THE NERITIC ZOOPLANKTON OF THE SOUTH EASTERN MEDITERRANEAN AT ALEXANDRIA

II.—Consideration of the Total Zooplankton Community

By

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In this paper, the zooplankton biomass is treated monthly in the offshore and inshore stations during the period of investigation (April 1961-March 1963). The method used and the hydrographic features of the area investigated are described in Part I. (see this volume page 225 – 273).

The relative abundance of the different constituents of the whole zooplankton population (both the permenent and temporary forms) is traced monthly. The monthly fluctuations are dealt whith here in terms of percentage of each species in relation to the total number of the community. The percentages of the copepod species are obtained from the average total number of all stages (i.e. nauplii, copepodite and adult stages).

A.—Offshore Community

The monthly average numbers of the total zooplankton are represented graphically in figure (1). The corresponding average for each station is shown in

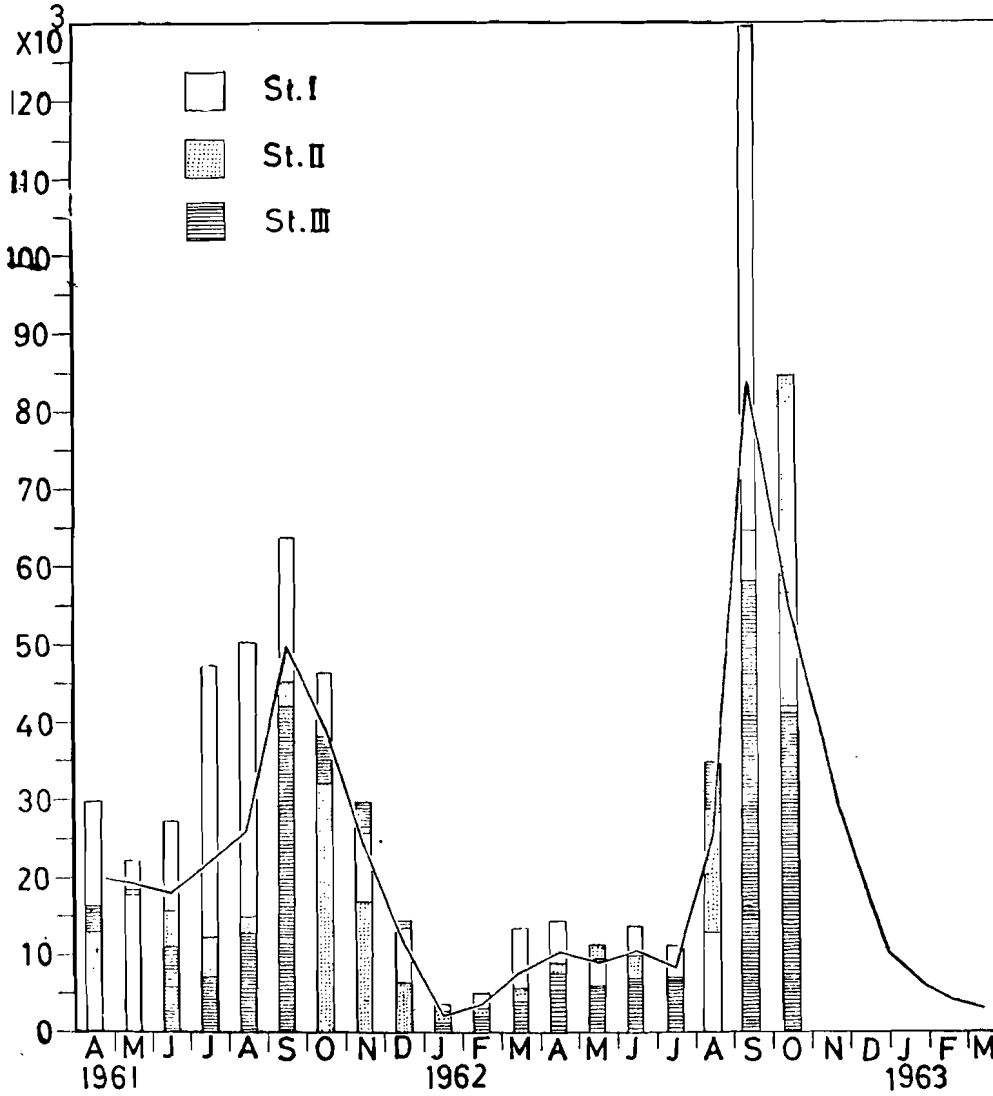

FIG. 1.—Histograms showing the total number of zooplankton (per m^3) at each of the offshore stations from April, 1961 to March, 1963, Continuous line represents the average of the three stations.

the accompanying histograms. The monthly fluctuations in the percentage occurrence of the important organisms are considered for the period April 1961 to May 1962. During this period samples were collected at shorter time intervals, hence they are more representable. The fluctuations are shown in the kite diagram (Fig. 2).

Spring Condition of 1961 :

April:

The average number of the total zooplankton organisms was relatively high. The chief constituent of the zooplankton during April was the copepod population which collectively composed about 84% of the zooplankton. The most common species was *Paracalanus parvus* forming 23.3%, followed by *Acartia* spp. (chiefly *A. negligens*) forming 17.5%. Both *Oithona nana* and *Centropages Kroyeri* constituted about 13% for each, while *Euterpina acutifrons* formed about 7%.

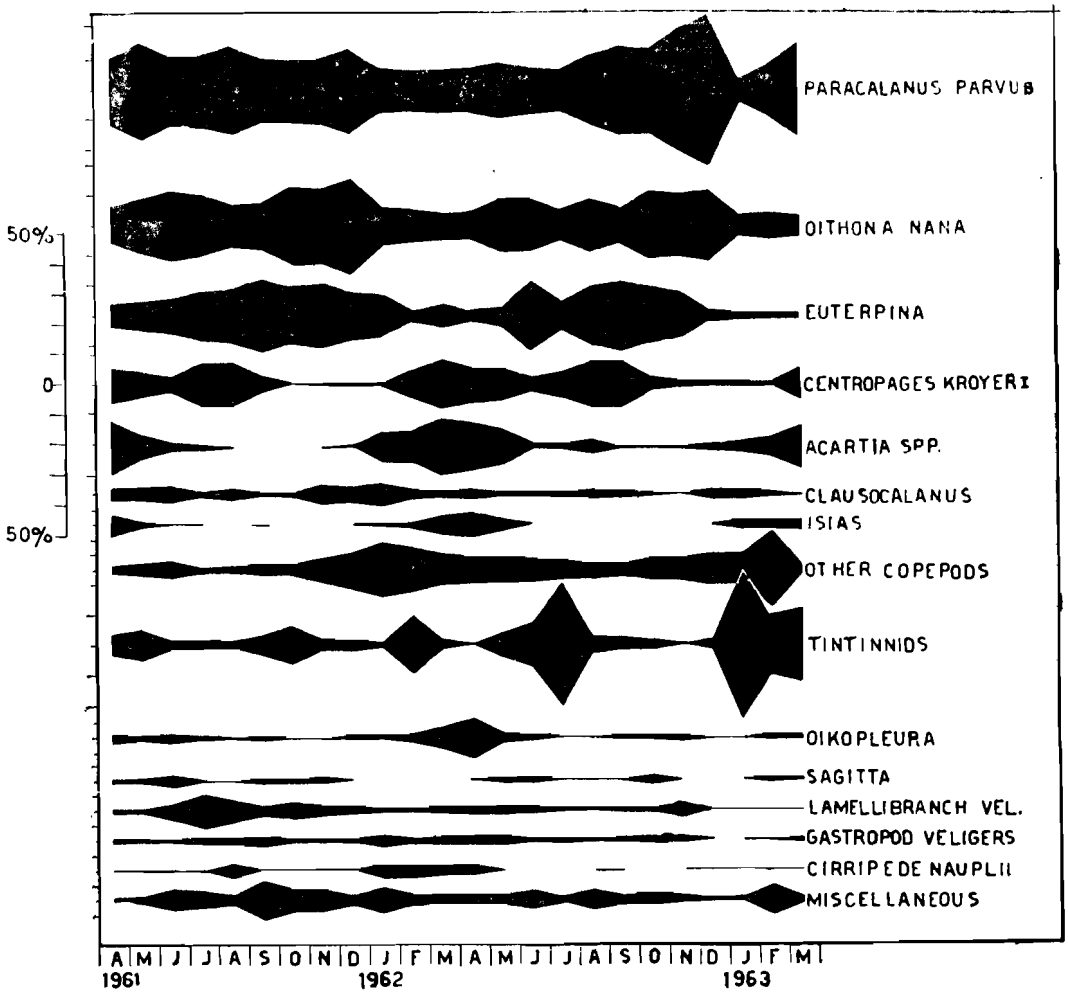

FIG. 2.—Seasonal variations of the important zooplankton species and groups in terms of their average precentage abundance relative to the total average at the offshore stations from April, 1961 to March, 1963.

The population of *Isias clavipes* accounted for 6%, which was the highest percentage recorded for the species during the period of investigation. *Clausocalanus arcuicornis* was less common being represented by 4%.

Tintinnids (chiefly *Helicostomella* spp., *Tintinnopsis beroidea* and *Favella* spp.) were represented by 7.6%. Other organisms of minor importance were in order of abundance as follows : *Oikopleura* spp., gastropod and lamellibranch veligers, *Sagitta* spp. and the copepods *Corycaeus* spp. and *Oithona plumifera.*

May :

During this month the average total number of zooplankton community was slightly lower than that of April. This was mostly due to the abrupt drop in the number of all adult copepod species at station I (the numbers of adults decreased from 14300 in April to 4600 in May). The copepods were still, however, dominating the other organisms constituting by itself 82%. During this months the species composition of the copepod population was similar to that in April. *Paracelanus parvus* reached its maximum abundance and it was represented by 31.7%, which was the highest percentage recorded for any copepod in the area during the priod of investigation. However, this increase in the percentage of this species was mostly due to a flourishing population detected at station II where the species dominated the total population by 44.2%. The population of *Oithona nana* and *Euterpina acutifrons* increased considerably, they were represented by 18% and 8.8% respectively. On the other hand, *Centropages kroyeri* and *Acartia* spp. (*A. negligens* and *A. latisetosa*) descreased to 8% for each. A character of this month was the decline in the population of *Isias clavipes* which was only represented by 1%. The average percentage of adult *Clausocalanus* was nearly unchanged.

During this month the numbers of tintinnids (chiefly, *Tintinnopsis beroidea, T. campanula. Tintinnopsis* spp., *Favella markusovszkyi* and *Favella* spp.) increased considerably at all stations giving an average of 10%. However, this high percentage was mostly due to the large numbers of these species at station III, where the tintinnid population accounted for 23% of the whole zooplankton community.

Other less important zooplankton organisms present in this month, were, in order of importance : *Oithona plumifera*, gastropod veligers, lamellibranch veligers, *Sagitta* spp., *Oikopleura* spp., *Corycaeus* spp., medusae, *Corycella* spp., and decapod larvae.

Summer Condition of 1961 :

June :

The average total number of the zooplankton community reached its summer minimum in June. This was mostly due to a decline in the zooplankton population at stations II and III. The average percentage of the total number of all copepod species was around its annual average (i.e. 76.8%). The increase in

the population of *Oithona nana* to its maximum during this month raised its percentage and it shared *Paracalanus parvus* the first position with 25% for each. The continuous increase of the population of *Euterpina acutifrons* was reflected on its abundance which increased to 11%, *Centropages kroyeri* decreased to 5.6%, while *Clausocalanus arcuicornis* increased to 5.3% which is the highest percentage recorded for this species. Of the larval forms present in this month, lamellibranch veligers was the most common, being represented by 5.2%.

The following forms in order of their abundance were of secondary importance. Medusae (mostly of *Obelia* spp. (4.1%); *Sagitta* spp. (3.4%), *Oikopleura* spp. (2.8%); *Acartia* spp. (2.4%); *Oithona plumifera* (2.0%); gastropod veligers (1.6%); *Corycaeus* spp. (1.3%); *Oncaea venusta* (1.0%); *Corycella rostrata* (0.7%); echinopluteus larvae (0.6%) and Cirripede nauplii (0.3%).

July:

In july there was a drop in the numbers of zooplankton individuals at stations II and III, but the average total zooplankton community was still slightly greater than that of June. This was due to a flourishing zooplankton population at station I. The species composition of the zooplankton was nearly the same as the preceding month. The average total number of copepods amounted to 78.8%, *Paracalanus parvus* was the leading species with 24%, followed by *Oithnoa nana* (20.0%), *Euterpina acutifrons* (15.4%) and *Centropages kroyeri* (14.0%).

The following copepods were numerically of minor importance and collectively accounted for 5.4%, these were : *Acartia* spp., *Clausocalanus arcuicornis, Oithona plumifera, Isias clavipes, Temora stylifera, Corycella* spp., and *Oncaea* spp.,

Of the larval forms present, lamellibranch veligers reached their maximum abundance for the year and constituted 10.6 / of the population. These larvae were most abundant at station III.

Tintinnids (mostly *Favella markusovszkyi* and *Eutintinnus fraknoii*) contributed with only 2.5%.

Other organisms of minor importance were : gastropod veligers, echinopluteus larvae, Cladocera (*Evadne nordmanni* and *Podon polyphemoides*), medusae and *Sagitta* spp.

August:

During this month, the increase in the average total number of the zooplankton community was mostly due to a rich zooplankton population recorded at station III. It is shown from figure (1) that the population there was nearly double that of the preceding month. There was also a significant increase in the population at stations I and II. *Paracalanus parvus* maintained the top position with 29.2%. It was particularly numerous at stations I and II, where it amounted to 36.5%

and 44.2% respectively. *Euterpina acutifrons* occupied the second position with 17.7%, the large numbers recorded for *Centropages kroyeri* gave it the third position with an average of 14.5%. This was the highest average percentage recorded for the species during the year. In 1962, however, the maximum of *Centropages* was recorded in September with an average percentage of 15.5%, while *Oithona nana* had an average of 14.2%.

Of the other copepods present during this month; *Clausocalanus arcuicornis* constituted 3%, while *Oithona plumifera*, *Temora stylifera*, and *Corycaeus* spp. accounted collectively for only 1.0%.

Of the larval forms, lamellibranch veligers were the commonest (7.0%), followed by cirripede nauplii (5.0%), and gastropod veligers (2.0%). Medusae accounted for 2.0%, while the tintinnid population decreased considerably reaching its summer minimum and was represented by a mere 1.6%.

Autumn Condition of 1961 :

September :

The average density of the total zooplankton was nearly double that of August, due to the presence of large numbers of *Noctiluca scintillans* and developmental stages of copepods (copepodites and nauplii).

The pelagic copepods constituted 70% of the average total population. *Euterpina acutifrons*, was the leading species (24.0%) followed by *Paracalanus parvus* (21.8%), *Oithona nana* (15.3%) and *Centropages kroyeri* (6.2%). The presence of high numbers of *Noctiluca* during the climax of the flood period gave it an average of 11%.

Tintinnids (mostly *Favella markusovszkyi*, *Tintinnopsis* spp., *Tintinnopsis radix*, *Salpingella acuminata*, *Eutintinnus fraknoii* and *Coxliella annualata*) increased in numbers and accounted altogether for 6.2 / .

Both lamellibranch and gastropod veligers constituted 6.5%, shared equally between them. Other organisms of secondary importance were : *Sagitta* spp., *Oikopleura* spp., medusae and cirripede nauplii.

October :

The average total number of the zooplankton community decreased considerably, particularly towards the end of this month. The copepod population alone constituted 72.6% and was dominated by *Oithona nana* (26.3%), *Paracalanus parvus* (21.3%) and *Euterpina acutifrons* (18.8%).

Tintinnids occupied the fourth position in the community with 12.6%. The most common species during this month were : *Favella markusovszkyi, Salpingella acuminata, Codonellopsis morchella, Epiplocylis undella, Tintinnopsis radix, Rhabdonella elegans, Steenstrupiella steenstrupii* and *Eutintinnus fraknoii. Noctiluca* ranked second to the tintinnids, forming 5.1% of the total plankton; lamellibranch veligers were also common forming 5%.

The following organisms were of minor importance; they are in order of their abundance : *Sagitta* spp., cirripede nauplii, *Oikopleura* spp. and medusae spp.

November :

The average number of the population during this month was almost 2/3 that of October. The percentage dominance of the copepod population was about 82%, with *Oithona nana* as the leading species (25%), followed by *Paracalanus parvus* (22%) and *Euterpina acutifrons* (19.5%). It is worth to note that the high average percentage of *Euterpina acutifrons* during this month was mostly due to a rich population recorded at station III, where the percenatge dominance of the species there was 30.5%. *Clausocalanus arcuicornis* and *Temora stylifera* followed *Euterpina acutifrons,* with an average of 6% and 5% respectively. The decrease, both in number of species and individuals of the tintinnid population caused their percentage abundance to fall to 3.7%. Of the planktonic larvae present during this month, lamellibranch veligers were still occupying the top position, forming 3.5%.

Each of the following organisms was represented by a few numbers only; these are in order of occurrence as follows : *Oithona plumifera, Sagitta* spp., *Oncaea* spp., medusae, echinopluteus larvae of echinoderms. *Noctiluca,* gastropod veligers, cirripede nauplii. *Corycella* spp., *Acartia* spp., *Centropages kroyeri* and spionid larvae of polychaetes.

Winter Condition of 1962 :

December :

The average total number during this month showed a further decrease. On the whole it was less than half the number in November. This is due to further drop in the numbers of nearly all planktonic organisms. However, the average percentage of the copepod population was almost similar to that in November (83%), *Oithona nana* was the most important organism with an average of 31%. *Paracalanus parvus* occupied the second position (28%), followed by *Euterpina acutifrons* (15%) and *Clausocalanus arcuicornis* (5%).

Tintinnids were represented by the same percentage (3.7%) as in the preceding month.

Of the other planktonic organisms present during December, the following are listed in order of their importance: lamellibranch veligers, *Acartia* spp., *Oncaea* spp., *Oikopleura* spp., *Oithona plumifera, Corycaeus* spp., *Corycella* spp., *Noctiluca* and gastropod veligers.

January:

The average total number of the zooplankton population reached its winter minimum during this month. The average percentage values for most of the copepod species were much smaller than in December. However, their relative percentage dominance was still high (72.5%), owing to the large drop in the community as a whole. *Paracalanus parvus* was the leading species (15.4%), followed by *Euterpina acutifrons* (14%), while the percentage of *Oithona nana* dropped to only (13.5%). The continuous increase in the population of *Acartia* spp. (specially *A. negligens* and *A. clausi*) gave them the fourth position among the copepods with an average of 10.2%. *Clausocalanus arcuicornis* and *C. furcatus* reached also their maximum percentage abundance (7%).

Of the larvae present, cirripede nauplii and gastropod veligers were common amounting to 4.8% and 3.6% respectively.

Other organisms of secondary importance were in order of their abundance; *Corycella* spp. (mostly *C. carinata*) *Oncaea* spp., *Isias clavipes, Corycaeus* spp., *Oithona plumifera*, Lamellibranch veligers, *Oikopleura* spp., *Centropages kroyeri* and small *Sagitta* spp.

February:

The average total number of zooplankton was still around its minimum winter level. The average percentage of copeopods reached its minimum value (64.5%).

Of the copepods, *Paracalanus parvus* was the most common (14.4%), followed by *Oithona nana* (11.3%), *Acartia* spp. (10.4%) (mostly developmental stages) and *Centropages kroyeri* (9.6%, mostly copepodites). The two species of *Oncaea* reached their maximum abundance and were represented by 4.5%, while the population of *Euterpina* dropped to 4.2%.

Tintinnids, chiefly *Tintinnopsis campanula, T. beroidea, Tintinnopsis* spp., *Eutintinnus fraknoii, Favella markusovszkyi, Favella serrata, Favella* spp., *Codonellopsis* spp., and *Steenstrupiella steenstrupii*, occupied collectively an important position (19%). It is worth to note that this average percentage was not surpassed, except in the sample of July 1962, where the average total number of tintinnids amounted to 41% of the total community during that period.

Of the other organisms present during this month, cirripede nauplii were the commonest (4.7%); *Oikopleura* spp. (3%), *Clausocalanus arcuicornis* (2.8%), *Corycella* spp. (2.2%) and *Isias clavipes* (2.1%). These are followed by a number of less important organisms such as *Oithona plumifera, Corycaeus* spp., gastropod and lamellibranch veligers.

Spring Condition of 1962 :

March :

During this month, the average total number of the zooplankton community was nearly double that of February. This increase was mostly due to the numerous population of both *Acartia* and *Centropages*. As a result, the percentage abundance of the total copepods increased considerably to its annual average (i.e. 76.6%). The copepod population was dominated by developmental stages of *Acartia* spp. (19%) and *Centropages kroyeri* (16.2%). Both percentages represent the maximum recorded for both species during the period of investigation. *Paracalanus parvus* occupied the third position (14%) followed by *Oithona nana* (7.7%), *Euterpina acutifrons* (7%) and *Isias clavipes* (5.8%).

Other copepod species are, *Oncaea* spp. (3.6%), *Clanusocalanus arcuiconnis* (1.9%), *Oithona plumifera* and *Corycella* spp.

The population of tintinnids dropped considerably (2.6%). The continuous increase in the population of appendicularians, which began in Febraury, gave a relative high percentage (6.8%). Of the larval forms, the cirripede nauplii were the most common (3.4%). followed by lamellibranch and gastropod veligers (both 4%).

April :

In April the average total number of the zooplankton population reached its spring maximum; thus reflecting the same trend of 1961. However, the average total number of this month was nearly half that of April 1961. The copepod population dominated all other zooplankton organisms (74%). As the preceeding month, *Acartia* spp. (mostly *A. negligens* and *A. latisetosa*) occupied the top position with 16.2%. This large percentage of *Acartia* was however mostly due to a rich population at station I. *Paracalanus parvus* occupied the second position (15%), followed by *Centropages kroyeri* (12.5%), *Oithona nana* (9.2%), *Isias clavipes* (8.5%); *Oncaea* spp. (4.1%) and *Euterpina acutifrons* (3.7%). Other copepods of secondary importance are, *Clausocalanus arcuicornis* (3.2%), *Oithona plumifera* (1.1%), and *Corycella* spp. (0.7%). Appendiculates reached their maximum abundance with (12.5%), followed by cirripede nauplii (3.1%); while both gastropod and lamellibranch veligers contributed only 5% of the total poulation. The percentage abundance of tintinnids decreased greatly to its minimum (2%).

May :

The average total number of the whole community was nearly the same as the preceding month. The average percentage of the total number of copepods maintained its annual average (i.e. 76.3%). *Paracalanus parvus* restored its top position among the whole community as in May 1961. Although with a relatively lower percentage (18.3%).

Oithona nana also occupied the second position with nearly the same percentage as in May 1961 (17.5%). The following species came next in order of relative abundance : *Acartia* spp. (12.4%), *Centropages kroyeri* (10.7%), *Euterpina acutifrouns* (6%), and *Isias clavipes* (4%). The following copepod species were of minor importance : *Corycrlla* spp., *Clausocalanus arcuicornis*, *Corycaeus* spp., *Oncaea* spp., *Oithona plumifera* and *Temora stylifera*. They collectively contributed 7.4%.

The increase in the total population of tintinnids (mostly *Favella markusovszkyi*, *Favella* spp., *Eutintinnus fraknoii* and *Helicostomella*), towards its summer maximum gave them a percentage of 7.8 of the whole community.

Of the other zooplankton organisms present during this month the following species are less significant : *Oikopleura* spp., gastropod veligers, lamellibranch veligers, echinopleuteus larvae, *Podon polyphemoides*, *Evadne nordmanii*, medusae and *Sagitta* spp.

B.—**Inshore Community :**

The population of the different groups of animals recorded from the inshore neritic stations, perticularly from the Eastern Harbour, (St. IV) is traced month by month. This treatment was found to be necessary for the following reasons :

1.—The zooplankton community in such semiclosed localities is greatly influenced by the production of rich planktonic larvae of benthic animals, thus differing from that in offshore stations.

2.—Certain groups of zooplankton organisms have a particular preference, or even confined, to inshore waters; such as certain species of copepods, tintinnids, medusae, rotifers and several groups of planktonic larvae.

3.—As the inshore stations are influenced by land drainage and effleuents, thus creating different ecological characters in both the Eastern and Western Harbours, which in turn affect the plankton population.

The following is a general survey of seasonal variations of the inshore plankton as traced month by month, during the period from April 1961 to May 1962.

The variation in the average total number of the whole zooplankton population in the Eastern Harbour is shown in figure (6) The percentages of the important organisms are represented in kite diagrams (Fig. 3). Reference is also made to the occurrence of the different species in horizontal haul catches taken at station V. As both stations IV and V are shallow, there is no marked difference between the species composition in either vertical or horizontal catches.

Spring Condition of 1962 :

April :

During April, the chief component was the copepod population constituting 84.5% of the whole plankton community. The population was dominated by *Oithona nana* (25%) and *Euterpina acutifrons* (24.5%). These were followed by *Centropages kroyeri* and *Paracalanus parvus* with 11% for each. *Acartia* sp p. (mostly *copepodites* and *Acartia negligens*) constituted 8%; *Isias clavipes* 3.2%, tintinnids (mostly *Helicostomella*) accounted for 6%, while *Noctiluca* was represented by about 2.5%.

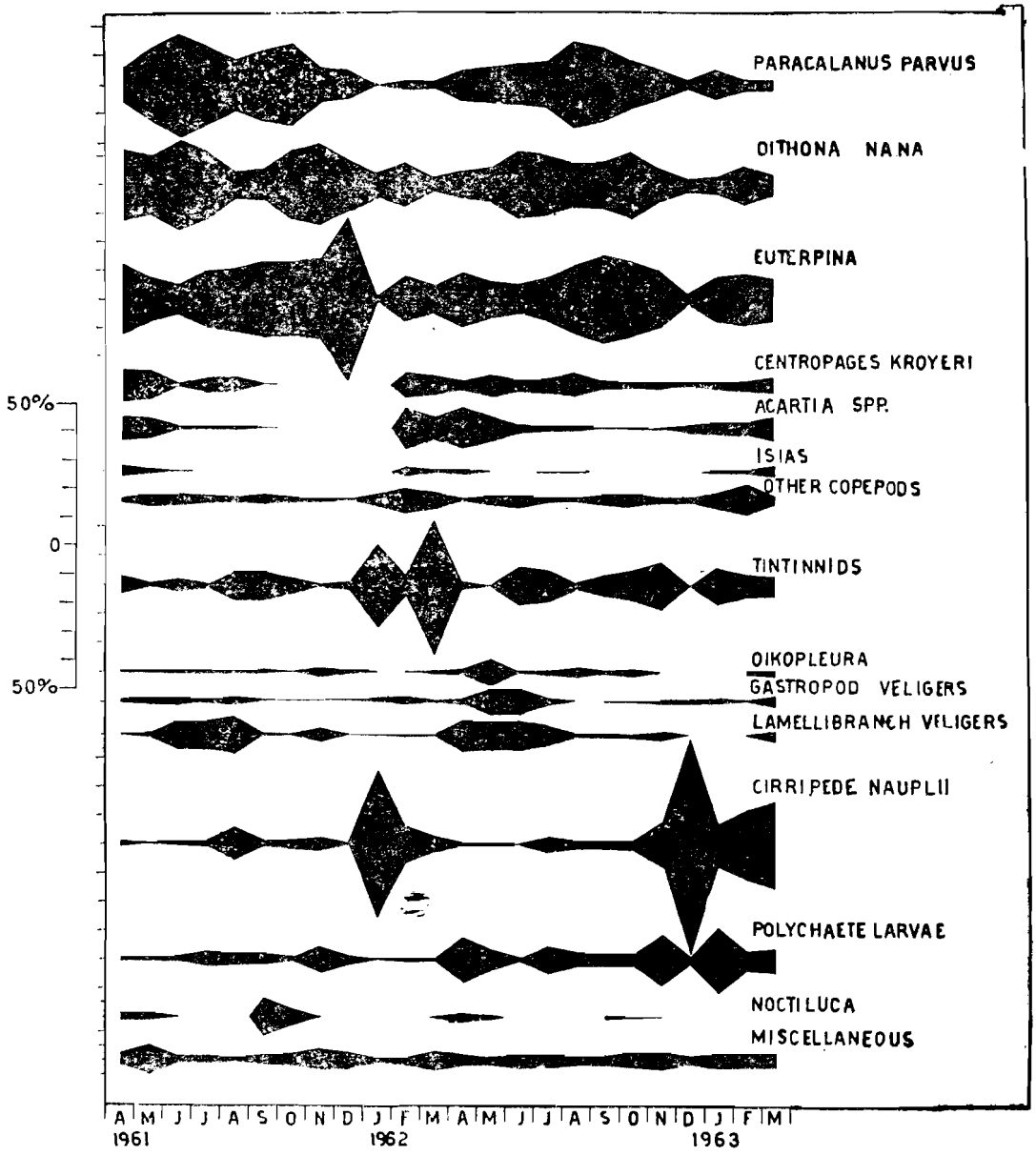

FIG. 3.—Seasonal variations of the important zooplankton species and groups in terms of their percentage abundance relative to the total population at station VI from April 1961 to March 1962

Although the copepod poupulation dominated also the zooplankton community at the Western Harbour (74%), yet the species dominance was quite different; the species dominance of copeopods at this station was as follows:

Isias clavipes (25%), *Paracalanus parvus* (23%), *Acartia* spp. (mostly *A. negligens*) (19%) and *Centropages kroyeri* (7%).

Tintinnids (mostly *Helicostomella*) were more common and contributed 24% of the population.

The following organisms were of minor importance, but they were better represented at station, IV; spionid larvae of polychaetes, both gastropod and lamellibranch veligers, cirripede nauplii, *Clausocalanus arcuicornis*, decapod larvae and nechtochaeta larvae of polychaetes.

May:

In May the increase in the total number of the zooplankton population at station IV was mostly due to a geat increase in the total number of copepod nauplii. *Paracalanus parvus* (26.8%) was the leading species as in the offshore stations with *Oithona nana* (21%), and *Euterpina acutifrons* (15%). These are followed by: *Acartia latisetosa* and *A. negligens* (collectively 7.7%); while *Centropages kroyeri* decreased tn about 5%. The following organisms were present arranged in order of importance: fish eggs (5%); *Noctiluca* (3%), nechtochaeta larvae of polychaetes and gastropod veligers (2.2% for each), *Isias clavipes* and *Clausocalanus arcuicornis* (1.1% for each) lamellibranch veligers, spionid larvae and decapod larvae shared altogether 3.5%. The population of the tintinnids dropped to e mere 1.2%.

In the Western Harbour, the species dominance was markedly different from that at "Eastern Harbour". For example, the tintinnids occupied the top position, contributing almost half of the total pouplation (49%); of these *Favella markusovszkyi* was the most common (27%). The total number of copepods constituted only 24% of the whole population. against 79% at station IV, with *Centropages kroyeri* as the leading species (6%); *Acartia negligens* was nearly equal in both localities; they shared altogether 12%, followed by *Oithona nana* (3%) and *Isias clavipes* (2%). *Oikopleura* spp. occupied the second position after *Favella markusovszkyi* (13.3%). Fish eggs were represented by 5.5%, while both gastropod and lamellibranch veligers contributed 3% and 1.5% respectively.

Summer Condition of 1962:

June:

In June the zooplankton population reached its highest maximum during the whole period of investigation, both at the Eastern and Western Harbours. At both stations this increase was mostly due to the abrupt increase in the population of *Paracalanus parvus* and *Oithona nana*.

In the Eastern Harbour the total number of pelagic copepods accounted for 83.5% with *Paracalanus parvus* as the leading species (42.7%) followed by *Oithona nana* (278%; while *Euterpina acutifrons* occupied the third postition (8%). Of the larval forms present, lamellibranch veligers were the most common (6.7%) followed by gastropod veligers (3%).

Other orgainsms were present in comparatively high numbers, yet their abundance was masked by the great increase in the total number of the zooplankton population during this month : these are in order of importance : *Clausocalanus arcuicornis*; *Oikopleura* spp., spionid larvae; *Centropages kroyeri, Sagitta* spp., decapod larvae and cirripede nauplii.

Tintinnids were represented by 4% in early June, but towards the end of this month, their numbers decreased considerably, and hence their percentage abundance was not significant.

In the Western Harbour the species of copepod population accounted for 86.5%. *Paracalanus parvus* (35%) and *Oithona nana* (30%) dominated the population, followed by *Euterpina acutifrons* (10%), *Clausocalanus arcuicornis* (5%) and *Crntropages kroyeri* (1.5%). Of the other organisms present, *Oikolpleura* spp. amounted to 3.5% ,while the total number of tintinnids (mostly *Favella markusovszkyi*) dropped to a mere 3%.

Lamellibranch veligers, *Appendicularia sicula* and medusae of *Obelia* spp., together with fish eggs collectively accounted for 7.5%.

July :

During this month the total zooplankton community in both stations dropped considerably. The decrease was most pronounced at the Eastern Harbour where the total number of organisms was nearly half as that of June.

In the Eastern Harbour too, both the total percentage of copepods (80%) and the succession of species dominance were nearly the same as in June. Thus *Paracalanus parvus* (27%), *Oithona nana* (24%) and *Euterpina acutifrons* (19.7%) occupied the first three positions respectively. Among other copepods present the following were more or less common, viz. : *Centropages kroyeri* (5%), *Clausocalanus arcuicornis* (3%) and *Acartia* spp. (*A. latisétosa* and *A. negligens*) (1%).

Of the larval forms, lamellibranch veligers (10%) comes first, followed by spionid larvae (4.7%) and Cirripede nauplii (2%). The total number of tintinnids was still low (1.5%).

In the Western Harbour, the copepod population dominated entirely the zooplankton population with 96.5%, thus masking all other zooplankton organisms. The succession of percentage abundance of the copepod species were as follows : *Paracalanus parvus* (44%), *Centropages kroyeri* (26%), *Oithona nana* (11%), *Euterpina acutifrons* (10%). *Favella markusovszkyi*, the most common tintinnid in this month, was not prominant (2%).

Other organisms of minor importance were : gastropod veligers, lamellibranch veligers, fish eggs, echinopluteus larvae, medusae and decapod larvae.

August :

In the Eastern Harbour (St. IV) a further decrease in the total numbers of the zooplankton community occurred, while the population at the Western Harbour increased considerably. The percentage of the copepod population in both stations, though still dominating, decreased considerably (being 58% and 80% in the Eastern and Western Harbours respectively). In the former the leading species was *Euterpina acutifrons* (22.6%), followed by *Paracalanus parvus* (18%), *Oithona nana* (10%) and *Centropages kroyeri* (5%).

In the Western Harbour *Paracalanus parvus* was, on the other hand, the dominant species (50%), followed by *Oithona nana* (18%), *Euterpina acutifrons* (14.5%) and *Centropages kroyeri* (8%). The population of tintinnids increased in both stations, *Favella markusovszkyi* was the most dominant (10%) and (15%) respectively. The following larvae were mostly represented at sattion IV viz. : lamellibranch veligers (13%), cirripede nauplii (11%), spionid larvae (3.6%) and gastropod veligers (3%).

Autumn Condition of 1961 :

September :

The average total numbers of the zooplankton increased during this month in both stations. The copepod population at station IV accounted for 63.5%. The species composition and the succession of dominance was nearly as the preceding month. Thus, *Euterpina acutifrons* occupied the top position (26.2%), followed by *Paracalanus parvus* (25%) and *Oithona nana* (11.2%). In the Wzstern Harbour the percentage of the total copepods decreased considerably to an average of 56.5%; but *Paracalanus parvus* was still the leading species (21.2%), followed by *Euterpina acutifrons* (20.5%), while *Centropages kroyeri* and *Oithona nana* were equally abundant (each 6.4%). In this month *Noctiluca* occupied a prominent position in both the Eastern Harbour (18%), and the Western Harbour (13.2%).

Tintinnids (mostly *Favella markusovszkyi* and *Tintinnopsis* spp.) were still, common, being represented by nearly the same percentage as the previous month viz. : 10% and 14% at the Eastern and Western Harbours respectively. Other organisms of minor importance were : spionid larvae, cirripede nauplii, lamellibranch veligers, gastropod veligers, rotifers, *Oikopleura* spp., *Sagitta* spp. and fish eggs.

October :

During this month, there was a further increase in the total zooplankton population, at both stations, towards the autumn maximum which was reached by the end of October. This increase was mostly due to a rise in the copepod population which now accounted for 79% and 65.7% at station IV and station V respectively. It is worth to note that for the first time the three dominant copepod species were nearly equally represented at both stations. Thus, in the Eastern

Harbour (St. IV) the population was dominated by *Paracalanus parvus* (28%), *Euterpina acutifrons* (26%) and *Oithona nana* (24%), while in the Western Warbour the three species were equally represented (each with 21%). On the other hand, tintinnids (mostly *Tintinnopsis radix, Favella markusovszkyi, Tintinnopsis* spp., *Favella* spp. and *Helicostomella* spp.) contributed only 5% of the total population at station IV; while in the Western Harbour (Station V) they were more abundant (especially at the beginning of the month) and accounted for (31.5%) of the total population. The more common species at this latter station were, in terms of abundance, *Tintinnopsis radix, Favella markusovszkyi, Coxliella annulata* and *Eutintinnus fraknoii.*

The following species were of secondary importance and are mentioned in the order of relative importance; Cirripede nauplii, spionid larvae, fist eggs, echinopleuteus larvae, decapod larvae, lamellibranch veligers, Oikopleura spp., *Clausocalanus aracuicornis, Oncaea* spp., medusae, *Sagitta* spp., rotifers and tadopole larvae of ascidians.

November:

In this month there was a sharp drop in the average total of the whole community at both stations. The copepod population still dominated all other groups with 70% and 87% at station IV and station V respectively. In the former *Euterpina acutifrons* (29.3%) was the leading species, followed by *Oithona nana* (21.6%), and *Paracalanus parvus* (13.2%). While in the Western Harbour, *Oithona nana* occupied the top position (30%), followed by *Euterpina acutifrons* (35%) and *Paracalanus parvus* (12%).

During this month too, the tintinnid population decreased enormously and contributed only by about 1% of the total population at both stations. Of the larval forms present during this month, spionid larvae of polychaetes were the most common, especially at station IV (8.5%), followed by lamellibranch veligers (4.2%) and cirripede nauplii (4%).

Rotifers (*Synchaeta* spp.) reached their maximum abundance during this month at station IV (5%), while at station V they amounted (2.5%). Other organisms of less importance were *Oikopleura* spp., medusae, *Sagitta* spp., gastropod veligers, nectochaeta larvae of polychaetes and *Noctiluca.*

Winter Condition of 1962 :

December:

There was a further drop in the zooplankton population in December, thus approaching its winter minimum with the copepod population constituting its highest percentage (85%) As in the previous month, *Euterpina acutifrons* was the leading species, and its percentage occurrence exceeded half that of all other organisms combined (57%). *Oithona nana* and *Paracalanus parvus* (10%) were still next in importance. The relative abundance of tintinnids (mostly *Favella* spp.) increased (3.5%). Other organisms of secondary importance are : spionid larvae of polychaetes, rotifers (*Synchaeta* spp. and *Keratella* spp.), decaped larvae, *Sagitta* spp., *Oikopleura* spp., lamellibranch veligers, and cirripede nauplii.

January:

In January 1962, the total population showed a further decrease and the percentage of the total copepods dropped considerably. At station IV it reached its minimum in the whole year (11.8%). This decrease in copepod abundance was due to a masking effect caused by a large production of cirripede nauplii, which dominated the population with 50.5%. The increase in the population of tintinnids (*Favella* spp., *Tintinnopsis* spp. and *Eutintinnus fraknoii*) also raised their percentage abundance to 28.6%.

Of the copepods *Oithona nana* was the most common (8.8%); while the population of *Euterpina acutifrons* and *Paracalanus parvus* dwindled considerably to a mere 2% and 1% respectively.

The winter decline in the total zooplankton population was also detected at the Western Harbour, where the population reached its winter minimum. The population was dominated by spioind larvae (22%) and cirripede nauplii (16.5%). The copepod population accounted collectively for 49.5% of the total zooplankton biomass. The species abundance were *Oithona nana* (15%) *Euterpina acutifrons* (12.5%). *Centropages kroyeri, Paracalanus parvus* and *Clausocalanus arcuicornis* shared equally 22%. Tintinnids were poorly represented and constituted less than 1% of the total population at station V (against 28.6% at St. IV). Other organisms of secondary importance in both stations were; lamellibranch and gastropod veligers cypris larvae of cirripede medusae and echinopleuteus larvae of echinoderms.

February:

During February the zooplankton biomass at station IV reached its winter minimum. However, although the total number of copepod orgainsms was nearly the same as in January yet due to the abrupt decrease in the numbers of other zooplankton organisms (mainly cirripede nauplii and tintinnids) the abundance of all copepods increased to 72.1% of the total zooplankton population. The succession in abundance of the copepod species was as follows: *Oithona nana* (18.8%) *Eutrpina acutifrons* (15.5%) *Acartia* spp. (*A. latisetosa, A. clausi* and *A. negligens*) (13.4%) *Centropages kroyeri* (8%) *Corycella* spp. (*Corycella rostrata* and *C. carinata*) (7.5%)- *Paracalanus parvus* (6.4%) and *Isias clavipes* (3%).

The percentage abundance of cirripede nauplii and tintinnids decreased to 13% and 7% respectively.

Other organisms of minor importance were; gastropod veligers, *Clausocalanus arcuicornis Oithona plumifrra* lamellibranch velibers spioniu larvae, *Oncaea* spp. nechtochaeta larvae of polychaetes, cypris larvae of cirripede and the rotifers *Synchaeta* spp.

In the Western Harbour the zooplankton community was dominated by the tintinnid population (mostly *Tintinnopsis campanula, T. beroidea* and *Favella* spp.) which constituted 46%. The copepod population was mainly composed

of the developmental stages of *Oithona nana, Euterpina acutifrons, Paracalanus parvus* and *Acartia* spp. all collectively accounted for 34.5%. Cirripede nauplii and rotifers (*Keratella* spp.) were also common, constituting 15% and 4% respectively.

Spring Condition of 1962 :

March :

In March, the zooplankton population at station IV, increased considerably. However, this increase was mostly due to the abrupt rise in the tintinnid population (mostly *Favella* spp., *Tintinnopsis campanula, T. radix* and *T. beroidea*) which now constituted 45.3% of the total zooplankton population. All copepods now constituted 33.7%, with *Euterpina acutifrons* as the most common species (9.6%), followed by *Acartia* spp. (8%), *Centropages kroyeri* (5.7%), *Oithona nana* (5.3%), and *Paracalanus parvus* (4.1%).

Other organisms of secondary importance were, in order of abundance, cirripede nauplii, nechtochaeta larvae of polychaetes, lamellibranch and gastropod veligers, decapod larvae, *Oikopleura* spp. *Isias clavipes*, spionid larvae, rotifers (*Keratella* spp.), cypris larvae of cirripede, *Oncaea* spp., *Corycaeus* spp., and *Corycella carinata,*

In the Western Harbour, the copepod population dominated over all other zooplankton organisms by 71%, while tintinnids (mostly *Favella* spp., *Tintinnopsis campanula, T. beroidea, T. lindeni*) accounted for 17%. The species abundance was as follows: *Acartia* spp. (*A. negligens* and *A. clausi*) (17%), *Isias clavipes* (16%), *Oithona nana* (15%), *Euterpina acutifrons* (10%), *Centropages kroyeri* (7%), *Paracalanus parvus* (6%).

Other organisms of secondary importance were, *Podon Polyphemoides* (3.5%), spionid larvae (2.5%), *Oikopleura* (2%), rotifers (*Keratella* spp.) (2%), together with cirripede (1%) and nechtochaeta larvae of polychaetes (1%).

April :

During April the density of zooplankton biomass of the Eastern Harbour was nearly double that of March. Here the copepod population formed 59.1% of the whole community. The succession of abundance of the copepod species was nearly a repetition of April 1961. Thus *Euterpina acutifrons* dominated by 18.7%, followed by *Acartia* spp. (14%), *Paracalanus parvus* (11.1%), *Oithona nana* (9.5%) and *Centropages kroyeri* (3.5%).

Of the larval forms present, spionid larvae reached their maximum abundance (15.5%), followed by lamellibranch veligers (11.4%), while tintinnids dropped to a mere 3%.

Other organisms of minor importance were, *Oikopleura* spp., *Noctiluca,* gastropod veligers, *Isias clavipes*, cirripede nauplii, medusae, *Clausocalanus arcuicornis*, nechtochaeta larvae of polychaetes and decapod larvae.

May:

In the first half of May, the density of the zooplankton biomass at the Eastern Harbour was nearly the same as in April, but towards the end of May, the zooplankton population reached its maximum for the year. This maximum, however, occurred earlier than that of 1961. The average percentage of the copepod species was, however, lower than that of May 1961, being 54.7%.

As in May 1961, the population was dominated by *Paracalanus parvus* (13.3%), *Eutrrpina acutifrons* (13.2%) and *Oithona nana* (11.5%), *Acartia* spp. (8.8%), (chielfy *A. latisetosa* and *A. negligens*) and *Centropages kroyeri* (7%). Other organisms present in large numbers were, lamellibranch veligers (10.3%), appendicularians (9.7%), gastropod veligers (9%), and spionid larvae (6.3%).

The following organisms contributed only a small percentage to the total population, viz.: cirripede nauplii, *Noctiluca*, decapod larvae, nechtochaeta larvae of polychaetes, *Clausocalanus arcuicornis*, *Isias clavipes*, cypris larvae of cirripede and fish eggs.

As in May 1961, the tintinnid population was poorly represented during this month.

In the Western Harbour the copepod population entirely dominated the whole zooplankton community forming 93%, but this great percentage was due to the large numbers of copepod nauplii, which collectively amounted to 90% to the total population. By referring these nauplii to their species, the succession in percentage abundance is as follows:

Eutrrpina acutifrons (40%), *Paracalanus parvus* (31.5%), *Centropages kroyeri* (10%), *Acartia* spp. (mostly *A. latisetosa* and *A. negligens*) (7%), and *Oithona nana* (5%).

Tintinnids (mostly *T. beroidea* and *Favella markusovszkyi*) were represented by 4.6%.

The following organisms constituted 2.4% of the whole community viz.: cirripede nauplii, gastropod veligers, lamellibranch, veligers, rotifers, and spionid larvae.

DISCUSSION

It is evident from the foregoing review of the variations in the total zooplankton population, that there are two maxima in the area under consideration, viz.: a spring maximum and an autumn one. In the offshore stations (Fig. 5) the first

maximum, which is also the minor one, occurred during April in both years. It coincides with the period when the water temperature gradually increases from its winter minimum, while the salinity is around its annual average. The autumn zooplankton maximum coincides in time with the period of salinity decrease caused by the flow of Nile flood water into the sea. The autumn maximum occurs in the offshore stations during September in both years (salinity 37.83‰ and 37.18‰ in 1961 and 1962 respectively). During this month the water temperature is around its maximum (average 25.9°C and 27.4°C in 1961 and 1962 respectively).

That temperature is of importance in regulating the seasonal distribution of zooplankton organisms in our area is shown by comparing the magnitude of both the winter and summer minima of the total zooplankton population (Fig. 5). The summer population is by far higher than that of the winter. However, during the flood season, the number of the zooplankton community increases greatly and more or less abruptly. The pre-flood season is characterised by a relatively high water temperature, high salinity and poor phytoplankton crop (Fig. 5). On the other hand, the flood season is characterised also by a high water temperature, but a lower salinity and high phytoplanktn crop. The pronounced effect of the phytoplankton bloom developed during the flood season on the high production of zooplankton organisms could not be ignored, in as much as it furnishes abundant and plentiful source of food for nearly all zooplankton orgainsms. However, the low water salinity during this period may also have an accelerating effect on the production and potentiality of most of zooplanktonts. Wilson (1942) has pointed out that a high salinity is known to be adverse to ordinary pelagic copepods and it is possible that when combined with a fairly hgih temperature may become a deterrant to copepod life in the epiplankton.

It is clear form the histograms (Fig. 1) that the zooplankton population at station I was on the whole numerically superior to that of the other two offshore stations. There is also an obvious trend for a gradual decrease in the total zooplankton community from station I to station III i.e. from east to west. The occasional increase in the population at station III as recorded in May and Octoper 1961 is probably of "outside" origin, being mostly due to a seaward flow of inshore water, rich in plankton organisms, from the Western Harbour.

At the inshore station (station IV, Fig. 6) although the zooplankton community increased in April 1962, yet the first maximum (which is also the prominent one) comes later, either in late May or in June; while in the Bay of Algeria, the spring maximum of zooplankton occurs earlier in February-March (Rose, 1927).

The periodicity of the autumn maximum, in the inshore area, differs from year to year; in 1961, it was recorded in October, while in 1962 it occurred earlier in late August.

The following table (Table 1), shows the time of occurrence of the two maxima of zooplankton in the area, together with the average temperature and salinity (for the whole water column sampled) recorded at the time of these maxima.

TABLE 1.—AVERAGE TEMPERATURE AND SALINITY DATA RECORDED DURING THE PERIODS OF ZOOPLANKTON MAXIMA IN THE AREA.

Period of occurrence		Inshore area			Offshore area		
		Month	T.°C	S ‰	Month	T.°C	S ‰
Spring	1961. . .	June	25.50	38.60	April	18.0	38.55
	1962. . .	Late May	22.60	37.63	April	18.2	38.47
Autumn	1961 . .	Oct.	25.20	35.70	Sept.	25.90	37.83
	1962 . .	Late Aug.	28.60	30.01	Sept.	27.40	37.18

Steuer (1935) on the basis of volume measurements of the plankton catches at Alexandria, dectected "false" maximum during May (caused by swarms of Salps), and a second pronounced one in October. However, no swarming of salps was detected in the samples collected and their occurrence in the area might therefore be accidental and not regular.

Regarding the composition of the zooplankton community, it is seen from the forementioned review, that as typical to several marine neritic habitats, the zooplankton of the area investigated is rather diversified not only in the groups of plankton organisms but also in the species recorded for each group. Of the Copepods for instance, 84 species were identified from the area; while the tintinnids were represented by 99 species. Of the population of the other permanent zooplanktonts present (other than Copepods and tintinnids) 67 species were identified.

The relative poverty, in quantity of several marine groups in the Mediterranean Sea particularly in its eastein basin was referred to by many authors (cf. Ekman, 1935). The estuarine shallow water condition off the Nile delta seem to favour the existence of a rich zooplankton population but not of all groups. Sewell (1948) referred to 121 pelagic copepods to occur in the Mediterranean Sea. How much of these lack in the Eastern Basin is not yet known. However, the 84 copepod species recorded in our area form about 2/3 of the number given by Sewell (l.c.).

The percentage composition of the different groups constituting the zooplankton in the area (Fig. 4) shows that small copepods are by far the most important constituents. They dominate the zooplankton community, either all the year round, as in the offshore stations with an average of 76.3%, or during most of the year as in the inshore stations with an annual averge of 65.0%.

The relative abundance of the other groups present also varies between the inshore and offshore stations. In the former (station IV) barnacle nauplii occupy the second position after the copepods (11.0%) to be followed by the tintinnids (8.3%), polychaete larvae (6.0%), lamellibranch veligers (4.0%), gastropod veligers (2.4%), appendiculates (1.3%) and *Noctiluca* (1.0%) (Fig. 4).

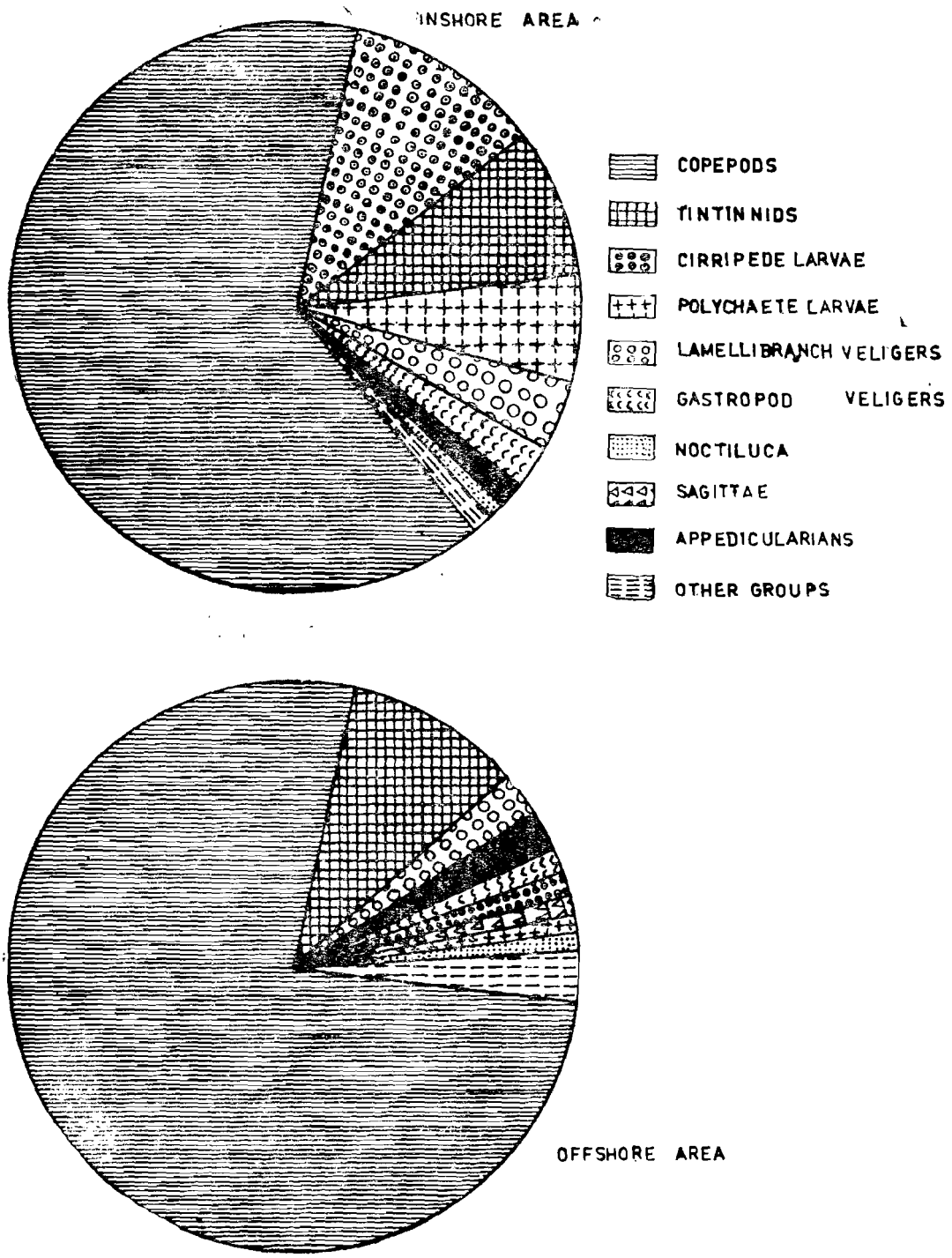

FIG. 4.—Average percentage composition of the zooplankton population in the offshore and inshore stations, based on ther occurrence in vertical hauls of the fine net.

In the offshore area, however, the tintinnids come next to copepods in abundance with annual average of 10.5%. The other holoplanktonic groups and the planktonic larvae (Fig. 4) constitute only a small percentage of the total population as follows : lamelibranch veligers (2.5%), appendiculates (2.2%), gastropod veligers (1.5%), cirripede nauplii (1.2%), while Chaetognaths, polychaete larvae *Noctiluca*, each with about 1.0% of the annual average. The relatively high percentage of the tintinnids at the offshore stations is due to the relatively low numbers of the average total zooplankton population at these stations. On the other hand the relatively high percentage of the larval forms in the inshore area seem to be natural, since the semi-closed shallow area (station IV) affords suitable grounds for several bottom dwelling animals which have larval phase in their life histories.

The production of organic matter by phytoplankton (and sea-weeds) is the basic condition for the existence of all groups of animal life in the marine biotopes. In general, there is a relation between the amount of basic organic production by phytoplankton and the population size of other marine organisms that occupy the lower links of the food chain in the sea, namely, the herbivorous organisms. At any time, assuming stable conditions, the standing stock of phytoplankton reflects the balance between production and losses due to sinking and grazing. The effect of grazing of herbivorous animals on lowering the standing stock of phytoplankton has been confirmed by several investigators. Consequently, grazing by copepods (the most important grazers in the sea) and other filter-feeding animals has been considered as one of the major factors regulating the standing crop of phytoplankton; it is also the factor responsible for establishing the inverse numerical relationship between zooplankton and phytoplankton crops (Harvey *et al.* 1935). However, apart from the other various theories which were put forward to explain the inverse relation between the zooplankton and phytoplankton (Hardy & Gunther, 1935; Steem an Nielsen, 1937; Bainbridge, 1953; Beklemishev, 1957), this relation is not always an inverse one. Lohmann (1908) found that, the annual distribution of zooplankton biomass at Kiel showed roughly the same trend as that of the phytoplankton. Steemann Nielsen (1961) concluded that "a direct relationship between phytoplankton and zooplankton is normal in the sea...".

The relationship between phytoplankton and zooplankton in the area investigated is shown graphically in figures (5 and 6). From both figures it is obvious that during the period of massive phytoplankton production in autumn (flood season), the zooplankton is also represented by maximal numbers. During this period, the copepods constituted about 75% of the total zooplankton, with their developmental stages constituting about 50% of their population against only 24% before the flood season. It is obvious therefore that the abundance of phytoplankton increased the rate of reproduction of copepods as well as other zooplankton organisms and some benthic animals with planktonic larval phase. Such a phenomenon was observed by many investigators (e.g.: Marshall & Orr, 1952; Grainger, 1959; and Edmondson, 1962). The rate of population growth of different zooplankton organisms is also strongly influenced by the abundance of food supply, (Bainbridge, 1958; Raymont, 1963). Both field observations and experimental studies indicate that many zooplankton groups other than copepods appear to be herbivorous on phytopanktan (Lebour, 1922; Marshall & Orr, 1955; Raymont,

1963). Inspite of the intensive grazing of these herbivorous animals, the standing stock of phytoplankton is maintained at its maximum for a time during the flood season. The high reproductive rate of phytoplankton during this period compensate for the loss due to the intensive grazing. This is in agreement with the statement of Steeman Nielsen (1961) that "in most cases the grazing of the zooplankton appears to maintain the standing crop of phytoplankton at the size best suited to prevailing growth conditions".

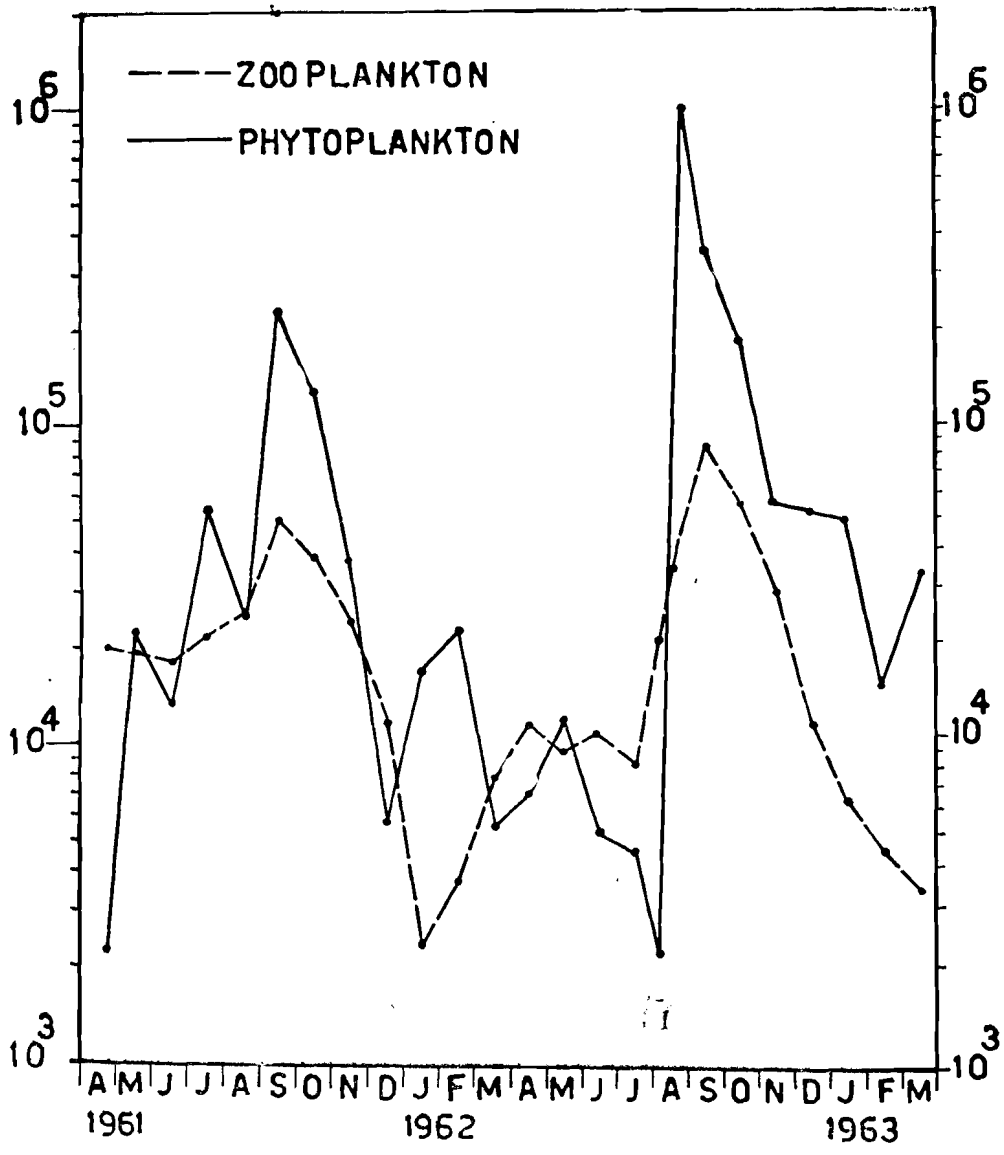

FIG. 5.—Monthly average of the total number of phytoplankton (cells/liter ; average of the whole water column 0–30 m) and the total number of zooplankton (individuals/m^3 from vertical hauls of the fine net) at the offshore stations from April 1961 to March 1963.

On the other hand, an inverse relation between the zooplankton and phytoplankton is established in winter (Figs. 5, 6). The built up of the winter phytoplankton crop is a result of a low rate of consumption of the relatively few grazers during this time. The relatively low winter temperature slow down the reproduction of most permanent zooplankters (mainly copepods) and some of the benthic animals with planktonic larvae.

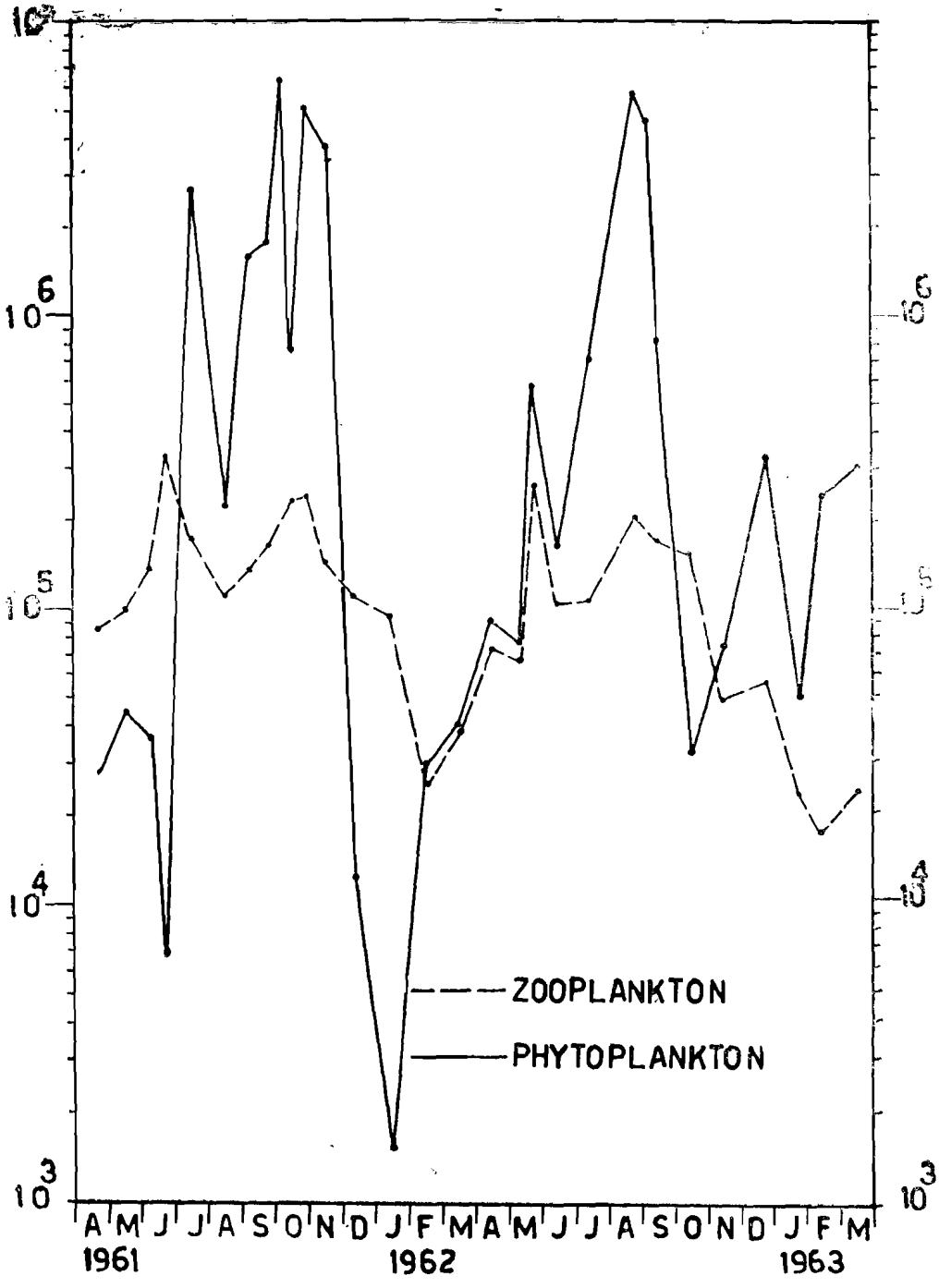

FIG. 6.—The total number of phyltoplankton (cells/liter) and the total number of zooplankton (individuals/m³) at station IV, from April, 1961 to Mach, 1962.

It seems that the winter phytoplankton increase recorded in the offshore area during this investigation, is not a true maximum and could not be compared with the corresponding winter maxima developed in other regions in the western Mediterranean; it is favoured mostly by the low rate of grazing caused by the low standing crop of zooplankton. In favour of this idea is that at station IV, where the zooplankton was relatively high (composed mostly of cirripede larvae and appendicularians), the phytoplankton decreased enormously to a minimum. It was also referred to that during the same month a low zooplankton crop at station V, was associated with a pronounced phytoplankton increase.

During spring, particularly in 1961, the zooplankton is more numerous than the phytoplankton, and the relation between both is of the inverse type as shown in the figures (5, 6). On the other hand, *Skeletonema costatum* (the dominant constituent of the phytoplankton) was able to build up a large population in July particularly at station IV, while the zooplankton was still numerous. This species seems to constitute a favourable diet for many zooplankton organisms (Lebour, 1922; Marshall, 1928 and 1947; Thomson, 1946). It is obvious therefore that, under its optimal conditions, *Skeletonema costatum* is able to maintain a dense population inspite of intense grazing. The same condition was found during the flood season when several phytoplankton species were represented by maximal numbers inspite of the intensive grazing by zooplankton.

Dowidar (1965), on the basis of cell numbers, found that phytoplankton production in the area investigated is higher than in other Mediterranean regions, especially during the flood season. Consequently, zooplankton production, in turn, is relatively high. Since zooplankton is considered directly or indirectly the main food for fish, especially for pelagic fish, the latter are greatly influenced by the behaviour and distribution of zooplankton.

North Sea fishermen have for a considerable time rely. on the abundance of certain plankton species, mostly *Calanus* spp. to indicate the presence of herring. Einarrsson (1955) (quoted from Hela & Laevastu, 1963) believes that he had established a positive correlation between the amount of zooplankton present in the water and the catch of herring in the North Atlantic. Japanese fishermen, in their fishing operations make extensive use of their knowledge of the relation between the plankton and fish.

Marukawa (1934) states that the copepods, not only provide food for fish, but often indicate the best fishing grounds. Clarke (1934) points out the fundamental quantitative relations that exist in certain cases between the copepods and the organisms which prey upon them.

In our area, the correlation between the plankton biomass and the pelagic fish is of paramount importance. It is well known that sardine fisheries along the Egyptian Mediterranean shores flourish during the autumn months, i.e. during the flood season. The swarming of sardines during this period is undoubtedly due to the dense phtoplankton crop which develops along the whole Dalte shores, especially around the Nile mouths. Egyptian sardines are composed mainly of *Sardinella aurita* Cuv. & Val. and *Sardinella maderensis* Lowe. Rapid fattening

of these species takes place during the autumn months (El-Saby, 1937). Analysis of the stomach contents shows that both diatoms and copepods are the important diet of these fish (El-Maghraby, 1963). Since 1966, this condition no longer prevails due to the complete storage of flood water in front of the High Aswan Dam. In other seasons of the year the occurrence of clupoid fishes in the area is also connected with abundance of food. Thus in March 1962 there was a swarming of sardine in the Western Harbour area, where a dense phytoplankton bloom existed. Also the same phenomenon was observed off Rosetta in April 1962.

SUMMARY

The total zooplankton community of the neritic waters of Alexandria region is investigated from both offshore and inshore stations for two consecutive years (April 1961 - March 1963).

The monthly average numbers of the offshore stations varied from about 2 to 90 thousands individuals/m^3. On the whole sta. I maintianed the highest population among the offshore stations and sta. III the least. During the period of investigation two annual maxima were observed, a minor one in spring and a pronounced one in autumn.

The spring maximum coincided with rlatively low temperature (18-20°C) and high salinity (38.5‰) while the autumn maximum was associated with relatively high temp (27°C) and low salinity (36-37.5‰). The population at the offshore stations is dominated all the year round with small sized species of copepods characteristic of neritic warm waters. Their contribution to the total population had an annual average of about 76‰. Next to the copepods in importance as holoplankton were the tintinnids and the appendiculates with annual averages of 10.5‰ and 2.2‰ respectively. The planktonic larvae had collectively an annual average of 6‰. The details of monthly variations of the different components in terms of their percentage occurrence relative to the total population is given. The average numbers of the total population at the inshore stations is relatively higher than that of the offshore stations, it varies from 20 to 250 thousand individuals/m^3. The population was also dominated by the small copepod species with an annual average of 65‰; next in importance were the planktonic larvae whose average amounted to 31‰. The contribution of tintinnids and appendiculates to the total pouplation was relatively smaller compared with the offshore stations being respectively in the order of 8.3‰ & 1.3‰. The relative abundance of the planktonic larvae at the inshore stations is natural; since such localities are sutitable homes of several bottom invertebrates.

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