Highest concentration of dissolved Zn was at st 857 (29.7 μg/litre). Surface values of dissolved Zn ranged from 2.9-29.7 μg/litre. This range is lower than that observed earlier in the Arabian Sea[4]. Particulate zinc made a significant fraction in the Laccadive Sea. Except at st 857, dissolved Zn was significantly lower at the surface than in deeper waters. Zirino and Yamamoto[7] observed that Zn speciation is markedly *p*H dependent. At *p*H 8.1 $Zn(OH)^{\circ}$ is the predominant form whereas Zn^{2+} is found when the *p*H is lower than 7.8.

At most of the stations Co was below the detection limit of the method used. However, in the Laccadive Sea both dissolved and particulate Co was below the detection limit. Dissolved Ni concentrations at surface ranged from 13.1-16.3 μg/litre whereas its value in particulate form was greater.

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Biochemical Studies on Zooplankton from the Laccadive Sea (Lakshadweep)

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Carbohydrate, protein and lipid were estimated in copepods, euphausid sp. and mysid sp. collected from the Laccadive Sea. Protein formed the major biochemical constituent followed by lipid. Carbohydrate content was the least (<6%). The differences in various biochemical components of neritic and oceanic forms were negligible.

The assessment of secondary production from marine ecosystem necessitates the study of physiology and biochemistry of zooplankton along with the information on biomass and species composition. Considerable information is available on the above aspects of zooplankton from temperate, boreal and polar seas[1-7]. Very few reports are available on the biochemistry of tropical zooplankton. Bogorov *et al.*[8] have discussed the biochemistry of Indian Ocean plankton. Nair *et al.*[9] and Gopalakrishnan *et al.*[10] have studied the biochemistry of neritic zooplankton organisms of the Cochin region.

Biochemical composition of some dominant zooplanktonic groups from the Laccadive Sea, collected during the 31st cruise (March-April 1978) of *R V Gaveshani* is presented in this paper.

Zooplankton were collected by vertical hauls (200 m to surface) using an IOS net[11], and were frozen immediately at −10°C in a deep freeze. Biochemical analysis was carried out later in the laboratory. Copepods (*Euchaeta marina*, *Undinula vulgaris*), mysids (*Siriella* sp.) and euphausids (*Euphausia diomediae*) were the dominant groups present in the samples. Adult animals were sorted out after thawing the samples for the determination of various biochemical constituents. Excess water from the specimens was removed gently by a filter paper before determining their wet weight. In order to compare the present results with the published data, the values were converted into constituents on a dry weight basis. Drying to constant weight was done by keeping the animals in an oven at 70°C.

The major biochemical constituents, viz. carbohydrate, protein and lipid were estimated using the method described by Raymont *et al.*[2] and the results are given in Table 1. Triplicate analysis was made and the average value taken. Owing to the small number of specimens only carbohydrate, protein and lipid fractions were estimated and the values for ash and chitin together were calculated from the difference.

The carbohydrate content was low in all the organisms with a maximum of 5.13% in copepod, *Euchaeta marina* and 4.65% in mysids, *Siriella* sp. As in all zooplankton species so far investigated from different marine areas[7] carbohydrate was the lowest. Nair *et al.*[9] reported the carbohydrate content of copepods from Cochin backwater as 3.8% and 2.7% for mysids which are slightly lower than the present values. Their observations are on *Acartia* sp. from the Cochin backwater, an environment which is subjected to varying hydrographic conditions, whereas the present study is on *Undinula vulgaris*, *Euchaeta marina* and *Oncaea* sp., which are mainly oceanic. The higher values noted may be due to the variation in the species and in the environment. Gopalakrishnan *et al.*[10] reported 4.1% of carbohydrate for *Acartia* sp. from the same area, which is higher than the average values

Table 1—Carbohydrate, Protein and Lipid Contents in Different Zooplankton Species

[Values, average, are expressed as per cent dry weight]

Group	Carbohydrate	Protein	Lipid
Copepods (Calanoida; *Euchaeta marina* and *Undinula vulgaris*)	2.58	59.35	24.56
do	2.5	61.92	24.78
Euchaeta marina	5.13	53.33	25
Cyclopoida (*Oncaea* sp.)	5.1	57.18	23.33
Euphausid (*Euphausia diomediae*)	2.55	60	31.77
Mysid (*Siriella* sp.)	4.65	59.03	21.75

(2.54%) reported here for copepods in general and less than that of for *Euchaeta marina* (5.1%).

Raymont *et al.*[2] reported low carbohydrate content (av. 2.3%) for *Neomysis integer* and for decapods from Southampton waters which is comparable with the values obtained here (2.55%) for euphausids. Eventhough copepods which feed on phytoplankton could obtain carbohydrate directly, the lower carbohydrate content suggests that glycogen, the usual storage form of carbohydrate, did not form a substantial part of the body reserve. The same feature was observed by Raymont *et al.*[7] for certain zooplanktonic organisms.

Vinogradov[1] reported widely varying carbohydrate content (6 to 28%) in *Euphausia superba*. Similarly Vinogradov[12] observed relatively high carbohydrate content (16 to 34% by dry weight) for general plankton taken from the Black Sea and a rather low carbohydrate content (9%) for *Calanus helgolandicus*. But in all these determinations the carbohydrate was not analysed directly indicating the possibility of overestimation.

The present investigation showed relatively high protein content in all the organisms and the values are comparable with those reported by Nair *et al.*[9]. The values reported (55.5%) by Gopalakrishnan *et al.*[10] for *Acartia* sp. from Cochin backwater were slightly lower than the present values. The variability in the protein content may be due to the fact that it is utilized as a metabolic substrate[13]. Raymont[13] also reported variation in protein with variation in environmental salinity. For cold water zooplanktonic forms protein values varying between 30 and 83% were reported and the highest value was observed in the marine copepod *Acartia clausi*[14]. Raymont *et al.*[2] reported an average protein value of 71% for *Neomysis integer* from the Southampton waters. Vinogradov[12] reported 40 to 60% protein for general plankton with 43% for *Calanus* and still higher values (> 50%) for mysids. Raymont *et al.*[7] found a mean value of 57% for the euphausid *Meganyctiphanes norvegica* which compared well with the values obtained for euphausid species (60%) from the Laccadive Sea.

Fisher[15] reported an average lipid content of 5 to 70% for *Euphausia krohnii* from the North Atlantic. Conover[16,17] observed around 60% for the cold water copepod *Calanus hyperborius*. Raymont *et al.*[5] reported variations in the lipid content (6 to 36%) of the euphausid *Meganyctiphanes* with season and body size. The present values for lipid (Table 1) compare well with those reported by Raymont[13]. Gopalakrishnan *et al.*[10] reported lipid content of 18.6% for copepods in general and 25.3% for *Acartia* sp. from the backwaters of Cochin. The lipid values for the oceanic forms reported here did not vary much with those of neritic forms.

The present study indicates that the variations in the different biochemical constituents between the neritic and oceanic forms are not appreciable. Protein forms the major biochemical constituent of the zooplankton as reported from other areas. These organisms have no extensive lipid stores and the carbohydrate reserve is very little.

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