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BIOCHEMICAL COMPOSITION OF ZOOPLANKTON FROM THE NORTHERN ARABIAN SEA

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ABSTRACT: Zooplankton standing crop and proximate principals were estimated for 8 coastal and 13 oceanic stations of the northern Arabian Sea during March 1991. Biomass did not show any significant difference ($p < 0.05$) between coastal and oceanic waters. Protein was the principal biochemical component among proximate principals with an average value of 29.6% in coastal and 34.2% in the oceanic zone, suggesting that protein form a major metabolic reserve. Other components such as lipids and carbohydrate seem to be low in tropical zooplankton. The organic carbon and caloric density did not show significant correlation. Average caloric density was 2.5 $k.cal^{-1}$. The average standing stock was 9.25 mg m^{-3} and 5.90 mg m^{-3} for coastal and oceanic water, respectively. Coastal region is more productive than oceanic region in terms of standing crop, as expected.

KEY WORDS: Zooplankton - biochemical composition - Arabian Sea.

INTRODUCTION

One of the major goals of the biological oceanography is to estimate potential harvestable yield from the ocean. Energy content in zooplankton is important to have better understanding of the organic production and cycling of biogeochemical elements in the ocean. Information on biochemical composition of zooplankton is of great importance in understanding nutritive value and energy pathways at different trophic levels. Besides, such studies may also provide data for testing hypotheses and monitoring the marine living resources.

In this study biomass, carbon content, proximate principals and caloric density of zooplankton from the northern Arabian Sea are presented.

MATERIALS AND METHODS

Zooplakton samples were collected from 21 stations (Fig. 1) during the 87th cruise of FORV Sagar Sampada (March 1991) using a Bongo net (mesh size 300 μm and mouth area 0.28 m^2). Vertical hauls were made from 200 m to surface in the oceanic stations while it varied for shallow stations (Table I). After recording biomass (displacement volume), samples were immediately deep frozen for biochemical analysis.

In the laboratory all samples were washed with distilled water and dried in an oven at 70°C until a constant weight was obtained. Biochemical principals were analysed in duplicate and expressed as percentage of dry weight. Protein was estimated by the method of Lowry *et al.* (1951), lipid by the method described by Parsons, *et al.* (1984), carbohydrate by the method of Dubois *et al.* (1956) and organic carbon by the method of EI Wakeel and Riley (1956). Caloric density was calculated using conversion factors 5.7, 4.0 and 9.3 K.cal g^{-1} for protein, carbohydrate and lipid, respectively as given by Elliot and Davison (1975).

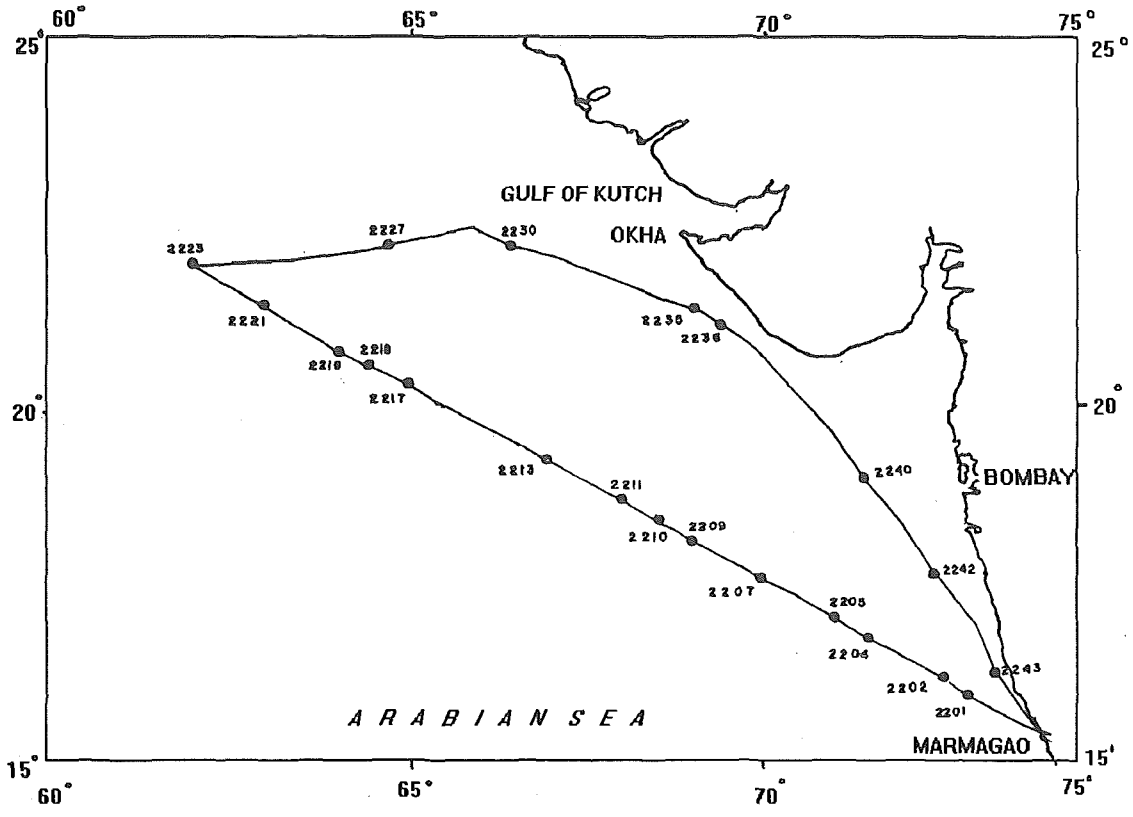

Fig. 1. Map showing the location of sampling site.

RESULTS AND DISCUSSION

BIOMASS:

Zooplankton biomass values ranged from 0.24 to 1.8 ml m^{-3} ($\bar{x}=0.18\pm0.54$ ml m^{-3}) in the coastal waters. Values for the oceanic water fluctuated between 0.08 and 1.76 ml m^{-3} ($\bar{x}=0.57\pm0.46$ ml m^{-3}). In terms of dry weight, biomass values ranged from 15.3 to 79.3 mg m^{-3} ($\bar{x}=36.95\pm23.42$ mg m^{-3}) and from 4.08 to 48.4 mg m^{-3} ($\bar{x}=17.0\pm13.3$ mg m^{-3}) in the coastal and oceanic waters respectively. The values of biomass (displacement volume) obtained here are higher than the values reported earlier for the same area (Krishnakumari and Achuthankutty, 1989) but the biomass values in terms of weight were similar. It clearly reflects the differences in season of collection. It appears that abundance of gelatinous organisms like salps in the samples may account for values of biomass in terms of displacement volume and low dry weight.

CARBON:

The observed values ranged from 11.90 to 32.42% ($\bar{x}=25.3\pm6.54$) in the coastal waters and from 12.60 to 38.0% ($\bar{x}=26.8\pm7.67$) in the oceanic region (Table II). These values are moderately higher when compared with the published values for the study area (Krishnakumari and Achuthankutty, 1989) but generally agree with the

values reported from the central Arabian Sea (Nandakumar *et al.*, 1988). Significant differences (1 tailed 't' test; $p<0.05$) in carbon content between coastal and oceanic waters was discernible. Variable species composition and availability of food are known to influence the carbon content of zooplankton (Omori, 1969; Platt and Irwin, 1973). The carbon values did not show any correlation with proximate principal and caloric density. In earlier studies significant correlation was found between carbon and calorific values of the zooplankton (Nandakumar *et al.*, 1988; Krishnakumari and Achuthankutty, 1989).

Table I: Displacement volume (DV), Dry weight (DW) and Standing crop (SC), of zooplankton at different stations

St.No.	Haul depth (m)	DV (ml. m^{-3})	DW (mg. m^{-3})	SC (mg C m^{-3})
		Coastal stations		
2201	75	0.24	15.60	4.84
2202		0.60	15.30	4.75
2204		0.32	60.00	17.10
2235	80	1.80	18.40	5.97
2236		1.46	30.00	6.47
2240	70	0.80	48.40	12.20
2242		0.75	28.60	8.12
2243	50	0.50	79.30	18.80
		Oceanic stations		
2205	200	0.08	4.08	1.60
2207	200	0.24	14.05	4.36
2209	200	2.32*	94.40*	22.60*
2210	200	0.43	48.40	12.30
2211	200	0.56	32.80	5.80
2213	200	0.87	14.60	3.30
2217	200	0.24	15.30	5.90
2218	200	0.24	12.60	1.60
2219	200	0.70	20.80	4.60
2221	200	0.44	4.42	1.15
2223	200	1.76	14.02	4.90
2227	200	0.73	8.70	2.70
2230	200	2.35*	185.60	45.60*

* values not considered for averaging.

PROTEIN:

Protein was the principal biochemical component which had lowest value of 16.8% at station 2227 and highest value of 50.4% at station 2211 (Table II). There was no

significant difference in protein content between coastal and oceanic stations. The values observed in this report are less as compared to the values of the northeastern Arabian Sea and the central Arabian Sea (Nandakumar *et al.,* 1988; Krishnakumari and Achuthankutty, 1989). Furthermore, it has been documented that protein content varies with season, age of the organisms at the time of collection and environmental conditions (Raymont, 1972). This may account for the observed differences in the protein values reported by different authors at different time of the year.

Table II. Proximate principals (% dry weight) and caloric density (k. cal. g^{-1} dry weight) of mixed zooplankton.

St. No.	Protein	Carbo-hydrate	Lipid	Carbon	Caloric density
		Coastal stations			
2201	37.80	2.74	10.20	31.04	3.22
2202	30.40	1.45	8.20	11.90	2.55
2204	38.23	2.91	6.20	28.50	2.88
2235	28.80	1.75	7.40	32.42	2.40
2236	22.0	3.74	12.10	21.58	2.53
2240	19.05	1.80	5.60	25.20	1.70
2242	32.40	1.60	8.40	28.40	2.70
2243	28.00	2.75	8.10	33.70	2.46
		Oceanic stations			
2205	46.80	3.35	8.50	38.00	3.60
2207	48.00	2.69	10.20	31.00	3.80
2209	17.24	2.66	4.80	24.00	1.54
2210	22.86	4.50	6.80	25.32	2.12
2211	50.40	4.87	12.10	17.60	4.19
2213	37.50	1.30	14.10	22.63	3.50
2217	30.66	3.04	5.40	38.43	2.36
2218	37.80	3.55	11.40	12.60	3.36
2219	23.47	2.24	7.50	21.91	2.13
2221	37.80	3.55	9.40	26.12	3.18
2223	36.93	2.01	10.60	34.90	3.17
2227	16.80	5.10	12.10	31.20	2.30
2230	38.45	2.08	8.40	24.57	3.05

LIPID:

Lipid content displayed wide variations, ranging from 4.8 to 14.0% ($\bar{x} = 10.2 \pm 3.45$). Mean values of lipid observed were 8.3 and 9.32% for coastal and oceanic sta-

tions, respectively. Values of lipid are low when compared with earlier values reported from the Arabian Sea (Nandakumar *et al.,* 1988; Krishnakumari and Achuthankutty, 1989) and is significantly lower than the reported values from the temperate regions. Lipid acts as energy reserves to sustain the animals through period of starvation, supply of energy for developing embryos, providing positive buoyancy for eggs and adults (Morris and Hopkins, 1983). Continuous and high rate of primary production and high temperature in the tropical water is believed to inhibit lipid deposition in the zooplankton (Lee *et al.*, 1971).

CARBOHYDRATE:

Low carbohydrate values were recorded in the present study (1.3 and 5.1%). Low values of carbohydrate seems to be the characteristics of zooplankton (Madhupratap *et al.,* 1979; Nandakumar *et al.,* 1988). Insignificant correlation of carbohydrate with caloric density observed during the present study suggest that the glycogen, the main storage form of carbohydrate does not contribute significantly to energy content in zooplankton.

CALORIC DENSITY:

Estimated values of caloric content varied from 1.54 to 3.80 k.cal g^{-1} dry weight. These values are similar to those observed for coastal waters of Cochin (Gupta, 1977), off the west coast of India (Goswami *et al.,* 1981) and the Bay of Bengal (Sreepada *et al.*, 1992) but are less than those reported for the northeastern Arabian Sea (Krishnakumari and Achuthankutty, 1989). The differences in caloric content observed here are attributable to seasonal differences in the food content, the time of collection, and varying species composition and maturity stages of zooplankton.

STANDING CROP:

Estimates of standing crop of zooplankton were made, based on dry weight and percentage of organic carbon at each station (Table I). The estimated values ranged from 4.75 to 18.80 mg C m^{-3} and from 1.15 to 45.60 mg C m^{-3} for coastal and oceanic waters, respectively. The values of standing crop observed in the present study generally agree with the reported values for the north-eastern Arabian Sea (Krishnakumari and Achuthankutty, 1989).

The present study did not indicate major variations in proximate composition between coastal and oceanic stations. Very high correlation observed between protein and caloric density indicates that protein formed a major constituent and seems to be an important metabolic reserve as compared to lipid and carbohydrates. Standing crop value have indicated that coastal waters are more productive than oceanic waters.

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