

## METAL DISTRIBUTION IN *HALOPHILA BECCARII* (ASCHERS) AND SURROUNDING ENVIRONMENT ALONG THE CENTRAL WEST COAST OF INDIA

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### ABSTRACT

*Halophila beccarii* (Aschers), the surrounding water and the sediments showed varying concentrations of Na, K, Ca, Mg, Fe, Mn, Cu, Ni, Sr and Li at different localities along central west coast of India. Iron was found to be maximum in both the plant and sediment samples (32,565 ppm and 75,500 ppm respectively). Maximum concentrations of Fe and Mn were found in the estuarine water of Goa. Metals such as Sr, Li, Cu and Ni were present in negligible quantities in the plant, surrounding water and sediments. *H. beccarii* from Vijaydurg area had higher concentrations of Ca (4475 ppm). Na/K and Fe/Mn ratios varied widely in the sediment, plant and water samples. Maximum (183.83) Fe/Mn ratio was found in the sediments collected from Vijaydurg.

*Key-words* : Metal distribution, seagrass, environment.

### INTRODUCTION

The concentration of metals in seagrasses like *Zostera marina*, *Thalassia testudinum*, *Diplanthera wrightii* and *Syringodium filiformae* was studied by McRoy (1966). Bhosle (1978) studied some metals in *Halophila beccarii* from Deogad, west coast of India. It was reported that certain macrophytes are indicators of heavy metals in coastal waters (Bryan and Hummestones, 1973; Melhuus, Seip and Seip, 1978). Moreover, trace elements in macrophytes are recycled, which have stimulatory effect on primary production in an ecosystem (Ramdas, Rajendran and Venugopalan, 1974). In view, of the importance of seagrass in the marine ecosystem, the metal concentrations in the seagrass *Halophila beccarii*, surrounding water and sediments, were investigated.

### MATERIALS AND METHODS

Samples of *H. beccarii* (Aschers), sediments and water from the vicinity of plant site, were collected from Mandovi estuary (Goa), Kolamb estuary (Malvan), Waghotoon estuary (Vijaydurg) and Shirgao creek (Ratnagiri) (Fig. 1).

Unfiltered water samples were preserved with concentrated HNO<sub>3</sub>. Plant samples (with rhizome and rhizoids) were handpicked during low tide, washed thoroughly to remove adhering debris, dried to a constant weight at 80°C, powdered and sieved through muslin cloth. The samples were again dried and used for the analysis.

The sediment samples (handpicked) were also used after drying at 80°C. One gram of sample was digested in hydrofluoric acid (1.5 ml) followed by

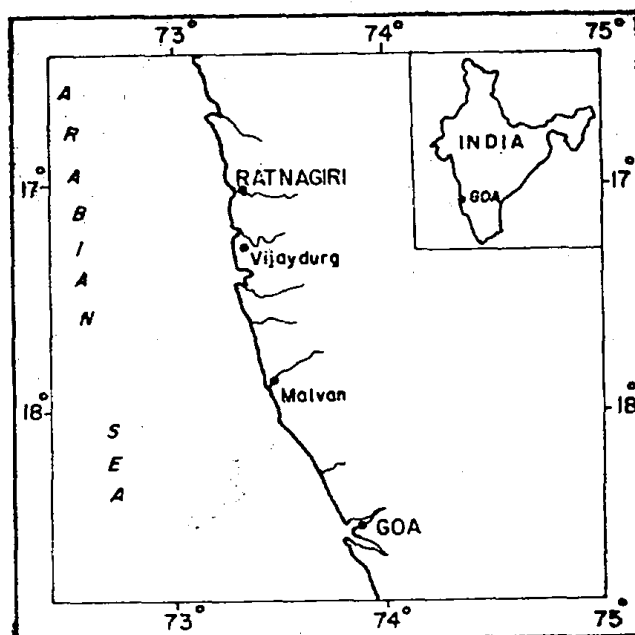


Fig. 1. Map of Central West Coast showing distribution and collection of *Halophila beccarii* (Aschers).

concentrated  $\text{HNO}_3$  (1 ml), concentrated  $\text{HCl}$  (1 ml) and perchloric acid (1 ml) in quick succession. Plant samples were digested as described by Agadi, Bhosle and Untawale (1978). Metal analysis was done using Atomic Absorption Spectrophotometer (Hilger and Watts Atmospect H-1550).

For analysis of water samples, a known quantity of preserved acidified water was filtered through GF/C filter paper No. 41. Major elements (Na, K, Ca, Sr, and Li) were determined using standard addition technique (Thomas and Gibb, 1975; Golterman and Clymo, 1978; Morrison, 1965).

In all cases triplicate subsamples were analysed and mean values were expressed in ppm. Standards were treated exactly in the same way as above, adding some distilled water but without sample.

#### RESULTS AND DISCUSSION

Plant and sediment sample from all the stations showed high concentrations of Na, K, Mg, Fe and Mn while Cu, Ni, Sr and Li were found in negligible quantities in plant material from all the stations (Table I).

The values of Na, K and Mg in *H. beccarii* from Mandovi estuary (Goa) were found to be higher than those found in the sediments. The sediment samples from Shirgao Creek, Ratnagiri showed highest concentrations of Fe (75,500 ppm), Mn (862 ppm) and Cu (121 ppm). The sediments from Vijaydurg and Ratnagiri showed comparatively higher concentrations of Mg, Fe, Cu and

Table I. Mean concentrations (ppm) of different trace metals in *Halophila beccarii* (Aschers), sediments and water.

Metal	Sediments					Plant					Water					
	Goa	Malvan	Vijaya- durg	Ratna- giri	Goa	Malvan	Vijaya- durg	Ratna- giri	Goa	Malvan	Vijaya- durg	Ratna- giri	Goa	Malvan	Vijaya- durg	Ratna- giri
Na	2250	950	1200	2100	7750	2650	3625	3000	373	328	368	326	373	328	368	326
K	3850	1275	1150	875	6500	4225	4825	3150	98	174	118	168	98	174	118	168
Ca	45	177	55	42	276	629	4475	278	53	86	61	84	53	86	61	84
Mg	3200	1500	2700	2750	9800	9400	7225	9175	614	990	774	1100	614	990	774	1100
Fe	37750	15750	73900	75500	32562	8650	23375	27000	7.4	1.05	2.75	0.55	7.4	1.05	2.75	0.55
Mn	767	260	402	862	575	500	560	555	0.76	0.18	0.17	0.09	0.76	0.18	0.17	0.09
Cu	26	25	83	121	11	6	3	5	0.42	0.32	0.27	0.19	0.42	0.32	0.27	0.19
Ni	25	4	35	37	10	4	5	6	0.22	0.46	0.30	0.54	0.22	0.46	0.30	0.54
Sr	2	—	4	7	3	6.5	1.5	1.5	3.5	8	4.8	8	3.5	8	4.8	8
Li	3	1.9	—	6.3	4.5	2.5	5.9	3.2	0.037	0.062	0.042	0.061	0.037	0.062	0.042	0.061
Na/K	0.584	0.745	1.043	2.4	1.192	1.75	0.57	0.95	3.81	1.89	3.12	1.94	3.81	1.89	3.12	1.94
Fe/Mn	49.22	60.57	183.83	87.57	56.63	17.30	41.74	48.65	9.75	5.83	16.18	6.11	9.75	5.83	16.18	6.11

Ni (Table I). Maximum concentrations of Sr (7 ppm) and Li (6.3 ppm) were recorded from sediments collected from Ratnagiri. Highest concentration of Na was observed in the sediments from Goa. Na/K ratio in the sediments varied from 0.584 at Goa to a maximum of 2.4 at Ratnagiri. The maximum Fe/Mn ratio was observed in the sediments (183.83) from Vijaydurg.

Waters from Ratnagiri were found to be rich in Mg (1100 ppm) which was quite high compared to the concentration of Mg observed at other stations. The water samples at all the stations were rich in Na, K, Ca while Sr, Li and Ni occurred in very small quantities. Na/K ratio in the water varied from 1.89 to 3.81 while Fe/Mn ratio was maximum (16.18) at Vijaydurg.

*H. beccarii* from Mandovi estuary (Goa) showed highest concentration of Na (7750 ppm) and Fe (32,562 ppm). Maximum concentration of Ca (4475 ppm) was recorded in the plant sample from Vijaydurg. Na/K ratio fluctuated from 0.75 at Vijaydurg to 1.19 at Goa. Maximum (56.63) Fe/Mn ratio was also recorded in the sample collected from Goa (Table I).

From the above results it could be said that *H. beccarii* (Aschers) may require Na, K, Ca, Mg and Mn in higher concentration for its better growth. However, further laboratory studies are required to come to definite conclusion on uptake and accumulation of metals by *H. beccarii*. The concentration of metals in *H. beccarii* and the environment fluctuated from station to station. High values of Na, K, Ca, Mg, Fe and Mn in *H. beccarii* indicated that they might be absorbed from water as well as sediments (Epstein, 1972). Maximum concentration of Ca was found in the plants collected from the sewage polluted area of Vijaydurg. Bhosle (1978) reported comparatively high values for Na, K, Ca, Mg and from Deogad.

High concentration of Ca in the environment enables plant to grow in the saline condition (Macnae, 1966; Epstein, 1972). Metals like Cu, Sr, Li and Ni are absorbed in low quantities by *H. beccarii*. Concentrations of Sr, Li and Ni in *H. beccarii* were found quite below toxic level (Treshow, 1970). In other seagrasses, Ni was reported to be in very low concentrations (McRoy, 1966).

Mn values in *H. beccarii* showed marked fluctuations at different stations. Accumulation of Fe was very high in *H. beccarii* and its environs compared to the concentration of other metals. The hinterlands of Goa are well known for Fe and Mn deposits which may be the cause for high concentration of these metals in the sediments of Mandovi estuary (Goa). High biomass of hydrophytes can be obtained in environment with high Fe/Mn ratios (Basiouny, Garrard and Haller, 1977). Thus the greater biomass of *H. beccarii* recorded at Vijaydurg and Ratnagiri which may be because of high Fe/Mn ratio in the sediments.

Marine plants are considered to be reservoirs of heavy metals (Burrell and Schubel, 1977). In marine algal species from Goa, the Fe and Mn con-

centrations ranged from 130.4–1976.22  $\mu\text{g/g}$  and from 25.09–3420.5  $\mu\text{g/g}$  (Agadi, Bhosle and Untawale, 1978) respectively. In the estuarine mangrove foliage, Fe ranges from 1697.66–3127.35  $\mu\text{g/g}$  (Untawale, Wafar and Bhosle, 1980). However, in *H. beccarii* accumulation of Fe and Mn was quite high, compared to the values recorded for mangroves and seaweeds. Ni and Cu values in mangrove plants and seaweeds were found to be greater than in *H. beccarii*.

Table II. Correlation among metal concentration in sediments, water and plant (n=12).

Metal	Correlation Coefficient (r)		
	Water-plant	Sediment-plant	Sediment-water
Na	+ 0.29	+ 0.29	+ 0.21
K	- 0.88	+ 0.90	+ 0.74
Ca	- 0.36	- 0.17	+ 0.57
Mg	+ 0.091	+ 0.072	+ 0.53
Fe	+ 0.63	+ .54	- 0.20
Mn	+ 0.51	+ 0.71	+ 0.32
Cu	+ 0.98	- 0.64	- 0.67
Sr	+ 0.35	- 0.88	+ 0.16
Li	+ 0.84	- 0.56	+ 0.46
Ni	- 0.62	+ 0.26	+ 0.084

In case of K, Mn, Cu, Sr and Li concentrations in *H. beccarii* and its environment, significant correlation was found while rest of the elements showed no significant correlation (Table II). The potassium content of *H. beccarii* was positively correlated with potassium content of the sediments ( $r = + 0.90$ ) and negatively correlated with K content of seawater ( $r = - 0.88$ ). Mn value in the plant was found to be positively correlated ( $r = + 0.71$ ) with Mn content of the sediments. Cu in plants showed highly significant positive correlation ( $r = + 0.98$ ) with the Cu content of the surrounding water. Sr values in plant were observed to be negatively correlated ( $r = + 0.88$ ) with Sr content of the sediments, while Li content of the plant showed positive correlation ( $r = + 0.84$ ) with Li content in the surrounding water. K contents in the sediments showed a negative correlation ( $r = - 0.67$ ) with Cu content of water in the vicinity.

From the results, it can be concluded that the tolerance limit of *H. beccarii* for Fe and Mn is very high and the variability in metal concentration was subject to different environmental factors.

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