

EUPHAUSIIDS OF SOMALIAN WATERS AND GULF OF ADEN COLLECTED IN S. W. MONSOON SEASON

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Fifteen species of Euphausiacea belonging to 5 genera were reported from the coastal waters of Somalia and Gulf of Aden. Ten species were found in the Gulf of Aden and eleven were collected off Somalian coast. Five species were common in the Gulf and Western Indian Ocean (0° – 10° N) while 4 of these species were also reported from Red Sea. Bathypelagic species of the genus *Thysanopoda* were present off Somalian waters and absent in the Gulf of Aden samples. Sex ratio and abundance are also discussed.

Key words: Euphausiacea, Indian ocean, Gulf of Aden.

INTRODUCTION

The western Indian Ocean (0° – 10° N) off Somalia and Gulf of Aden has a diverse fauna of euphausiids. Brinton and Gopalakrishnan [1] and Ponomareva [2] studied the distribution of euphausiids in the Indian Ocean based on International Indian Ocean expedition material. The present study documents the occurrence, abundance and sex ratio of euphausiids collected in July 1973.

MATERIAL AND METHOD

In July 1973 nine zooplankton samples were obtained from the western part of Indian Ocean and Gulf of Aden (Fig. 1). Sampling was done by Indian Ocean Standard net (mesh size 0.33 mm) on Board P.N.S. Zulfiqar. Five stations were located off Somalia and four in the Gulf of Aden. Euphausiids were sorted and examined under microscope and identified to species with the help of Boden [3] and Brinton [4]. Observations on sex ratio were also made.

RESULTS AND DISCUSSION

A total number of 1957 specimen belonging to 5 genera and 15 species were identified in 9 zooplankton samples (Table 1). Station 1-4 represent a part of western Indian Ocean (0° - 10° N). Station 5-9 represent the Gulf of Aden. In the Aden Gulf 4 genera and 10 species were encountered (Table 2), while in western Indian Ocean 5 genera, and 11 species were found (Table 3). 3 genera and 5 species: *E. sibogae*, *E. diomedae*, *S. carinatum*, *S. affine* and *N. gracilis* were common in both the areas.

S. carinatum was the dominant species in the Gulf of Aden, while in western Indian Ocean *E. tenera* was in the greatest number. *E. diomedae*, *E. sibogae*, and *S. affine* had a wide range of distribution, these 3 species occurred from Red Sea Ponomareva [5] through Gulf of Aden to the western Indian Ocean. Although Red Sea had very high temperatures and salinities while in Gulf of Aden oceanic conditions prevail Ponomareva [5]. The sample from station 2 was richest in number of species as well as in quantity. This

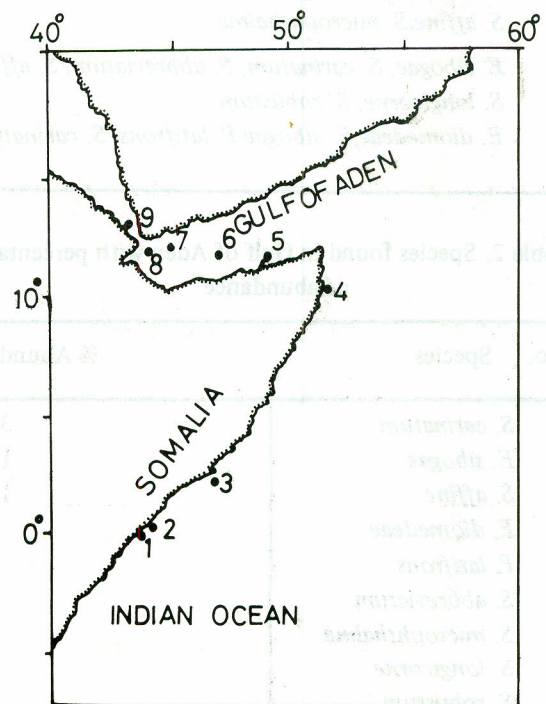


Fig. 1. The map showing locations of stations where sampling was done.

station corresponds to the nutrient rich upwelling area of Somali current.

In order of frequency of abundance *Stylocheiron carinatum* was the commonest, and hauled at 4 stations, *Stylocheiron affine* and *Thysanopoda tricuspidata* at 3 stations *Thysanopoda monacantha* and *Euphausia diomedea* at 2 stations each, while the rest of them were found at 1 station only. In regard to quantity *Euphausia tenera* was the predominant species followed by *Euphausia dio-*

Table 1. Occurrence of species of euphausiids at nine stations shown in Fig. 1.

Station No.	Species collected
1.	<i>S. carinatum</i> , <i>T. tricuspidata</i> , <i>T. monacantha</i>
2.	<i>E. diomedea</i> , <i>E. sibogae</i> , <i>E. mutica</i> <i>E. tenera</i> , <i>S. affine</i> , <i>S. microphthalma</i> , <i>T. astylata</i> , <i>T. tricuspidata</i> .
3.	<i>S. carinatum</i> , <i>S. microphthalms</i> , <i>S. affine</i> , <i>T. tricuspidata</i>
4.	<i>E. diomedea</i> , <i>S. carinatum</i> , <i>S. affine</i>
5.	<i>S. longicorne</i> , <i>S. carinatum</i> , <i>N. gracilis</i> , <i>S. affine</i> ,
6.	<i>S. longicorne</i> , <i>E. sibogae</i>
7.	<i>P. latifrons</i> , <i>S. longicorne</i> , <i>S. carinatum</i> , <i>N. gracilis</i> , <i>S. affine</i> , <i>S. microphthalma</i>
8.	<i>E. sibogae</i> , <i>S. carinatum</i> , <i>S. abbreviatum</i> , <i>S. affine</i> , <i>S. longicorne</i> , <i>S. robustum</i>
9.	<i>E. diomedea</i> , <i>E. sibogae</i> , <i>P. latifrons</i> , <i>S. carinatum</i>

Table 2. Species found in Gulf of Aden with percentage of abundance.

S. No.	Species	% Abundance
1.	<i>S. carinatum</i>	35.00
2.	<i>E. sibogae</i>	13.30
3.	<i>S. affine</i>	10.90
4.	<i>E. diomedea</i>	9.70
5.	<i>P. latifrons</i>	2.40
6.	<i>S. abbreviatum</i>	1.20
7.	<i>S. microphthalma</i>	1.20
8.	<i>S. longicorne</i>	1.20
9.	<i>S. robustum</i>	1.20
10.	<i>N. gracilis</i>	1.20

medea and *Thysanopoda astylata* ranked third. Ponomareva [2] reported 3 genera and 8 species in the western Indian Ocean off Somalia; *E. paragibba* and *Thysanopoda acutifrons* reported by her, were not found in the present study, Brinton and Gopalakrishnan [1] mentioned abundance of 4 genera and 8 species in the western Indian Ocean. Findings of the present study agree well with those of Brinton and Gopalakrishnan [1].

Table 3. Species found in western Indian Ocean (0°–10°N)

S. No.	Species	% Abundance
1.	<i>E. tenera</i>	47.30
2.	<i>E. diomedea</i>	21.0
3.	<i>T. astylata</i>	8.2
4.	<i>S. affine</i>	6.1
5.	<i>E. mutica</i>	5.1
6.	<i>S. carinatum</i>	3.5
7.	<i>T. tricuspidata</i>	2.8
8.	<i>S. microphthalma</i>	1.2
9.	<i>T. monacantha</i>	1.0
10.	<i>E. sibogae</i>	0.76
11.	<i>N. gracilis</i>	0.5

Sex ratio has been studied in abundantly encountered species. *Euphausia tenera* had nearly equal ratio of males and females (1:1:2). *Euphausia diomedea*, *E. mutica*, *Thysanopoda astylata* and *Stylocheiron affine* had almost twice the number of females than males. In *Stylocheiron carinatum* and *Thysanopoda tricuspidata* juveniles and immature specimens dominated. As to subarctic species it is known that females are higher in number before breeding, males prevail after breeding Ponomareva, [6]; if the same is true for tropical species it may be assumed that breeding of *E. diomedea*, *T. astylata* and *S. affine* in western Indian Ocean take place in July while in *S. carinatum* and *T. tricuspidata* breeding had ceased long before, as larval stages and juveniles occurred in the plankton. Time of breeding might have some relationship with temperature and salinity of Sea water but I could not find any significant relation with these physical parameters.

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with certain disadvantages as it requires a highly specialized apparatus i.e. Cytoscope. Secondly, the depression in freezing point may be falsified if colored water has been used for adulteration, because chloride and lactose contents are the main factors affecting the freezing point lowering rate [8].

Zivner [20] has proposed the use of lactose content as a criterion for detecting 2-30% exogenous water in milk. Recently Woodman [23] has reviewed the traditional and novel methods for estimating milk carbohydrates. Polarimetric method for routine testing is inconvenient which involves prior protein separation. Lactose method of B. galactosidase for measuring lactose in milk has been suggested by Klay and Fox [11]. Reinherder and Reisswitz [12] have simplified the enzymic method to semi-automatic.

The present paper is based on the enzymic digestion method for estimation of proteins and their relationship to added water. Proteases found in traces in fresh milk but more profusely in colostrum Keenan and Sempet [13] are not supposed to affect the present methodology as the procedure is based on the total free amino acids whether present initially or released after proteolytic digestion will hardly matter.

The method is simple, economical and accurate with a variation of $\pm 2\%$. Moreover, other methods of proteins estimation Hossain et al. [9], Nelson [15] used in dairy laboratory involve highly sophisticated equipments as BPC, Homban and Newome [10], Protomat, Mikrocen

INTRODUCTION

Adulteration of milk is a common problem in Pakistan faced by public as well as bankers. Confectionary and dairy industries. A number of methods have been proposed and used for determining the degree of adulteration in milk. The methodology is mainly based on the estimation of a component or components which are almost unaffected during seasonal, environmental or physiological changes. Protein, carbohydrates and ash are regarded as comparatively invariable constituents of milk (Marked, 1963) shown in Table 1 and 2. The ratio of lactose, protein and ash has been found constant as 1.7:2.5:1.0 [7].

In most of the laboratories associated with dairy industries fat (F) is estimated by the modified Gerber or Babcock's method and density (D) is determined by using an ordinary lactometer. The total solids (T) are calculated by Reber's formula $T = 0.12D + 1.12F + 0.72$ which indirectly indicates the quantity of added water.

The specific gravity and refraction of copper-sulfate of milk Woodman [22] is used for calculating the added water as refraction decreases by one division for each 2% addition of water.

The use of ash content of milk in determining added water is not very useful because of added minerals in exogenous water and variation in chloride contents in milk Davies [3] and Sanders [19].

Freezing point determination of milk McDonalds [14] Nelson [16] is regarded as the most accurate method as all the components of milk are taken into consideration.