A STUDY OF THE COPEPODS OF THE INSHORE WATERS OF PALK BAY AND GULF OF MANNAR

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Introduction

It has been reported by Prasad (1956) that the general trends in the fluctuations of the total copepods, including copepodites, in the Gulf of Mannar and Palk Bay were different. According to him the fluctuations were apparently dicyclic at station G in the Gulf of Mannar, with one peak during December–March and another during September or October, as against the fluctuations at station P in Palk Bay, starting from a very low level and almost continuously increasing until it reached a maximum in September or October and then declining. In order to study the causes which bring about these differences in the population of copepods at the two stations it was suggested that a detailed analysis of the composition of population and the behaviour of the dominant species be taken up.

I wish to thank Dr. S. Jones for many valuable suggestions and I am also highly indebted to Dr. R. Raghu Prasad, Central Marine Fisheries Research Station, for suggesting the problem and the constant help and criticisms throughout this work.

Material and Methods

The study is based on the routine samples collected at the Central Marine Fisheries Research Station once a week from both the stations from January 1952 to December 1954 (for details and locality see Prasad, 1956). From station P, however, during 1952–53, samples of four-day interval have been studied. The observations on total copepods based on samples for 1952 and up to June 1953 have already been published (Prasad, 1956). In the present work the samples have been reanalysed and enumeration of the various species was done by the same method adopted by Prasad, 1954–56. But, however, here the total count of a 2 c.c. sub-sample was taken. Prasad (1956) in his study on total copepods included copepodites also, but in the present work they have been counted separately.

Total Copepods and Copepodites

As seen from Fig. 1, the trends in fluctuations of total copepods observed by Prasad (1956) for the years 1951–53 were true also for the years 1953–54,

excepting that in 1954, at station G there was an abundance of copepods in May–June; they were relatively few in September and the increase in their population, which in the previous years commenced in December, started early in November this year and resulted in a population which was the greatest at station G during all the five years so far observed, from 1950–54. At station P whilst the trend in general was the same in 1954, as in the previous years, the maxima showed interesting differences. Three distinct peaks were encountered, the first in April, the second and the highest in August and the third in December. It is interesting to note that as at station G, the highest population of copepods for the years 1951–54 was recorded in 1954.

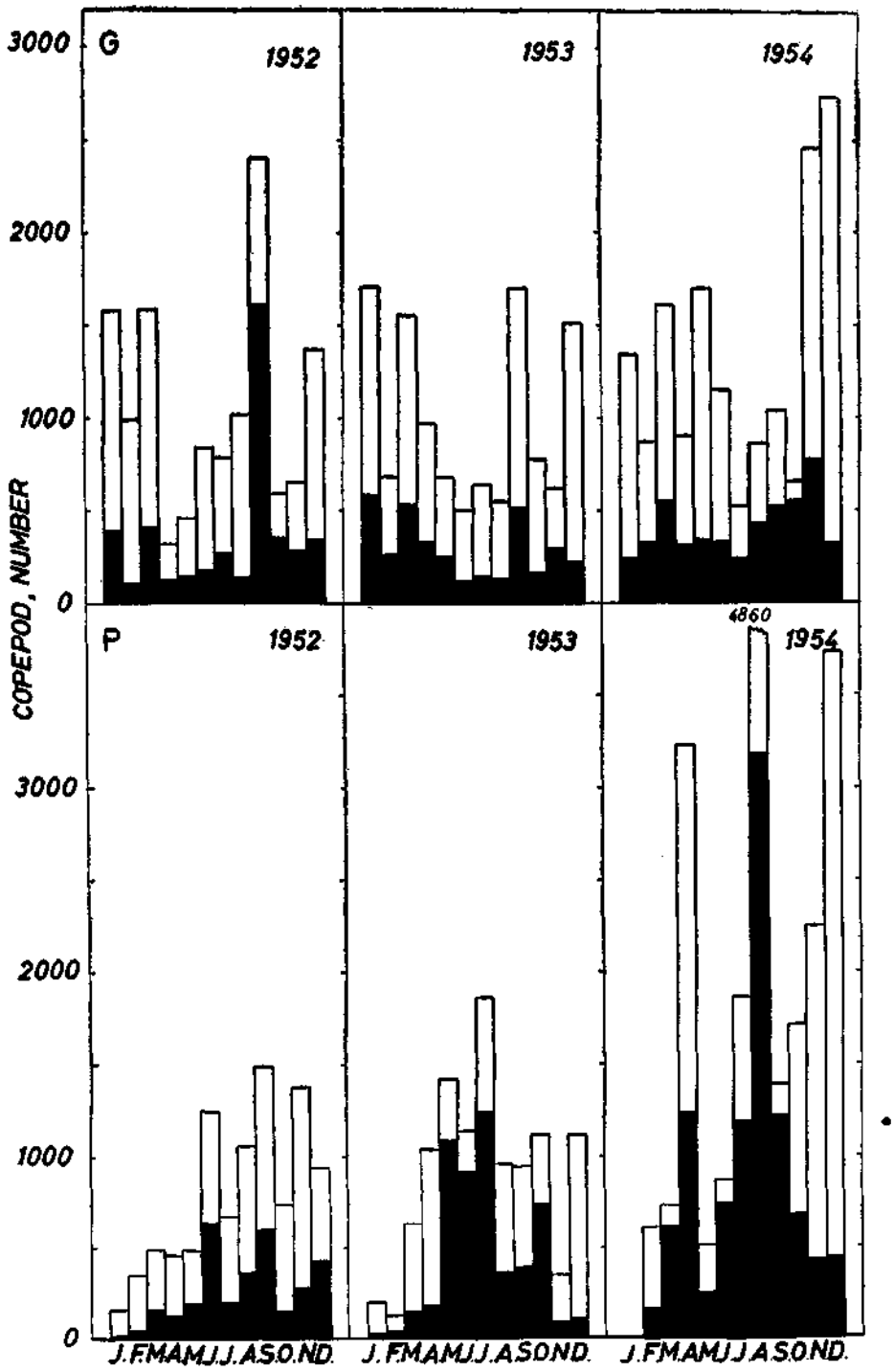
Another noteworthy feature, observed by Prasad (1956) during 1951–53 and also noted in the present work, during 1953–54, was the numerical difference in the total standing crop of copepods at the two stations. At station G it was higher than that at P chiefly because of the greater number of *P. parvus*, *Acrocalanus*, *Corycæus* and *Oithona*. However, in 1954 there was a reversal in the trend; at station P it was considerably higher than that at station G. This was due to an hitherto unusual outburst of a single species, *Paracalanus parvus*, at the station during December.

The occurrence of copepodites showed marked differences between the two stations. The total standing crop at station G was considerably less when compared to that at station P. At station G, they occurred uniformly at a low level throughout the year with, however, a slight increase during September–November (*see* Fig. 1). At station P, on the other hand, there was considerable fluctuation in their numerical abundance. From January–April copepodites were very few and the population was composed more of adults. From May–September there was a high percentage of copepodites (Fig. 1). After September copepodites declined and by November–December the population was again composed of adults.

Composition of the Copepod Stock

The species which contributed to the bulk of the copepod stock were same in both the stations but there were differences in the numerical abundance of individual species. In the abundance of species and individuals, Calanoids stood foremost, with the Cyclopoids and Harpocticoids far behind at both the stations.

The important species which contributed to the bulk of the stock in both the stations were:



TEXT-FIG. 1. Numerical variations in total copepods at stations P (below) and G (above) during 1952–54.

Shaded bars represent Copepodites.

Clear bars represent the Adults.

Acartia (*Odontacartia*) *erythræa* Giesbrecht, *Paracalanus parvus* Claus, *Acrocalanus* spp., *Metacalanus aurivilli* Cleve, *Corycæus* spp., *Oithona* spp., *Euterpina acutifrons* (Dana).

Acartia (*Odontacartia*) *erythræa* Giesbrecht

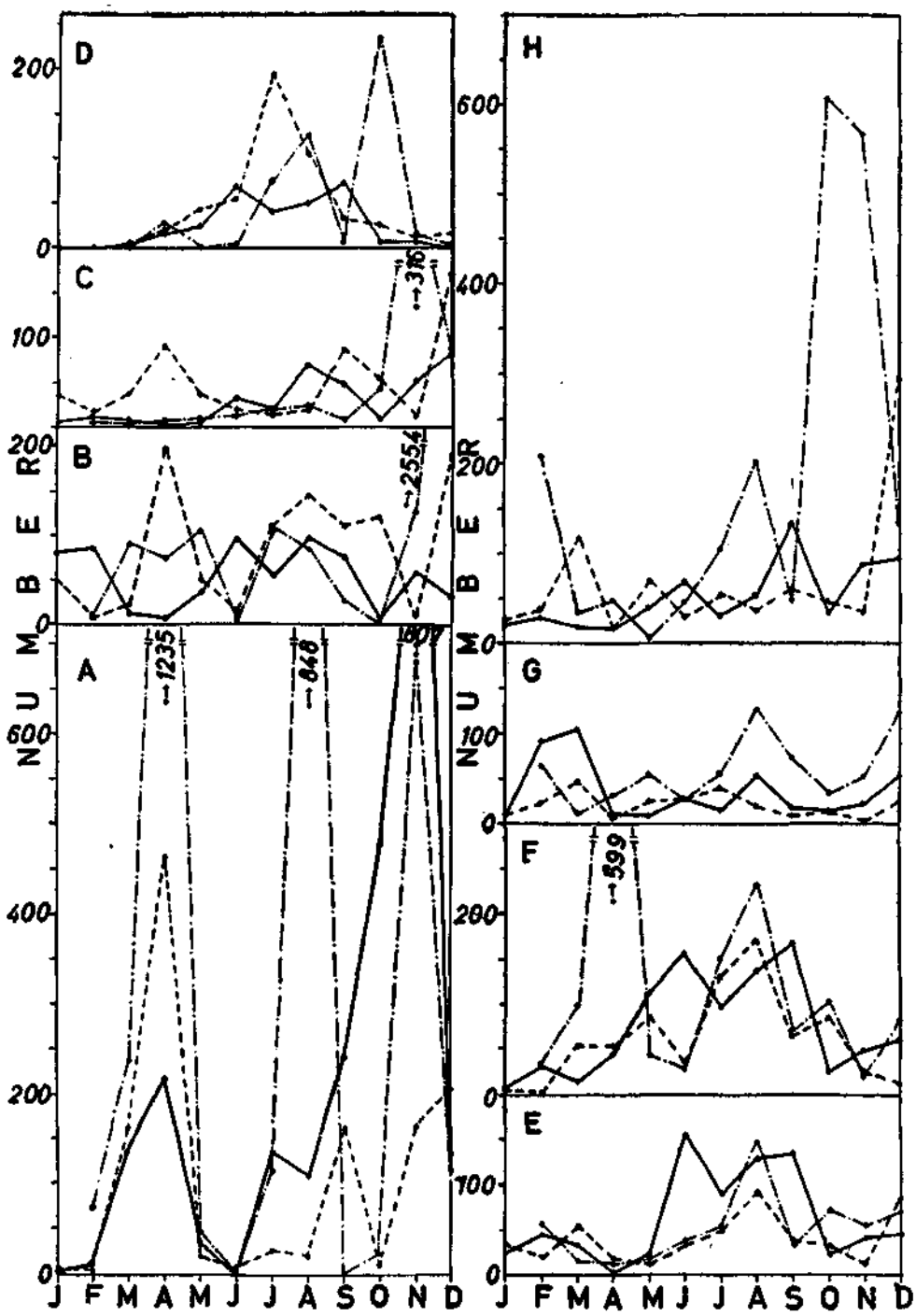
The distribution of *A. erythræa* at stations P and G showed two or three distinct peaks in all the three years, none of which extended for more than two months (Figs. 2 and 3). *A. erythræa* was more predominant at station P, attaining at times about 85% of the total adult copepods (Fig. 4). The first maximum occurred in April, decreased in numbers and remained at a low level during May–July. A second peak was noticed sometime between August and September, August in 1954 and September in 1953. This peak, however, was not observed during 1952. A third maximum, usually higher than the second, was in November both in 1953 and 1954. However, in 1952 this started early in July and had a relatively higher magnitude and a longer duration. In 1954 the April peak was the highest, the August peak the second and the November peak of the least magnitude. It was due to this great magnitude of *Acartia* that there was a marked peak in the total copepods in April 1954. In 1953 *Acartia* population was very poor with only two minor peaks, one in September and another in December. Soon after the maximum in November–December, the population reached a low level. During January–February, May–June and October, *Acartia* was at the lowest ebb.

At station G, the fluctuations in *Acartia* population were slightly different. The maxima were less defined and of lesser magnitudes. However, in March 1953 *Acartia* attained nearly 70% of the adult population. There was a distinct first maximum observed in all the three years during early March, as against April at station P. After March, the population suddenly declined and remained at a low level till November or December when it again rose to another maximum. The latter was in November 1954 and in December 1952 and 1953. In 1952 and 1953, there was an additional peak during September.

The population of *Acartia* during December–February at station G was found to be mixed in all the three years, when a small proportion of an unidentified species of *Acartia* occurred along with *A. erythræa*. At station P the former was found during March–April, but in lesser numbers.

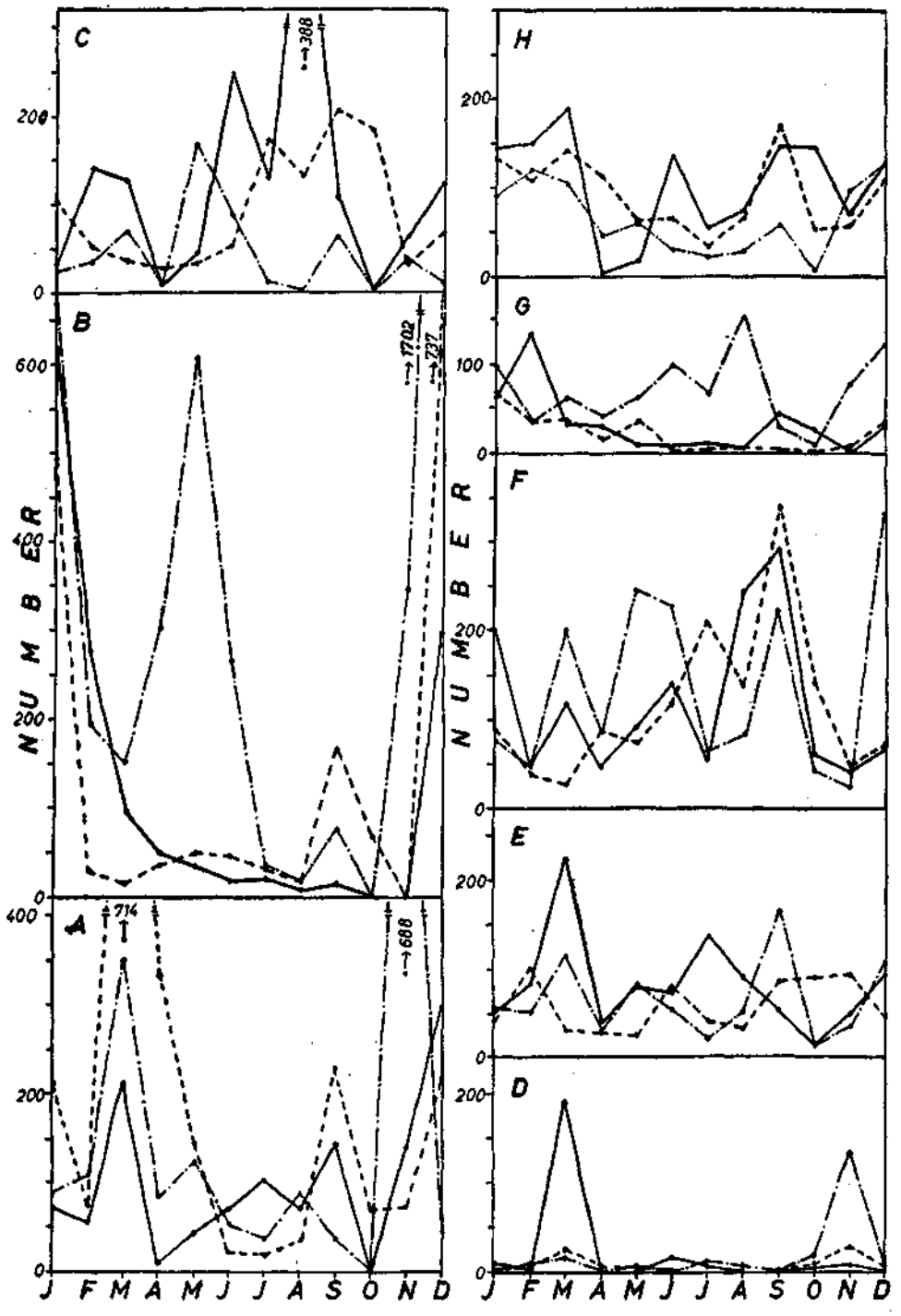
Paracalanus parvus Claus

No other species differed so much in the trend of their seasonal fluctuation between the two stations as *P. parvus*, during 1952–54. It was present



TEXT-FIG. 2. Numerical variations of the different species at station P during 1952–54.
——— 1952, - - - - 1953, .—.— 1954.

(A) *Acartia erythræa*
(B) *Paracalanus parvus*
(C) *Acrocalanus* spp.
(D) *Metacalanus aurivilli*
(E) *Corycæus* spp.
(F) *Oithona* spp.
(G) *Euterpina acutifrons*
(H) Other copepods



TEXT-FIG. 3. Numerical variations of the different species at station G during 1952–54.

——— 1952, - - - - - 1953, .—.— 1954.

(A) *Acartia erythræa*
(B) *Paracalanus parvus*
(C) *Acrocalanus* spp.
(D) *Metacalanus aurivilli*
(E) *Corycæus* spp.
(F) *Oithona* spp.
(G) *Euterpina acutifrons*
(H) Other copepods

throughout the year in both the stations. But, whilst it formed a major portion of the total annual population at station G and in 1954 was the most predominant species there, at station P it did not form a significant portion. At G the maximum was during December–January, when it occurred in enormous numbers and constituted 50–60% of the total population (Fig. 4). Soon after January it decreased in numbers and throughout March–November remained at a very low level. In 1954, however, there was a second increase during April–June (Fig. 3) which was mainly responsible for the total copepod peak in May–June. By December this species again increased to a very high level and remained so till the end of January.

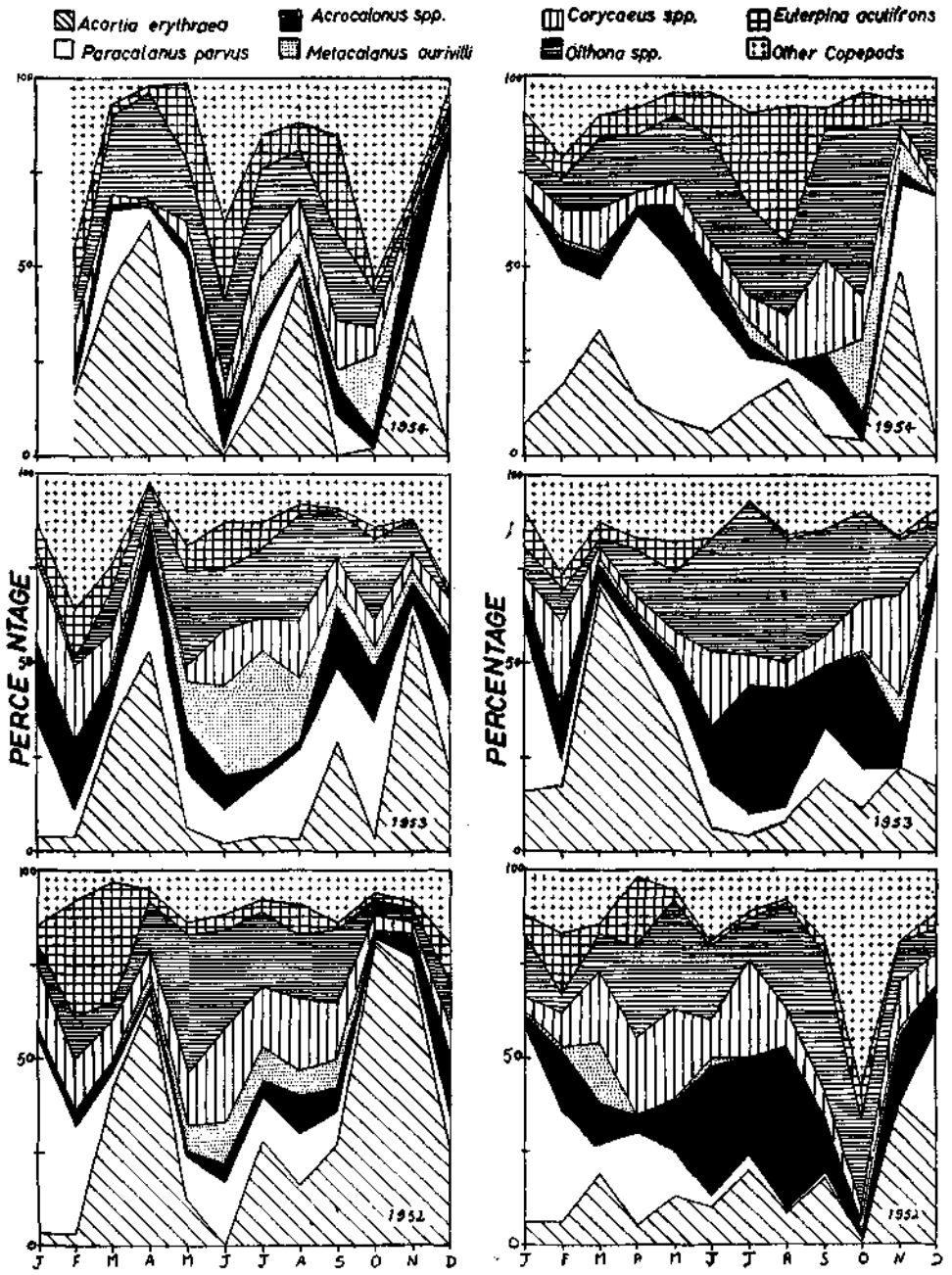
At station P, on the other hand, *P. parvus* did not show much of fluctuations during any part of the year, excepting in December 1954 when there was marked increase in the number contributing to nearly 60% of the population (Figs. 2 and 4). During the other two years the species was at its minimum from November–March and rose to one or more minor peaks between April and October. Even during these peak periods it did not form any considerable percentage of the population. However, during January it formed a significant portion of the total population since all other species were at a low level.

Acrocalanus spp.

The genus *Acrocalanus* was represented at both the stations mainly by three species: *Acrocalanus gracilis*, *A. gibber* and *A. monachus*. As seen from Figs. 2 and 4 the genus was not a major constituent of the total copepod population at station P during any part of the year. These occurred almost throughout the year in small numbers, occasionally rising to minor peaks which did not show any fixed periodicity. In 1954 there was a noticeable peak in November, but as seen from Fig. 5 this did not have any significant part in the total population. At station G, on the other hand, there was a fairly good population from June–August in 1952, with a peak in August; and July–September in 1953 (Fig. 4). In 1954 there was a peak of short duration in May.

Metacalanus aurivilli Cleve

This minute copepod occurred at both the stations, relatively more abundant at station P, where the species attained a peak between May and September and formed a notable constituent of the total population (Figs. 2 and 3). In 1954 a second peak occurred during November. At station G (Fig. 4) the species was not of any considerable importance. However, there was an abundance in March 1952 and November 1954. In 1953 it



TEXT-FIG. 4. Variations in the percentage composition of the copepod stock at station P (on the left) and G (on the right) during 1952–54.

was present only in small numbers during February–April and October–December.

Corycæus spp.

Corycæus were present in fair numbers throughout the year at both stations. They were often more abundant during July–September at station P, whereas at station G their distribution was rather erratic with minor peaks in March, July and September–November.

Oithona spp.

Oithona formed a major part of the total population throughout the year at both the stations (Fig. 5) but contributed to a higher percentage at station G. The maxima showed irregularity at both the stations with, however, constant peaks in September at station G and in August at station P. At the latter station there was a high peak in April 1954.

Euterpina acutifrons (Dana)

This copepod occurred throughout the year with slight variations in its abundance. It, however, showed noticeable fluctuations from year to year. At station P peaks were noticed in January–February 1952 and August and December 1954. At station G it was generally more common in January–February and in December, but in 1954 there was conspicuous increase in its number during May–August.

Other copepods

This group consists of many species which appear in the plankton usually in small numbers and do not have any individual significance in the population, unless a sporadic maximum of a particular species occurred to markedly affect the population level. Such an instance was noticed at station P, in February 1954, when there was an abundance of *Centropages tenuiremis*. In 1954 during July–August large numbers of the harpacticoid, *Stenhelia* sp. caused a peak in the total population and during October–November there was another peak due to the sudden appearance of a Paracalanid copepod. The latter was observed in large numbers only in two samples, collected on 22–10–1954 and 8–11–1954. Soon after the middle of November it disappeared from the plankton.

The more common species included in this group are: *Canthocalanus pauper, Paracalanus aculeatus, Centropages furcatus, C. tenuiremis, C. dorsispinatus, Temora turbinata, T. discaudata, Pseudodiaptomus aurivilli, Schmackeria serricaudata, Calanopia thompsonii, C. aurivilli, C. elliptica, Labidocera*

spp., *Pontella* spp., *Tortanus gracilis*, *T. forcipatus*, *Oncea* sp., *Macrosetella* sp., *Microsetella* sp., *Peltidium* sp., *Procellidium* sp., and *Metis* sp.

Discussion

As already stated, the total copepod population at the two stations, although alike in species composition, was essentially different in the mode of fluctuations. From the detailed observations of the three years' data given above, it may easily be inferred that this difference is due to the diversity of patterns of distribution of individual species.

The intensity of spawning, in general, appears to have been high at station P than at G. Spawning in copepods appears to be taking place almost throughout the year at both stations, with, however, high intensity at station P from May–September, as indicated by the nauplii. At station G on the other hand, spawning seems to be of more or less the same intensity, with only a slight increase during September–November. The difference in the spawning behaviour of the copepod population at the two stations may be, to a very large extent, due to the differences in the phytoplankton cycle and consequently the availability of food. A detailed account on the spawning of copepods in this area and its relation to the phytoplankton is under preparation and will be published in course of time.

The copepodites at station P (Fig. 1) formed the major portion of the population, attaining at times as much as 85%, during May–September in all the three years. At station G, on the other hand, these were relatively of small percentage throughout the year. However, during September–November, along with the slight increase of the nauplii, the number of copepodites also increased, but not to such an appreciable extent as to cause any distinct peak in the total population. The copepodites were lowest during May–September when they were high at station P. It was to a great extent due to this abundance of copepodites at station P that during May–July the total population was at a higher level than at station G, for adults at both stations at this time had a similar low trend. In 1952, however, the total copepod population of the year was relatively low, especially during April–May. It was also noticed that the spawning intensity was low as indicated by the population of nauplii and copepodites. This period coincided with the swarming of *Noctiluca* and consequent reduction in the phytoplankton (Prasad, 1956) which might have caused the observed reduction in the total copepod population.

The two stations showed differences in the distribution of the individual species also. *Paracalanus parvus* was often more abundant at station G

and reached maximum during January when they were very few at station P. This species, together with a relatively higher standing crop of *A. erythræa*, was mainly responsible for the January peak of the total copepods. In February there was a slight fall in the total population due to the abrupt decimation of *Paracalanus*, but in March again went high owing to the increase in number of *Acartia*, which started by the end of February. Soon after March owing to the diminution in number of *Acartia* the total population remained at a low level till June–July. There was a departure from this trend in 1954 due to a second maximum of *P. parvus* in May–June, which caused a peak in the total population. After July the total population rose to a second maximum during August–September due to the increase in numbers of *Acrocalanus* and *Oithona*, closely followed by a peak of *A. erythræa*, in September. By October the total population was again in the downward trend but went up again in November, because of the third maximum of *A. erythræa*. This *Acartia* peak together with the sudden and steep rise in the number of *P. parvus* caused a high total population in December. Although *Acartia* started diminishing soon after December, *P. parvus* maximum extended throughout January.

As against this, the population was at a low level at station P during January–March. January abundance of *P. parvus* was not met with here. The total copepods increased only by April, primarily due to *A. erythræa* which reached its maximum during this month as against March at station G. Soon after April there was a sudden disappearance of *Acartia*, which was almost absent during May–June. But the total population did not fall owing to the increase of the copepodites from May onwards, followed by the maxima of *P. parvus*, *Metacalanus aurivilli*, *Oithona* spp., and *Corycæus* spp., all of which started increasing by June–July and were in considerable numbers till September. By the end of July *Acartia* reappeared, and reached a maximum in August or September causing an overall peak of total copepods. By October all the forms diminished again and the total population, as at station G, was in the downward trend. However, in 1953 total copepods were at a minimum in November because of the relatively poor population of *Acartia*, which in the other two years was abundant during the month. By November, and in December 1953, the copepod population again went up at station P, because of the third maximum of *Acartia*, which attained a peak in the same month, as against December at station G. By December although *Acartia* diminished considerably, the population as a whole did not show any marked fall because of the tendency of other species to increase. Soon after December the population reached the lowest level.

During November–December 1954, both stations were alike not only in having a large copepod stock but also in the magnitude of the individual species responsible for the population. *A. erythræa* and *P. parvus* had similar trends in both the stations. Whilst at station G the third maximum of *A. erythræa* was in November coinciding with that of station P, at latter station there was an unusually large population of *P. parvus* in December comparable to that of station G.

Summary

The paper deals with a detailed study of the composition of the population and the behaviour of the dominant species of copepods in the Gulf of Mannar and Palk Bay.

It is observed that the species which contributed to the bulk of the copepod stock were same at both the stations and the differences in the modes of fluctuation of the total copepods between them were due to the differences in the occurrence of copepodites and to the diversity of patterns of distribution of the individual species. Details of the distribution patterns of the important species are given.

The spawning activity of the copepod populations of the two stations, as indicated by nauplii and copepodites, was also different during the three years. Intensity of spawning appears, in general, to be high at station P, where during May–September the nauplii and copepodites reached numerically high magnitudes.

References

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