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A SURVEY OF THE PLANKTON OF MONTEREY BAY

by

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Ecology - Marine, plank
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I. INTRODUCTION

The greatest mass of marine life is made up of the animals and plants in the plankton. Plankton is one of the most important biotic features of the sea since it is a basic food source for practically all marine organisms at some stage in their life history. Phytoplankton is extremely important in this respect as it is the primary link in the food chain.

Plankton organisms generally drift passively in the sea. They may possess no very distinct organs of locomotion but often have cilia or other means of locomotion on a small scale. Even the active members of the plankton such as copepods and Crustacean larvae seem to have only restricted activities, their wider movements being at the mercy of currents, etc.

In general, then, it can be said that the majority of the planktonic organisms possess only limited powers of locomotion and are carried more or less passively about in the sea by wind, currents and tidal streams. They are very abundant and important members of the marine community.

The purpose of this paper is to add to the identification of planktonic forms found in Monterey Bay, and also to compare the composition and population fluctuation with findings of previous years.

Four previous studies on the plankton of this area are available. The were made by Bigelow and Leslie (1930), Baldwin and Frazier (1947), Connell and Dixon (1948), and Hendrickson

and Krutzsch (1949). The paper by Bigelow and Leslie (1930) contains much information on the physical and chemical nature of the bay waters. The period of observation was roughly the same as ours. The other papers cover the same period as ours and contribute valuable data as to the variation and dominance of animal and plant types.

Mr. Gwilliam shared in the physical labor involved in making the hauls and worked only on the Coelenterates. The remainder of the work of identification and tabulation of the numerous forms encountered was done by Mr. Boone.

II. METHODS AND MATERIALS

Six tows were taken in the bay at weekly intervals (with the exception of the last tow) from June 23 to July 26. Tows were about 15 minutes in duration and made from 200 yards southwest of red bouy #4 (600 yards northeast of Hopkins Marine Station) past the bouy 200 yards out into the channel and back. This is approximately the locality of Bigelow and Leslie (1930) station #15, Connell and Dixon (1948), and Hendrickson and Krutzsch (1949).

All hauls were made in the forenoon between 0700 and 1100 Pacific Daylight Saving Time.

Two nets were towed simultaneously. One was 20 inches in diameter with an 80 inch number 4 mesh sleeve, the other was 9½ inches in diameter and had a 33 inch number 12 mesh sleeve. The small net was towed on the surface. The 20 inch net was allowed to sink the length of the tow line, 52 feet, into the water. As the boat moved forward an oblique sample of water was taken. A 20 pound weight was attached to the bridle of the large net causing it to sample water approximately

15 to 25 feet below the surface.

The temperature of the water varied from 13.5° C. to 15.1° C. Only one of the hauls was taken when the weather was clear and sunny. Contrary to the findings of Hendrickson and Krutzsch (1949) we were unable to notice any decrease in numbers and kinds of forms on this day.

The hauls were spread thinly in sea water in the laboratory and given a macroscopic examination after which 100cc of settled plankton was preserved for study during the week. The method of estimating abundance and relative frequency of forms is that originated by Baldwin and Frazier (1947), i.e., #1 indicates abundant, #2 common, #3 occasional, and #4 rare. When any form occurs in such a frequency as to dominate the entire haul it is designated as D.

Many generic and specific identifications are tentative.

General references used in identification are listed in the bibliography.

Methods used were purposely patterned after former papers in order to facilitate comparisons.

For convenience, the four papers previously mentioned will be referred to only by year, e.g., Bigelow and Leslie's paper will be cited as (1930).

III. DISCUSSION OF FORMS

Diatomes. All hauls contained a large number of diatoms. A record only of the species of Chaetoceros was made in relation to population changes. This species was found occasionally in haul #1 but increased to dominance of the plankton in haul #5. In haul #6 a sharp decline occured to a level below that of haul #1 and was designated as rare.

Both (1947) and (1949) observed a somewhat similar change. (1948) found a decline in the population of Chaetoceros from dominance in Haul #1 to a 4 category in #6.

The following is a list of forms identified. Cupp (1943) and Gran (1931) were extremely valuable in identification.

Chaetoceros debilis Cleve
" decipiens Cleve
Asterionella japonica Cleve
Biddulphia sp
Coscénodéscus sp/
Eucapmia zoodiacus Cleve
Grammaetaphora angulosa Ehrenberg
" mariana Kutzing
Rhizosolenia delicatula Cleve
" stolterfathii H. Peragelle
" sp.
Thalassionema nitzschioides Grunow
" rotula Meun

Protozoa. Only the most conspicuous of the protozoans were identified.

Dinoflagellata. Haul #2 was almost dominated by the Dinoflagellate Noctiluca miliaris. This form was also found in all hauls by #6. (1949) and (1947) report this species while (1948) record a very few species.

Peridinium divergens (Calkins) (see Kudo, 1947, p. 258 Fig. 110 d) was present in all hauls occasionally except in haul #6 where it was rare.

Two other forms, Gonyaulax sp. and Ceratium sp. were sporadic members of the plankton both being found in hauls #1 and #4.

Radiolaria. Each haul contained the prominent radiolarian species Aulosphaera labradorensis (Haecker) pictured in Kudo (1947) p. 424, Fig. 199 c. Two other species also present occasionally in each haul were Aulacantha sp. and Lamporanchium sp.

Ciliata. The tinntinnoid protozoan Tinntinnus ehrenbergii was noted in each haul. This interesting form reached the abundant stage in haul # 5. (See MacGinitie 1949, p. 102, Fig. 6 D and E). (1948)reported this form as occasional in their third haul.

Coelenterata. The only Coelenterates taken in this years plankton hauls were medusae. Most of the specimens taken were small, and some were damaged beyond any possibility of identification.

At no time were the numbers of medusae great, but one of the larger forms, Thaumantias sp (?), was certainly noticeable when present.

No Scyphozoan medusae were taken in the plankton, but a large Pelagia was recovered by Mr. Bill Welshons on the beach near Monterey Harbor. This was not taken in the regular hauls, so it is not listed below.

Only one genus of Siphonophores was represented, and this only in the first and last hauls. (1949) reported five siphonophore species . In general, a greater variety of Coelenterates was taken in 1949.

Mayer's Medusae of the World was used extensively. Kyman's Invertebrates, Kramps Medusae, Bigelow's The Medusae were also used, but to a lesser extent. All identifications must be presented as tentative. This seems desirable in view of the fact that many of the medusae were immature specimens and in many cases only a very few specimens were available for comparisons.

Hydrozoa

Hydroida

Anthomedusae

Cladonemidae. Cladonema mayeri (Mayer pp 100ff, plate 9, fig. 2Φ. One specimen assigned to this genus and species was recovered by Mr. J.D. Clark in the kelp beds off Lover's Point on 17 July. This is the so-called "walking medusa", whose hydroid stage is reported as probably Stauridia, and has not, according to Fraser, been reported from this coast.

Oceanidae. Rathkea sp. (Mayer, pp 175ff, plate 20, fig. 11). This small medusa was taken in Hauls #1, #2, and #4. In the first haul they were present in fair numbers, in haul #2 only one was seen, and in haul #4 they were present in fair numbers again. This form was evidently reprted for the first time from this coast by (1949).

Leptomedusae

Tucopidae. Obelia sp. (Mayer pp 238ff and plate 30). These small medusae were present in all hauls, showing a slight rise the second week after which they returned to the previous level.

Thaumantiadae

Heliceptinae. Thaumantias sp. (Mayer pp 190 ff and fig. 102, p. 198). This medusa was present in hauls 2, 3, and 4, being most numerous in haul 2. The size of this medusa varied from 8 to 15 mm in diameter and the bell was about 5mm deep. It lacked lithocysts, had a small (narrow) velum and a peduncled manubrium that, at times, extended just beyond the bell margin. This form resembles Thialidium reported in previous years, but the absence of lithocysts and the comparitively long peduncle place it in this family. The hydroid of this medusa is said to be a Campanularian.

Trachymedusae

Olindiadae. Vallentinia (young Olindias ?) sp. This small (bell diameter 8mm) medusa was found only once and only one specimen was taken on July 14. It fits Mayers description of Vallentinia, which he believes to be a young Olindias. This form, however, was evidently sexually mature, for after

having been kept alive and apparently healthy in the lab. for two days it spawned. Hyman (p. 458, fig. 141 B) figures a medusa from Monterey Bay which resembles this form very closely.

Narcomedusae

Aeginidae. Solmissus sp. On the last haul, a medusa was taken that was assigned to this genus. Medusae buds in various stages of development were observed scattered about in the sub-umbrellar area. (see Hyman, p. 466, fig. 146 C).

Siphonophora

Calycophora

Monophyidae. Muggiaea atlantica. (Hyman, p. 474, fig. 150 A and B). These were the only siphonophores present and were taken only in hauls 1 and 6. In the first haul, only one one incomplete individual was recovered. In haul 6 they were quite numerous. Only one was seen with a cormidial chain, and in this case it was approximately ½ inch long and presumed to be incomplete.

Ctenophora

Tentaculata. Pleurobrachei bachei Agassiz presented an interesting population variation. Hauls #1 and #2 were dominated by this Ctenophor. A sudden drop in numbers occurred in the third haul for the remainder of the hauls this form was a rarity. A somewhat similiar situation was noted

in 1947, while a gradual build up was recorded by both Connell and Dixon and Hendrickson and Krutzsch.

No alternation of dominance of Pleurobrachei and Calanus, as discussed in the papers of 1930, 1947 and 1948, was noted.

Hormiphora sp. A single specimen was found in haul 5 and was identified by using the key given by (1949) p. 15.

Cydippid larvae were found in each haul becoming common in haul #6

Nuda. In all previous years this class of Ctenophores was represented by the genus Beroe. No specimens were taken in our hauls this year.

On the day before haul 3, members of the stanford staff obtained a fairly large number of this form, while our haul on the following day yielded none. This is an indication of the dynamic changing nature of the plankton.

Ectoprocta. Cyphonautes larvae were common in hauls 5 and 6. (See Borradaile and Potts, p. 611, fig. 420). The first two hauls also contained 3 or 4 specimens.

Chaetognatha. The arrow worm, Sagitta bipunctata Quey and Gaimard and Sagitta furcata (?) were found only in haul 6. In previous years all hauls have contained a few specimens of chaetognaths. S. furcata was almost twice as long as S. bipunctata. Michael (1908) figures both of these species.

Annelida. Each haul contained a few unidentified annelidx trochophore and post trochophore larvae. Many of the trochophores observed had three segments with discernible setae.

Polynoidae. Three post trochophore larvae, one each in hauls 3, 4, and 6 were placed in this family

Spionidae. Post trochophores larvae of this family were found in all hauls and occurring commonly in haul 3. (1949) recorded this family a abundant and noted a similar change in abundance. The total numbers were not as high this year.

Platyhelminthes. Haul 2 contained on larva tentatively identified as a Mullers larva of a polyclad flatworm.

Echinodermata. Ophipplutei were found occasionally in all hauls though never as abundant as the echinoplutei which reached the level of abundant in haul 4.

Strongylocentrotus sp. Each haul contained newly metamorphosed sea urchins. In Haul 4 and 3 they were dommon. Apparently, the were much more common this year than in previous years.

Mollusca.

Gastropoda

Prosobranchia. Each haul contained gastropod veligers mainly of a spiral form. Hauls 3 and 6 contained the most numbers. No plano-spiral types were found as mentioned by (1949).

←Pelycopoda. Bivalve veligers were noted as common in

hauls 3 and 4, a few being present in all hauls.

Cephalapoda. Loligo opalescens. A few young squid of this species were found in hauls 4 and 6. (1949) did not record this species while the papers of 1947 and 1948 do. This is surprising since Mr. Gordon Fields of the Hopkins Marine Station states that this species breeds in the shallow waters around the bay.

Arthropoda.

Arachnida

Acardia. Two halocardian mites were found, one in haul 1 and another in haul 2. It was not possible to identify them beyond family.

Crustacea. Members of this group were probably the most conspicuous of the zooplankton both in numbers and in importance.

Branchiopoda. Each haul contained may naupli which were unidentifiable.

Cladocera. Three species were present in all hauls. References to Baker (1938) showed them to be Podon polyphemoides, Evadne nordmanni and E. tergestina, E. nordmanni being the least common. E. tergestina and Podon polyphemoides displayed an interesting re-reversal in frequency, the former being abundant in hauls 1 and 2 and becoming rare in haul 6, while the latter did exactly the opposite, cominating the haul in #6. (1949) report individuals of the genus Podon as being constantly more abundant than Evadne.

Cladocerans were not reported as being important in 1947. Cladocerans as a whole almost dominated the plankton in the lass three hauls.

Copepoda. Except in haul 6 animals of this group dominated the plankton. The most numerous copepod was Calanus finmarchicus, Eucalanus californicus, and Euchaete sp. made up the bulk of the rest of the population. These findings parallel almost precisely the observations of (1949).

One specimen with very short antennae was found in haul 3 and tentatively placed in the Order Harpacticoida.

Lebour (1916) (p. 10, plt. 4) was helpful in identifying the nauplii of C. finmarchicus which were present in each hayl.

Cirripedia. The characteristic sheild shaped carapace of the barnacle nauplii made it possible to distinguish this class. A few individuals were found in each haul except 5.

A very much specialized nauplius was found in haul 5. Thes animal was very evidently specialized for a planktonic existence as it had a long (8.0 mm) dorsal spine and 2 ventral spines (12 mm long) plus great elongations of the bristles of the appendages. Because of the shield shaped carapace this animal was tantatively placed in this group.

One cypris larva was found in haul 3. Other reports do not mention finding any of these forms

Malacostraca

Mycidacae. Animals of this group were found in every haul. Two genera were identified, these were Boreomysis and Stilomysis. (See Zimmer 1909 pg. 140 and pg. 145)

Isopoda. Haul #1 contained one specimen of Exspheroma sp. Since this animal is found only in the intertidal area its occurrence in the plankton is probably accidental and was probably due to net contamination.

Amphipoda. Two hyperidae amphipods were identified. They were present in all hauls except # 5. They were Hyperia galba and H. spinipes (see Holmes 1905 and Boeck 1872). They were most abundant in haul 3.

Decapoda. All hauls contained crab larvae. As in 1949, zoea were more common in the early hauls while megalops became more numerous in the later hauls. The first and last two hauls contained a few post-megalops. In hauls 1 and 2 , young prozoea were especially abundant.

Anomura.

Porcellanidae. Larvae with the long, lance-like spines were found in each haul in about the same numbers. Emerita analoga: Two zoea from hauls 2 and 4 with a short anterior spine were identified as this

species upon comparison with Johnson and Lewis (1942) p. 75, plt. 1 and with specimens raised in the lab. by Mr. Dan Nystrom. Blepharipoda occidentalis. One zoea found in haul 4 appeared to be of this species when checked with Johnson and Lewis (1942) p. 83, plt. 3.

Brachyura. Typical zoea and megalops were present in all hauls, many appeared to be of the genus Cancer.

Chordata

Urochordata

Thaliacea. Doliolum sp. Haul 6 contained one member of this genus. Due to the poor condition of the specimen it was impossible to identify it further. In previous years, Doliolum was more prominent, In 1949 members of this genus were found in all but two of the hauls.

Appendicularia. Members of this group were very common in all hauls except 5 in which they became rare. (1948) reported the same type of population change but the overall numbers were much greater this year.

The most abundant species was probably Oikopleura diocia figured in Grasse (1948) p.896, fig. 360 B. The larger species O. parva was also present in a few numbers in each haul. (See Grasse 1948, p.846, fig. 360 A).

Vertebrata. Fish eggs and larvae were found in all hauls in relatively constant numbers. No attempt was made to identify them.

IV. SUMMARY

1. Six weekly samples of plankton of Monterey Bay were studied from June 23 to July 26. Changes in composition and relative abundance of forms were tabulated and discussed.

2. The genus Chaetoceros dominated the phytoplankton and showed a gradual increase in abundance then making a sharp decline in the last haul.

3. The most conspicuous forms in the Zooplankton were Pleurobrachia, echinoplutei, Cladocera, Copepoda, nauplii, zoea, and Appendicularians.

4. Large variations in water temperature and its effect on the planktonic forms was less noticeable this year than in previous years.

5. Emphasis was placed upon species identification and comparison of forms with ones found in previous years.

6. Population changes and relative abundance of important forms were illustrated by the use of charts and graphs.

7. Comparison of findings this year with those of former years shows that most planktonic organisms are very unstable in relation to numbers and are in constant flux with very remarkable and sudden variations in abundance being the rule rather than the exception.

8. Fewer medusae and a lesser variety were found in the plankton than in 1949 and 1948.

TABLE I.

Relative occurrence of some of the major components of the weekly plankton samples.

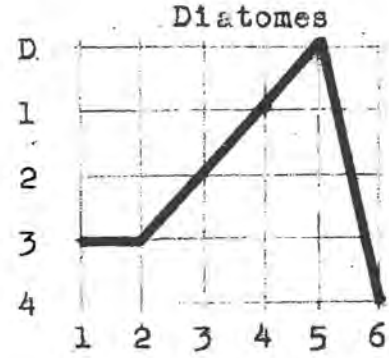
D - Dominant. #1 - Abundant. #2 - Common. #3- Occasional. #4 - Rare.

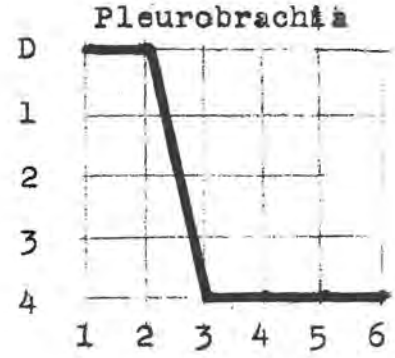
Date	6/23	6/30	7/7	7/14	7/21	7/26
Temperature	14°C	25°C	13.5°C	14.5°C	14°C	15°C
Diatomes						
Chaetoceros sp.	3	3	2	1	D	4
Protozoa						
Noctiluca sp	2	1	3	3	4	
Coelenterata						
Obelia sp	3	2	3	3	3	3
Ctenophora						
Pleurobrachei sp	D	D	4	4	4	4
Annelida						
Spionidae larvae	4	3	2	4	4	4
Echinodermata						
Echinopluteus	4	4	3	2	4	4
Ophiopluteus	4	4	3	1	2	2
Strongylocentrotus sp		3	2	2	4	3
Mollusca						
Gastropod veligers	3	4	3	4	4	2
Pelycopod veligers	4	4	3	3	4	4
Crustacea						
Clodocera						
Evadne sp	1	2	3	4	4	4
Podon sp	4	4	3	3	2	D
Copepoda	D	D	D	D	D	1
Nauplii	2	2	2	2	4	4
Mycidacae	4	3	4	4	4	4
Amphipoda	4	3	4	4		
Decapoda						
Anomuran Zoea	4	4	3	4	4	4
Porcellanidae Zoea	4	4	3	4	4	4
Brachyuran Zoea	3	4	4	4	4	4
Unidentified Zoea	4	4	4	4	4	4
Chordata						
Urochordata						
Appendicularians	2	2	2	2	4	2

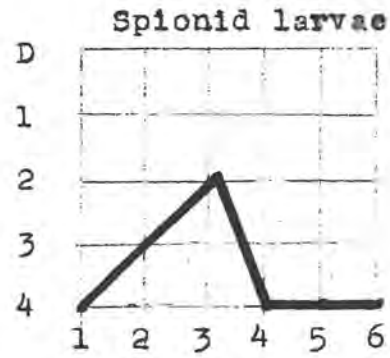
TABLE II

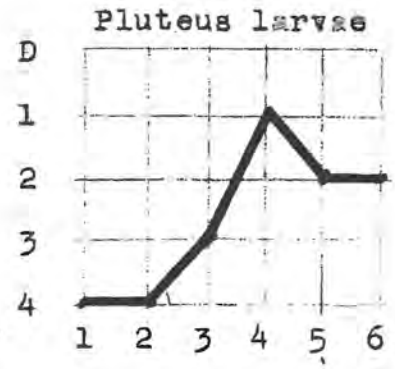
Time-abundance chart of selected weekly samples

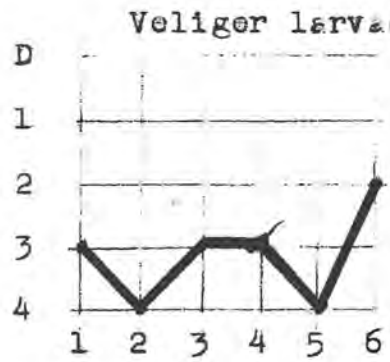
Ordinate - Estimated abundance (D - Dominant. #1 - Abundant. #2 - Common. #3 - Occasional. #4 - Rare.)
Abscissa - Haul number











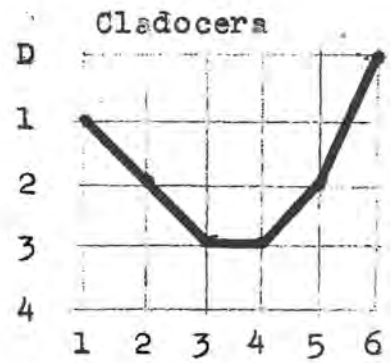
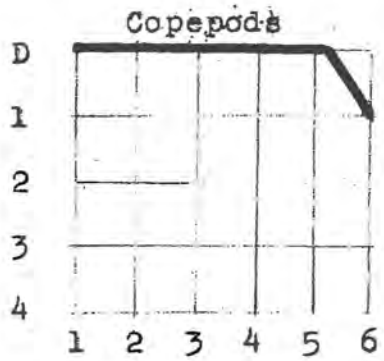
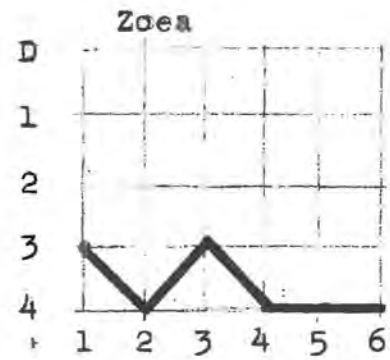
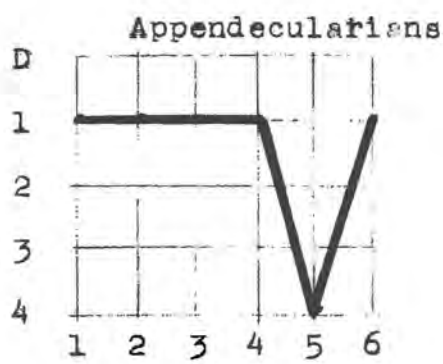
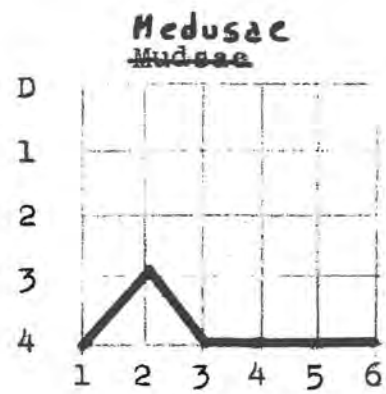


TABLE II (Cont.)









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