with the Celtic Sea material. Some of these were taken to the north in the neighbourhood of Cleggan Head, Co. Galway, others to the south near Tearaght Light, the original locality of Bourne's specimens. From this comparison there can be no doubt that the larvae from the west coast of Ireland are identical with those from the Celtic Sea. It is therefore necessary to re-examine Bourne's suggestion of a distinct Irish species or subspecies which, it will be recalled, was based on differences

¹ These specimens were supplied through the courtesy of Capt. A. K. Totton of the British Museum.

² These specimens were collected during May-September 1890-1905 by the Irish Fisheries Department, and were kindly handed over for examination by Mr W. J. Rees. They were formerly part of the late Mr E. T. Browne's collection.

in distribution, size, colour and certain details of micro-anatomy. The Celtic Sea records, together with those from the west coast of Ireland and the numerous records from the Faroe-Hebrides area clearly indicate that *A. albida* has a continuous distribution along the western seaboard of the British Isles. The specimens from the neighbourhood of Cleggan Head do not appear to have come to Bourne's notice. This may possibly account for Bourne's statement that the 'northern form' has a distribution entirely separate from that of the 'Irish form'. With regard to colour, Bourne stressed the absence from his specimens of the brown coloration of the throat region which is typical of *A. albida*. He examined the specimens several years after their collection and noted that the throat coloration might have been lost since capture. In this connexion, it may be mentioned that the larvae obtained in June 1939 clearly showed the characteristic brown coloration at the tips of the marginal tentacles and in the throat, whereas this had already begun to fade, especially from the throat, in the larvae taken during the earlier cruises of 1937 and 1938. All the Celtic Sea larvae were examined in 1941. This possibility of fading during storage considerably reduces the importance which Bourne attached to the colour differences between his specimens and typical *A. albida*. The third difference noted by Bourne is that of size. His specimens from the south-west coast of Ireland were smaller than larvae from the Faroe Channel. On the whole, the Celtic Sea larvae were also smaller when compared with the measurements given by Vanhoffen and others. Considerable size variation among larvae of the same developmental stages was noticeable in the Celtic Sea material and also in the specimens from the Faroe Channel. This slight size difference alone cannot be considered sufficiently important a criterion upon which to base a specific or subspecific difference. Finally, the minor anatomical differences observed by Bourne are not of value from a systematic standpoint, and the morphology of the typical *A. albida* as described by Carlgren, Vanhoffen and others, is essentially the same as that of the Irish specimens studied by Bourne. It would thus seem that there is no justification for the separation of the *Arachmactis* from the south-west of Ireland into a species or subspecies distinct from the *A. albida* of the Celtic Sea and the Faroe-Hebrides region.

The distribution of *A. albida* in the Celtic Sea in June 1939 seems to show some correlation with the salinities of the surface layers (for chart of salinities at 5 m., vide Mare, 1940, p. 477). The larvae were present where salinities were greater than 35.2 ‰ but were entirely absent from the central tongue of lower salinity water (< 35.2 ‰), extending southwards from the St George's and Bristol Channels. The centre of distribution lay in high salinity water (> 35.4 ‰) which was present at all depths along the edge of the continental shelf. Salinities at depths less than 25 m. probably varied little, but at about 25 m. there were indications from both salinity and temperature values of a sharp discontinuity. In the deeper water of 50 m. there was less correlation between salinity and the occurrence of larvae.

Matthews (1914), Harvey (1929, 1930) and others have given a general description of the cyclonic circulation of water in the Celtic Sea and its bearing on the distribution of many species is reviewed by Russell (1939). The salinities observed in June 1939 support this picture of circulation, and the correlation between surface salinities and the occurrence of larvae indicates that water movements in the area may have a marked influence on the dispersal and distribution of *Arachnactis*. The small numbers of larvae obtained outside their centre of distribution (Sts. 2, 3 and 19 off the Channel mouth and St. 27 north of the Scillies) were probably carried there by the cyclonic current.

It is of interest to note that Mare (1940), working on the phytoplankton of the Celtic Sea, found some evidence of mixing of Atlantic and Channel water close to the Scillies in the occurrence in April 1939 of both oceanic and neritic species of diatoms. In June 1939 a surface patch of high salinity water (> 35.5 ‰) at St. 27 again indicated the presence of water of mixed origin in the Land's End-Scillies channel, but Mare states that no phytoplankton species was especially associated with it. Some few *A. albida* were, however, taken at this station; they were all early epiplanktonic stages which may well have been carried there by water movements.

It is probable that the adult of *A. albida* is a benthic species (Carlgren, 1931). In the Celtic Sea adult examples, liberating larvae in May and June, may be expected to occur near the edge of the continental shelf in the area round lat. 50° N., long. 10° W.

It remains to be seen from future work if the correlation between water movements and the occurrence of *A. albida*, here indicated, is reliable, for the species may then prove to be a useful summer indicator of oceanic water in the Celtic Sea.

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SUMMARY

The distribution of *Arachnactis albida* in the Celtic Sea in 1937-9 is described. The species appears to have a definite centre of distribution in the neighbourhood of lat. 50° N., long. 10° W. The larvae have been taken as far south as lat. 48° , and eastwards up to the mouth of the English Channel, but they are absent from the tongue of low salinity water continuous with the St George's and Bristol Channels. Their distribution in the remaining area can be correlated with the cyclonic circulation.

The larvae obtained from the Celtic Sea are specifically identical with those found off the west coast of Ireland and with the typical *A. albida* of the Faroe-Hebrides region.

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