

Energy content of suspended detritus from Arabian Sea

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Energy components of suspended matter included phytoplankton, zooplankton and detritus inclusive of microorganisms adsorbed to detritus. Of these, detritus contributed most of the energy (98%). The average caloric content of suspended detritus was 3705 cal.g^{-1} dry wt.

Studies on the energy pathways of Andaman and Laccadive Seas have shown that the contribution of detritus to the total suspended matter is very high¹⁻³. Information on nutritional value of detritus during its formation is very limited²⁻⁴. Therefore, the present work has been carried out to estimate the energy value of suspended detritus from the Arabian Sea.

Water samples were collected from different depths (surface, 50 and 100 m) using PVC Niskin samplers from 27 stations (lat. $7^{\circ}19'$ to $14^{\circ}25'N$; long. $70^{\circ}59'$ to $76^{\circ}4'E$) and 33 stations (lat. $14^{\circ}59'$ to $21^{\circ}4'N$; long. $65^{\circ}55'$ to $73^{\circ}18'E$) in the Arabian Sea respectively during 33 (15 June - 13 July 1987) and 34 (16 July - 8 August 1987) cruises of *ORV Sagar Kanya*. At each depth, total suspended matter and chl *a* were estimated. Total suspended matter was quantified by filtering 5 l seawater through pre-weighed Millipore filter papers ($0.45 \mu\text{m}$ pore size) and dried to constant weight in an oven at $70^{\circ}C$. Chl *a* was estimated fluorometrically onboard and converted to carbon values⁵. Energy values of phytoplankton were derived from carbon values⁶ using the conversion factor $1 \text{ mg carbon} = 11.4 \text{ calories}$. Zooplankton biomass determined as displacement volume was used for computing carbon⁷ and energy values⁸. Energy content of total suspended matter was determined with a Parr (1200) adiabatic microbomb calorimeter. Energy values for detritus were obtained from the difference of values between total suspended matter and phyto- and zooplankton.

For microscopic analysis, 500 ml seawater was fixed with 5% formalin and allowed to settle. From this, aliquots of 1 ml were subsampled. Microscopic examination of suspended material revealed that detritus consisted of phytoplankton (diatoms, other green and blue-green algae) and intact zooplankton such as copepods, nauplii and ostracods. By counting under microscope it was found that detrital portion of

the suspended matter included plant materials (26.8%), animal matter (0.9%), moults and broken appendages of crustacea (0.3%), faecal pellets (1.51%) and organic aggregates (70.5%).

Energy values of phytoplankton, zooplankton, detritus and total suspended matter, integrated for the euphotic zone are presented in Table 1. Energy value of the total suspended matter varied from $22.49 - 1338.81 \text{ Kcal.m}^{-2}$ during the 33 cruise and $73.84 - 537.16 \text{ Kcal.m}^{-2}$ during the 34 cruise. Detrital energy on an unit weight basis ranged from 1.24 to 6.13 Kcal.g^{-1} dry wt and 1.97 to 5.53 Kcal.g^{-1} dry wt respectively. The mean calorific value (3705 cal.g^{-1} dry wt) in the present study is lower than the reported values for the Laccadive Sea¹, Andaman Sea³, Gulf of Aden, Equatorial Atlantic and Gulf of Mexico⁹ but higher than the Red Sea⁹ and Menai Straits¹⁰.

Contribution of energy by phytoplankton and zooplankton was $< 2\%$ whereas that by detritus was 98%. Taking the total investigated area, to be of $1.86 \times 10^6 \text{ km}^2$, the phytoplankton, zooplankton and detrital energy amounted to 5.54×10^{12} , 0.61×10^{12} and $457 \times 10^{12} \text{ Kcal}$ respectively. As in the present study predominance of detritus over living matter has been reported from the Laccadive and Andaman Seas¹⁻³. Dominance of detritus in open ocean has been explained and the possible source could be the organic aggregate existing in the oceans^{1,2,11}.

During the present study no data were collected with reference to sediment flux. However, samples collected from sediment traps deployed in the Bombay High area of the Arabian Sea¹² ($19^{\circ}20'N$ and $71^{\circ}20'E$) showed that the average sediment flux amounted to $6565 \text{ mg.m}^{-2}\text{d}^{-1}$. The relative POC content of total suspended matter ranged from 1-10%. This would be equivalent to $66-656 \text{ mg C.m}^{-2}\text{d}^{-1}$. Average primary production measured during 33 cruise was $216 \text{ mg C.m}^{-2}\text{d}^{-1}$. This would

Table 1—Energy values of phytoplankton (P), zooplankton (Z), detritus (D) and total suspended detritus (TSD) at different stations (integrated column values Kcal.m⁻²; depth range 0-100 m)

St No	P	Z	D	TSD	St No	P	Z	D	TSD
Cruise 33					Cruise 34				
1	40.18	0.09	1298.54	1338.81	3	0.24	0.20	291.56	292.00
2	2.16	0.82	459.10	462.09	4	0.78	0.30	202.46	203.53
3	13.31	0.21	1065.78	1079.30	5	1.39	0.27	150.68	152.33
4	13.36	0.31	540.80	554.46	6	1.36	0.23	124.01	125.60
5	1.74	0.16	498.26	500.16	7	1.39	0.37	113.84	115.60
6	0.81	0.39	180.66	181.86	8	1.58	0.27	136.22	138.07
7	1.12	0.22	69.67	71.01	9	1.92	0.40	107.81	110.13
8	1.52	0.22	321.68	323.43	10	1.19	0.11	100.03	101.33
9	5.13	0.34	576.68	582.15	11	2.23	0.54	93.70	96.46
10	0.99	0.17	128.65	129.81	12	2.42	0.26	122.57	125.26
11	0.92	0.20	21.38	22.49	13	1.10	0.50	145.60	147.20
12	1.89	0.79	471.11	473.79	14	2.32	0.23	206.24	208.80
13	3.22	0.42	189.50	193.14	15	1.10	0.40	122.03	123.53
14	1.55	0.32	301.40	303.27	16	7.39	0.37	182.31	190.07
15	1.07	0.22	128.01	129.30	17	1.26	0.34	143.21	144.80
16	3.91	0.46	197.56	201.93	18	1.10	0.22	114.15	115.47
17	0.83	0.54	351.49	352.86	19	4.23	0.22	158.16	162.60
18	0.93	0.49	382.45	383.88	20	2.42	0.20	81.43	84.05
19	2.03	0.28	240.65	242.97	21	0.50	0.22	99.35	100.07
20	1.41	0.32	91.00	92.73	22	5.14	0.29	102.81	108.24
21	0.90	0.36	240.22	241.47	23	0.75	0.32	156.13	157.19
22	2.00	0.55	335.61	338.16	24	5.50	0.19	136.62	142.31
23	1.71	0.32	84.59	86.61	25	1.04	0.70	120.13	121.87
24	1.78	0.31	147.79	149.88	26	1.72	0.17	72.73	74.62
25	0.98	0.70	237.06	238.74	27	0.34	0.11	73.39	73.84
26	3.59	0.36	513.97	517.92	28	0.94	0.27	129.06	130.27
27	0.99	0.36	185.56	186.90	29	3.80	0.30	131.10	135.20
Av.	4.08	0.37	342.93	347.38	30	0.94	0.27	112.60	113.80
Cruise 34					31	1.42	0.30	159.61	161.33
1	1.07	0.11	535.98	537.16	32	0.71	0.42	140.67	141.80
2	1.65	0.10	182.39	184.13	33	1.00	0.36	161.57	162.93
					Av.	1.88	0.29	148.79	150.96

mean that the contribution by phytoplankton biomass to the organic carbon pool is less than the detrital carbon. In fact data collected during cruise 91, 103, and 118 of *R.V. Gaveshani* (5°N-21°N) in the Arabian Sea showed that of the total organic carbon, phytoplankton carbon (representing live part) was 2-48%, while that of detrital carbon (non-living parts) was 50-80%¹³. Ryther and Menzel¹⁴ found that in the western Arabian Sea living matter contributed 10-20% of total organic carbon. Further Finenko and Zaika¹⁵ found that living seston formed 10-50% of the seston in the central Arabian Sea. Thus, it is evident that in the Arabian Sea the low phytoplankton biomass (0.021 gC.m⁻³) is insufficient to support zooplankton biomass (1.45

gC.m⁻³) and that detritus could probably be a possible source of food¹⁶

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