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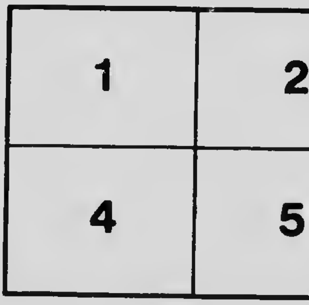
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The Swarming of Odontosyllis

by

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The Swarming of Odontosyllis.

By C. McLEAN FRASER, PH.D.

(From the Pacific Coast Biological Station, Departure Bay, B.C.)

Presented by DR. A. B. MACALLUM, F.R.S.C.

(Read May Meeting, 1915.)

On Feb. 10, 1913, Mr. F. A. Potts of Trinity Hall, Cambridge, read a paper on "The Swarming of Odontosyllis," at a meeting of the Cambridge Philosophical Society, which paper appeared in the Proceedings on April 23, following. Observations made on *Odontosyllis phosphorea* Moore, a species of Annelid found in the vicinity of the Biological Station, Departure Bay, B.C., provided material for the body of the paper, to which is added a comparison of the habits of this species with that of other Syllids and Nereids.

The observations made and recorded were of much interest and the conclusions appeared to be so but as is often the case when conclusions are based on very limited observations, further examination shows the necessity of considerable revision.

As far as the phenomenon of swarming is concerned, repeated observations confirm all of Mr. Potts' statements without producing [illegible] of value in addition. The time of day at which spawning [illegible] place seems definite without doubt, but definite as regards [illegible] [illegible]ion of the sun, not definite as to the time on the clock. Very [illegible] have been seen very much before sunset, but from sunset or possibly a little before it until almost dusk, that is for a period lasting from half an hour to an hour, they appear at the surface whether the sun sets early or late.

There is nothing further to indicate that the males are attracted to the females as they are in *O. enopla*. In every instance each individual whether male or female comes to the surface without any apparent regard to the position of any other individual. The movement at the surface seems just as liable to be away from as towards the nearest individual of the other sex. It would therefore seem that although the number of individuals is great, the chance for fertilizing all of the ova, or even a large portion of them, is very slight. The chances might be increased if the eggs were pelagic at or near the surface but they are not so. They may remain suspended for some time in water that is somewhat agitated but if placed in a receptacle where the water remains still they soon sink to the bottom. Since the water of the sea s ms the most favorable for spawning when there is scarcely a ripple on the surface the eggs surely must be fertilized soon after ejection or not at all. No doubt this seeming waste is at least partially obviated by the movements of the Annelids themselves. As the female circles around with a motion that has been aptly described by an observer as a "wavy wiggle," the eggs are scattered right and left over an area relatively large. At the same time the male with a similar undulatory movement scatters the sperm, giving thereby a strong impetus to the movement of the very active spermatozoa. In the denser part of the swarm therefore, where these circles of distribution overlap, the chance for the fertilization of each ovum is not so slim as it would at first appear.

All of this then may be observed in the one evening if conditions are favorable and was observed by Mr. Potts. Numerous repetitions have merely substantiated the fact that the routine of the evening in which he was an interested spectator, is practically the same as that on any other evening during which the spawning occurs. With regard to the distribution of *Odontosyllis* in space and of its swarming in time, the limited extent of his observations did not serve as a satisfactory basis for his rather sweeping conclusions, but it is quite true that he makes a proviso for this in his paper.

Taking in the first place the geographic distribution of *Odontosyllis*, as Mr. Potts surmised, the limit was by no means reached in the much circumscribed area near Snake and Five Finger Islands. The Hexactinellid sponge referred to, as well as a number of other siliceous species are present over a wide area in the Strait of Georgia, an area of which we have not as yet found the limits. It has been traced in a southeasterly-northwesterly direction, i.e., running the same general direction as the strait and parallel to the eastern shore of Vancouver Island and the other outlying islands, to the northwest as far as Northwest Bay and Ballenas Islands, at least 15 miles from the original location and to the channels between Lasqueti and Texada Islands, 20 miles or more in a slightly different direction, while to the southeast they are just as plentiful around Gabriola Reefs and Breakwater Island, at least 15 miles away in that direction. Furthermore, *Odontosyllis* has been found in a somewhat different kind of bottom in the channels between the islands east of Vancouver Island to the south of the Station. In some of these instances the depth was much less than that indicated in the drawing of the originally described area. Dredging has not been done at a distance of much more than 25 miles from the Station in this direction but this Annelid has been found in the most distant of these dredgings. It would seem, therefore, that instead of having a restricted distribution, it is one of the most widely dispersed species to be found in the vicinity. As to its presence or absence in Departure Bay I have nothing definite to record. If it is not to be found in the bay it is not because the bay is too shallow as the species has been found at a less depth than is found here in many places. The bottom in general and especially in the deeper parts is different from that where *Odontosyllis* has been found and it may be for that reason that it is not present if it is not. Since I have been especially interested in the distribution of this species we have dredged very little in the bay. Possibly if a diligent search were made it might be found. The reason for the swarming at the entrance to the bay it will be considered to better advantage after the time of swarming has received some attention. To this we shall now turn.

The swarms of *O. phosphorea* were first noticed in 1911 on August 15 and 16 and in 1912 on August 18. From this Mr. Potts concludes that there is a possibility of a periodicity in the case of *O.phosphorea* similar to that of the Palolo worms. If he had carefully considered the data before him he should not have come to such a hasty conclusion. According to his own remarks on *Nereis osawai* of Japan, after reading Izuka's paper on the subject "Their date of appearance is absolutely fixed for the days following the new moon." I believe the species found in the Gulf of Mexico has an even more restricted periodicity which is also absolutely fixed for a date definitely related to the time of the new moon. In 1911 full moon appeared on Aug. 9 and the last quarter on Aug. 17, Aug. 15 and 16, when the swarms of *Odontosyllis* were observed, were consequently nearly the end of the third phase. In 1912 there was new moon on Aug. 12, the first quarter falling on Aug. 19, consequently Aug. 18 is near the end of the first phase. Large swarms were also seen on Sept. 5. Since the last quarter of the moon came on Sept. 4, this date is near the beginning of the fourth phase.

In 1913 observations were made over somewhat the same period as in 1912, and dates nearly the same as those in 1912 were obtained. This approximation seemed to make it worth while to go into the matter much more fully in 1914. This was more readily accomplished since Dr. A. Willey, who was at the station for a portion of the summer, became interested in the outcome also. Either one or both of us made examination of the locality in which *Odontosyllis* had been found swarming, at more or less regular intervals from the middle of June until the middle of December. The accompanying table shows the results of these examinations as well as those for the two preceding years. As the phases of the moon are given it will be seen at a glance that there is no indication of periodicity in the swarming but apparently it may take place at any time within a period of three or four months. There are gaps between the dates, it is true, but none are of very great length and the search in every case, particularly if none or few were found, was sufficiently prolonged to get accurate information as far as the area in question is concerned.

TABLE OF OBSERVATIONS.

Date		Result of Observation	Time	High tide	Low tide	Moon's Phases New	Full
1912							
Aug.	18	Plentiful	19 30	16 37	23 24		
	20	None		18 25	1 50		
	21	None		19 30	3 02		
	27						•
Sept.	5	Plentiful	19 00	18 13	0 39		
	10					•	
1913							
Aug.	2					•	
	11	Few	19 30	15 39	20 00		
	14	Few		17 45	23 30		
	15	None		18 08	23 51		
	16						•
	21	Numerous		20 06	13 48		
	22	Numerous		20 27	14 22		
	28	Few		16 26	21 24		
	31					•	
Sept.	6	Numerous	19 00	20 47	15 34		
	13	None		17 09	23 15		
	15						•
1914							
June	18	None					
	23	None					
July	1	None					
	18	None					
	22	None				•	
	25	Few	20.00	20 00	12 48		
	30	Numerous		22 29	16.42		
	31	Numerous		23 11	17 56		
Aug.	1	None		15 42	19 36		
	3	Few		17.15	22 23		
	5						•
	14	Numerous	19 30	21 47	[illegible] 16		
	19	Numerous		17.27	[illegible] 44		
	20	Few		17 49	[illegible] 20		
	21					•	
	29	Plentiful	19 00	[illegible].29	18.30		
Sept.	4						•
	5	Plentiful		18 10	0 34		
	19					•	
	21	Very plentiful	18.30	18.00	0 43		
	22	Three		18 30	1 28		•
Oct.	3						
	6	Numerous	17.30	17 42	0 46		
	8	Numerous		18.17	13 44		
	18					•	
	27	Few		13.19	20.21		
Nov.	2						•
	4	Five (3m & 2f)	17.30	16.33	0.10		
	11	One	17.00	12 22	19 10		
	12	None		12.56	19 50		
	17	One female		15.40	23.06	•	
	24	None					
Dec.	7	None					
	16	None					

With regard to the time of tide Mr. Potts says, "The tide was full or just falling." This is scarcely accurate. On Aug. 15, 1911, it was low tide at 14.53 and high at 21.10, on Aug. 16, low tide at 15.34 and high at 21.40. The 1912 tides are given in the table. Sunset in the two cases in 1911 occurs well on in the rising tide and on Aug. 18, 1912 at about half tide on the fall. It seems more nearly correct to say that the largest swarms are found at high tide or somewhat before that time, as far as the area at the entrance of Departure Bay is concerned (See table). A possible reason for this lies in the fact that the flood tide comes in from the south. The current is divided by Protection and Newcastle Islands, part going through Nanaimo Harbor and Newcastle Channel to reach Departure Bay. The outer current is less obstructed and as usual arrives at the north end of Newcastle Island before the other current, but the distance it works into the bay varies, apparently depending more upon the direction and force of the wind than on any other factor. Unless the surface of the water is very smooth the line where the two currents meet can readily be traced across the entrance of the bay. The outside current would tend to carry these annelids, coming from the deep in the Strait of Georgia, forward with it until the other current meets it and as there is practically still water here (the doldrums on a small scale) the individuals become collected into a swarm and it is here they are found the most plentifully. When the water is very smooth the area may be very much extended but on ordinary occasions searching for them outside of the entrance to the bay has always produced negative results. This would account for the greater numbers being found on the rising tide. If the water is very smooth during the height of the spawning period they are probably found at any time of the tide. A smooth surface seems to be one of the requisites for swarming. I have never been able to find any at the surface even when the surface was but moderately disturbed. After some days of storm, they have been found on the next smooth evening to be present in very large numbers. It may readily be that at times during the spawning period, when it has not been possible to find any or many at the entrance of the bay, on account of tide and current conditions, they may have drifted in some other direction and at some other smooth spot they may be plentiful.

I have no doubt since *Odontosyllis* is found over such a wide area in dredged material, that the phenomenon of swarming occurs at other places as well as at the entrance to Departure Bay, as especially among the islands to the south there is an endless variety of current conditions and in this variety there must be some that suit. The swarming takes place at such an awkward time of the day for making observations at a distance from the station that none of these places have so far been discovered

The district along the east coast of Vancouver Island is very abundantly supplied with polychætes, both as to variety of species and to number of individuals. It must be that many of these come to the surface to spawn and possibly some of them swarm as does *Odontosyllis*. There is not much chance of finding these otherwise than by accident unless a study is made of them throughout the year so that some idea may be obtained as to when the swarms should be looked for. As yet nothing has been done except for a short time in the summer. Only one case, apart from *O. phosphorea*, has come under my notice. On Sept. 30, 1913, late in the afternoon, probably about 5 o'clock, a male specimen of *Nepthys cæca* (Fabricius) was found swimming at the surface near the station float. Apparently it came to the surface to spawn but no others were seen then or at any time since.

The polychætes serve as a main article of diet for many of the flat-fish, hence the extensive and intensive study of their life-histories is of importance from an economic as well as from a purely biological point of view. It is quite true that little attention has yet been paid to any of the flatfish of the Pacific with the exception of the halibut but many other species are of just as good flavor (in my opinion, much better) as the halibut, although of course they are much smaller. Since they are probably abundant in various localities, they must receive attention some day and the sooner the better.