

Metal Concentration in Some Seaweeds of Goa (India)

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Abstract

Seventeen species of marine algae collected from five localities of Goa, were analysed for Co, Cu, Fe, Mn, Ni, Pb and Zn, using atomic absorption spectrophotometer. All the seven metals showed considerable variations in their concentration. The role of different seaweeds as indicators of metal pollution is discussed in relation to the degree of accumulation of metals.

Introduction

Monitoring of metal pollution in marine environments is becoming more and more important. It has long been recognized that the release of waste into the marine environment not only affects the composition of water and sediments, but adversely affects the flora and fauna.

Along the Indian coastline, certain areas are well known for their luxuriant growth of seaweeds. Marine algae have long been used throughout the world, for food and industry (Chapman 1950). In marine ecosystems, the algae are responsible for primary production. They also play an important role in the formation of detritus, on which several vertebrates and invertebrates feed.

There is a lack of knowledge about the distribution of trace metals in the seaweeds of India. Recently, Zingde *et al.* (1976) have studied the distribution of a few trace metals in marine flora and fauna of Goa.

The ability of seaweeds to accumulate trace metals is well documented (Saenko *et al.* 1976, Zingde *et al.* 1976). Keeping in view the importance of seaweeds as primary producers and their role in detritus formation and as indicators of pollution (Edwards 1972, Fuge and James 1974), it was felt necessary to study the accumulation of different metals in the seaweeds of Goa coast.

Five observation points along the Goa coast were selected for this study representing different environments (Fig. 1). Chapora and Dona Paula are situated along the Chapora and Zuari estuaries respectively, while Anjuna, Baga and Cabo-de-Rama are purely marine areas and do not have any estuarine influence. Of the

seventeen species collected, 6 belong to Chlorophyta, 7 to Phaeophyta and 4 to Rhodophyta (Tab. I).

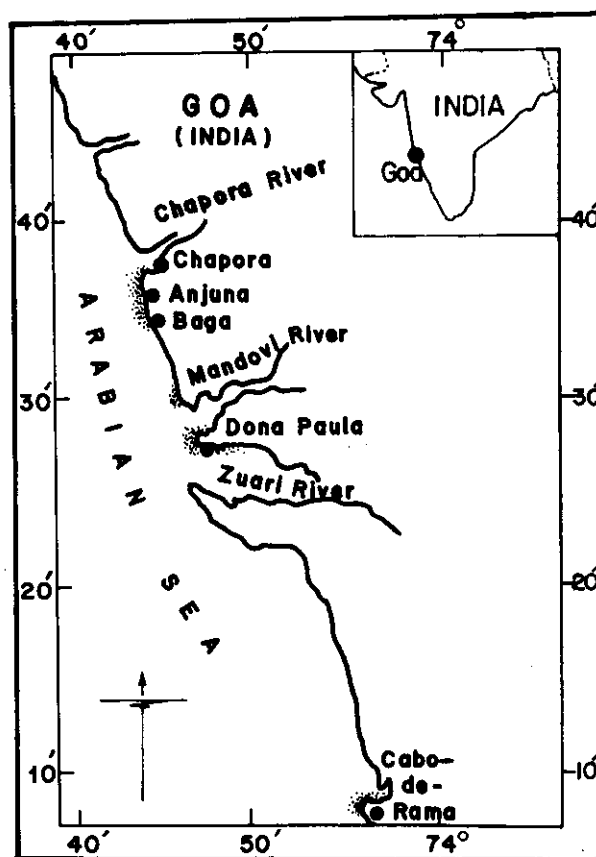


Fig. 1. Map of Goa (India) coast showing the sites of seaweed collection

Tab. I. Species Distribution along Different Stations along the Goa Coast

Sl. No., Name of the species	S T A T I O N S				
	Chapora	Anjuna	Baga	Dona Paula	Cabo-de-Rama
Chlorophyta					
1. <i>Caulerpa peltata</i> Lamour.	—	—	—	—	+
2. <i>Caulerpa sertularioides</i> (Gmel) Howe.	—	+	—	—	—
3. <i>Codium elongatum</i> C. Ag.	—	—	—	—	+
4. <i>Enteromorpha clathrata</i> (Roth) J. Ag.	+	—	—	—	—
5. <i>Ulva fasciata</i> Delile	—	+	+	—	—
6. <i>Ulva reticulata</i> Forssk.	+	—	—	—	—
Phaeophyta					
1. <i>Colpomenia sinuosa</i> Derb. et Sol.	—	—	—	+	—
2. <i>Dictyopteris australis</i> Sonder	—	—	—	+	+
3. <i>Dictyota</i> ssp.	—	+	+	+	—
4. <i>Padina tetrastrum</i> Hauck	—	+	+	+	+
5. <i>Sargassum tenerrium</i> J. Ag.	—	+	+	+	+
6. <i>Spathoglossum asperum</i> J. Ag.	—	—	—	—	+
7. <i>Stoechospermum marginatum</i> (Ag.) Kuetz.	—	—	—	—	+
Rhodophyta					
1. <i>Acanthophora specifera</i> (Vahl.) Boergs.	—	+	+	+	+
2. <i>Gracilaria corticata</i> J. Ag.	—	+	+	—	+
3. <i>Gracilaria verrucosa</i> (Huds.) Papenfuss	+	—	—	—	—
4. <i>Hypnea musciformis</i> (Wulf.) Lamour.	—	+	—	+	—

Materials and Methods

Samples of marine algae were collected from five localities as shown in Figure 1 and Table I. Algae were handpicked from the intertidal regions, cleaned, isolated into groups and washed thoroughly with fresh water. The samples were dried in an oven at 80°C. They were then powdered and sieved through a piece of muslin cloth. Powdered samples were redried in an oven to constant weight.

For analysis, a known amount of seaweed powder was digested with nitric acid, perchloric acid and finally with hydrochloric acid. The residue thus obtained was dissolved in a known volume of glass distilled water and the solution was used for the estimation of Co, Cu, Fe, Mn, Ni, Pb and Zn by atomic absorption spectrophotometry (Hilger and Watts Atmospeck H 1550). All the reagents were of A. R. grade. Standards were also treated in the same way.

Results and Discussion

The results obtained for Co, Cu, Fe, Mn, Ni, Pb and Zn are based on mean values of three determinations and are expressed in ppm dry weight (Tab. II).

Metal concentrations of seaweeds from Anjuna, Baga, Dona-Paula and Cabo-de-Rama showed less concentrations of Co, Cu, Fe, Mn, Ni and Pb, as compared to the Chapora area. In the Goa waters, a high concentration of Mn (average 45.2 µg/l) has been reported earlier (Zingde *et al.* 1976). Particulate iron concen-

trations of 4–105 mg/l and 5–180 mg/l have been recorded from Mandovi and Zuari respectively (Kamat and Sankaranarayanan 1975 b). Annual variations in the dissolved iron concentrations have been reported in the range of 0.01–3.5 mg/l from Zuari (Kamat and Sankaranarayanan 1975 a). High values of Fe and Mn in seawater may be due to rich iron and manganese ore deposits in the hinterlands, which are transported and shipped by waterways. Evidently, such high values in seawater explains the higher concentrations of trace metals in seawater.

Cu and Zn concentrations are low in Goa waters (Zingde *et al.* 1976), and the values recorded in seaweeds for Cu and Zn confirm this. However, a very high concentration of 80 ppm Cu recorded for *Acanthophora specifera* from Anjuna could not be explained. Co and Ni concentrations were also higher than the values reported by Saenko *et al.* (1976).

The values of trace metal concentrations in the seaweeds collected from different localities along the Goa coast show some variations as compared to the values recorded by Zingde *et al.* (1976), for Mn, Cu and Zn, in six seaweed species from the same area.

The difference in these values may be because of several factors like period of collection, environmental parameters, age and maturity of the seaweed at the time of collection, their position from the shore as well as different methods used for the analysis. Even a difference in processing may lead sometimes to differences in results. It is also observed that the algal species change

Tab. II. Trace Metal Concentration in the Seaweeds of Goa Coast (values expressed in ppm/dry weight)

Station	Sl. No., Name of species	Co	Cu	Fe	Mn	Ni	Pb	Zn
I. Chapora	1. <i>Enteromorpha clathrata</i>	15.18	30.23	1292.51	2685.53	34.55	9.17	11.58
	2. <i>Ulva reticulata</i>	10.56	13.85	1169.23	1721.04	39.06	17.76	8.89
	3. <i>Gracilaria verrucosa</i>	14.52	15.61	1076.77	3420.56	13.52	8.59	11.74
II. Anjuna	1. <i>Caulerpa sertularioides</i>	4.35	5.03	587.50	74.58	17.02	14.9	11.07
	2. <i>Ulva fasciata</i>	6.07	6.70	722.34	111.25	9.61	15.24	23.80
	3. <i>Dictyota</i> ssp.	9.24	5.84	710.20	94.77	9.31	9.51	9.95
	4. <i>Padina tetrastromatica</i>	4.35	7.86	1004.53	344.20	10.31	2.95	7.60
	5. <i>Sargassum tenerrimum</i>	7.92	4.53	471.93	79.81	7.31	34.73	5.40
	6. <i>Acanthophora specifera</i>	7.39	80.41	490.61	90.72	13.62	6.07	12.61
	7. <i>Gracilaria corticata</i>	7.92	4.53	564.96	144.86	22.03	11.00	12.27
	8. <i>Hypnea musciformis</i>	6.07	6.55	615.82	96.81	9.61	16.04	11.74
III. Baga	1. <i>Ulva fasciata</i>	8.58	7.30	353.46	1075.65	7.01	16.04	2.79
	2. <i>Dictyota</i> ssp.	5.94	10.32	784.94	153.47	8.01	16.04	7.38
	3. <i>Padina tetrastromatica</i>	8.58	4.03	657.81	530.65	8.51	10.89	4.47
	4. <i>Sargassum tenerrimum</i>	7.92	5.79	128.09	42.67	3.50	12.61	11.30
	5. <i>Acanthophora specifera</i>	7.26	12.59	238.85	63.11	9.51	8.02	11.80
	6. <i>Gracilaria corticata</i>	11.88	3.52	261.97	180.19	6.00	9.74	3.69
IV. Dona Paula	1. <i>Colpomenia sinuosa</i>	10.56	21.06	1796.22	258.15	23.03	20.06	21.48
	2. <i>Dictyopteris australis</i>	3.03	8.36	685.74	131.52	11.31	20.97	21.26
	3. <i>Dictyota</i> ssp.	2.64	12.99	582.69	100.39	11.71	14.1	18.19
	4. <i>Padina tetrastromatica</i>	5.67	6.70	755.66	418.78	18.33	28.31	11.70
	5. <i>Sargassum tenerrimum</i>	4.88	8.96	451.32	140.55	8.71	14.55	6.04
	6. <i>Acanthophora specifera</i>	13.20	7.40	796.11	344.16	14.72	17.19	13.80
	7. <i>Hypnea musciformis</i>	8.84	8.56	779.74	238.79	12.72	11.80	10.36
V. Cabo-de-Rama	1. <i>Caulerpa peltata</i>	9.63	12.59	1596.86	136.24	18.33	19.48	18.19
	2. <i>Codium elongatum</i>	8.84	3.82	680.92	72.42	17.72	12.95	11.97
	3. <i>Dictyopteris australis</i>	1.32	9.72	492.54	32.98	5.30	14.55	57.44
	4. <i>Padina tetrastromatica</i>	4.62	3.17	388.52	205.09	8.01	13.75	9.78
	5. <i>Sargassum tenerrimum</i>	1.32	15.46	130.48	43.02	6.31	11.48	38.49
	6. <i>Spathoglossum asperum</i>	1.98	5.54	130.40	25.09	0.50	18.34	24.55
	7. <i>Stoechospermum marginatum</i>	5.94	33.60	868.16	84.61	15.32	197.52	203.88
	8. <i>Acanthophora specifera</i>	1.32	13.45	1012.24	88.20	13.02	13.75	28.71
	9. <i>Gracilaria corticata</i>	10.95	9.22	1028.61	159.91	14.32	18.68	15.21

their behaviour and capability to accumulate the trace metals.

Seaweeds collected from five localities gave high values of Pb, although the value of 197.5 ppm Pb in *Stoechospermum marginatum* appears to be abnormally high. Haug (1961) has emphasized the importance of alginates in the uptake of lead in *Laminaria digitata*.

Sargassum tenerrimum, *Padina tetrastromatica* and *Acanthophora specifera* collected from four stations showed variations in the concentrations of the seven metals. These differences may be due to the environments to which they are exposed. Another possible reason for this variation may be the stress received by the seaweeds as a result of the fluctuations in temperature, salinity or turbidity (Seeliger and Edwards 1977). This may affect the metabolic rates in the algae, resulting in the decreased or increased uptake of metals. The uptake of metals may take place through ion-exchange for which it must be present in a dissolved ionic form (Bryan and Hummerstone 1973).

High concentration of Cu and Pb in particular and Co, Fe, Mn and Ni in general observed in the seaweeds of Chapora needs further investigation for locating the source. Keeping in view the importance of Chapora Bay in which large fishery potential exists, such a high concentration of heavy metals such as Cu and Pb cannot be overlooked.

Seaweeds are well known for their ability to accumulate trace metals. Moreover, this bioaccumulation is magnified to several thousand times, with respect to their concentration in seawater. Further it has been suggested that the trace metal concentrations in the seaweeds are not subject to short term erratic fluctuations, but integrate the concentration of metals in seawater over relatively long periods of time, making them valuable tools for monitoring harmful trace metals in seawater (Preston *et al.* 1972). All the species studied from five localities represent their ability to accumulate trace metals.

Since the algal species are of major importance as primary producers in coastal waters (Mann 1973), their

implication as metal concentrating agent cannot be underestimated. Primary producers are consumed directly or indirectly as detritus by fishes and invertebrates transferring their metal content to the next link of food chain (Seeliger and Edwards 1977).

The trace metal accumulation in the seaweeds of Goa coast though in no way is alarming at present, demands further study.

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