

Concentration of Some of the Heavy Metals in the Oyster, *Crassostrea madrasensis* (Preston), from the Cochin Region

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High concentrations of zinc, copper and iron were observed in *C. madrasensis*, collected from the Cochin backwaters over 1 yr (1975-76). High concentrations were observed during December to May. Low values were confined to June to November, when the fresh water discharge through the rivers was maximum. The high levels of these metals are considered to be due to industrial and domestic pollution.

STUDY of the concentration of heavy metals by marine food organisms is important in view of their being a threat to human health. Sastry and Bhatt¹ and Bhatt *et al.*² have worked on some of the metal concentrations in the oysters from the Bombay region. Zingde *et al.*³ have reported the concentration of some of the metals in *Crassostrea cucullata* and *Crassostrea gryphoides* from the Goa region. High concentrations of heavy metals are reported in oysters from other parts of the world by various workers⁴⁻⁹. In the Cochin area the oyster, *Crassostrea madrasensis*, forms a regular fishery round the year and is abundant in the Ramanthuruthu channel near the Cochin Harbour mouth. The paper deals with the seasonal variations in the metal concentrations in *C. madrasensis* from this region.

The oysters were collected at monthly intervals during the year 1975-76, from the Cochin backwaters. These were sorted out into spat, juveniles and adults according to size and weight. After removing the shell, the samples were cleaned in distilled water and dried in an oven at 60°C. The metals were estimated in the dried material after wet digestion with perchloric acid and nitric acid, as per the methods given in the *Manual of methods in aquatic environment research*¹⁰. The elements were estimated using the atomic absorption spectrophotometer (Hilger & Watts Atomspek H-1550). The average moisture content in the adult specimen was 80%. In juvenile and spat the average moisture contents were 81.8 and 82.2% respectively.

Seasonal variations in the concentration of iron, manganese, copper and zinc in the adult and juvenile *C. madrasensis* are shown in Fig. 1.

Iron concentration in the spat varied between 100 and 1020 µg/g dry material, in juveniles the variation was between 100 and 1300 µg/g and in the adult specimens it varied from 120 to 1600 µg/g. Highest concentrations were observed during April. The levels of iron concentrated by the oysters were compared with that of the water around

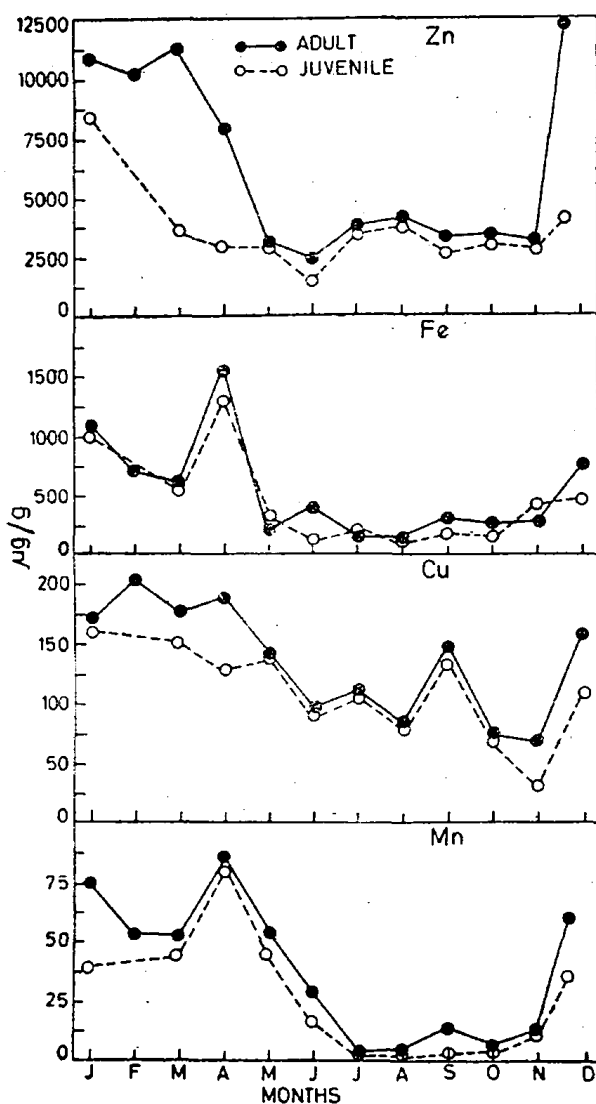


Fig. 1 — Seasonal variation in the metal concentrations in *C. madrasensis*

and it was found that during January/February the total iron concentrations in the waters varied between 500 and 600 µg/litre.

Manganese levels in the oysters were rather low. The levels in spat ranged between 5 and 39 µg/g. In the adult and juvenile specimen it varied from 5 to 80 and from 5 to 85 µg/g respectively. As in the case of iron, highest concentrations were observed during March to April. Low levels of manganese in these oysters indicate the poor accumulating ability. Zingde *et al.*³ have observed higher levels of manganese in the waters around Goa (6-102 µg/litre), but observed only very low levels (3.2-17.5 µg/g) in the oyster *C. cucullata*, thereby concluding that the species has little tendency to accumulate manganese.

Concentration levels of copper in the spat varied from 10 to 140 µg/g. In the juveniles and adults it varied from 40 to 160 and from 70 to 205 µg/g respectively. The seasonal pattern of the distribution of copper concentration was erratic. In

general as in the case of other metals low values were observed during June and November and values increase thereafter. The capacity of oysters to concentrate copper several fold to what is available in the environment is well known. Brooks and Rumsby⁴ have observed oysters concentrating copper up to 14000 times of the soluble metal ion present in the environment. The ionic copper value of the waters around the area of collection in January/February varied between 3 and 5 $\mu\text{g/litre}$.

Levels of zinc in spat, juveniles and adult specimens showed a great accumulation of this metal. The concentration also showed a very high variability and the levels in the spat varied between 3400 and 3900 $\mu\text{g/g}$. In the juveniles and adult specimens it varied from 1750 to 8400 and from 2450 to 12500 $\mu\text{g/g}$ respectively. As in the case of other metals maximum values were observed in March and April.

Sastry and Bhatt¹ indicated that oysters accumulate zinc from sea water by a factor of about 10000. Bhatt *et al.*² have reported zinc concentration in *C. gryphoides* ranging from 171 to 403 ppm with concentration factors in the range of 5500-13000. Zingde *et al.*³ have reported values of zinc for *Crassostrea* sp. varying between 323 and 2800 $\mu\text{g/g}$. The oyster samples analysed from Quilon region during January/February showed an average zinc concentration of 1574 $\mu\text{g/g}$. The high levels of zinc in the oysters from the Cochin region are indicative of zinc pollution in the environment. The zinc concentration in the particulate matter in this region varied between 11 and 26 $\mu\text{g/litre}$. Ratkowsky *et al.*⁸ have reported concentration levels of zinc in oysters from the Tasmanian region of greater than 10000 $\mu\text{g/g}$ (wet weight) due to zinc pollution. Thrower and Eustace⁶ have also reported high zinc concentration in the oysters collected from the Ralph Bay (21000 $\mu\text{g/g}$ dry wt) due to industrial pollution.

There is a marked seasonal variation in the metal concentrations in oysters in both juveniles and adult specimens. The concentration values show a definite pattern: low concentrations are confined to June-November; increasing values occur from December onwards; and the highest concentrations occur during March/April. During June-November the backwaters get flushed with fresh water discharge as a result of monsoon rains, when the salinity values reach as low as 1‰. The main flow of fresh water in this region is through the Periyar river. A number of factories including an electrolytic zinc plant are situated 15 km upstream of the river, from the sampling zone, and these discharge effluents into this river. Minimum accumulation of these metals by the oyster during June-November is believed to be as a result of low concentration of the metals in the medium due to dilution by large amount of fresh water flow through the river. During the rest of the year the fresh water flow through the river is extremely low, thereby increasing the levels of the metals. Relatively lower value of zinc has been reported by Bhatt *et al.*² for *C. gryphoides* from the Bombay region, for *C. cucullata* and *C. gryphoides* by Zingde *et al.*³, from Goa region

and also values for various metals obtained for *Crassostrea* sp. (iron 192 $\mu\text{g/g}$, manganese 9 $\mu\text{g/g}$, copper 67 $\mu\text{g/g}$ and zinc 1574 $\mu\text{g/g}$ dry wt) from the Quilon region, indicate that the effluent discharged in the river from the industrial area has considerable effect on the accumulation of metals like zinc by oysters in the Cochin backwater.

Ratkowsky *et al.*⁸ have given the average concentration levels of zinc and copper away from the urban industrial centres as 1000 and 30 $\mu\text{g/g}$ respectively for Tasmanian oysters. Ikuta¹¹ has reported the concentration of copper in *Ostrea* sp. from 320 to 687 mg/kg wet weight, in the region contaminated by industries and mines. For oysters from the uncontaminated area of the same bay, he has given values of copper between 40 and 99 mg/kg wet weight. The present observations indicate that the concentration of metals in the oyster *C. madrasensis* is on the higher side.

Like zinc, iron concentration in the oyster at different stages of their growth is quite high and more or less same both in the juveniles and adults. The manganese levels in the oyster is also high compared to those reported for *C. gryphoides*², and *C. cucullata*³. In the clam *Sunetta donacina*, Bhatt *et al.*² observed a higher manganese content (59-83.9 ppm). The copper levels reported for *C. cucullata*³ are 2-3 times of the values obtained for *C. madrasensis* from the Cochin region. This may be explained as the species specificity for the metal. Wide variation in the salinity of the environment and also the presence of other metals and the changes in their relative concentrations may be affecting the uptake of metals by the oysters, as reported by Phillips¹² in the case of *Mytilus edulis* for the uptake of copper.

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