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On

# BLUE REVOLUTION

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## LITTLE FLOWER COLLEGE
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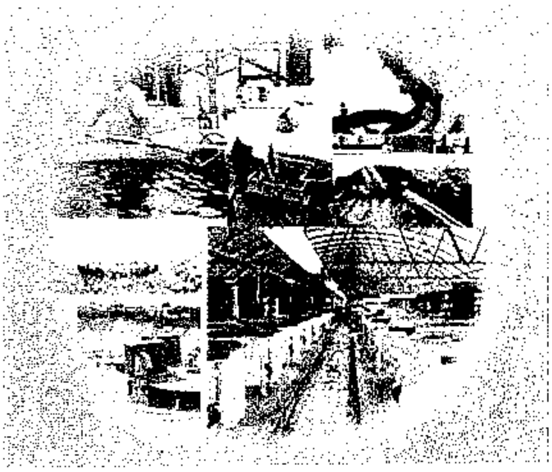

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# MARINE POLLUTION

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Marine environment particularly, the coastal and estuarine zones are vulnerable to pollution because of increasing anthropogenic activities like fishing, recreation, shipping and aquaculture. Some of these areas are now under the direct threat from the increasing load of various pollutants. Beaches and even oceans have turned out to be dumping sites of domestic wastes, industrial effluents, hydrocarbons and solid waste materials. Major pollutants include heavy metals, persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCB), organic chlorine pesticides (OCPs), oil and grease etc. UNEP has envisaged a global project to assess the impact of persistent toxic substances (PTS) on human health and on the environment. Under this project, 160 countries have been divided into 12 regions. The Indian Ocean falls in the sixth zone. In this article, the recent environmental changes and challenges in our coastal and marine environment is discussed briefly. Several water bodies in the country are in mortal changes of pollution caused by excessive sewage, industrial effluents, fertilizer and pesticide run-off. The seas around India have several hot spots with regard to thermal wastes, nuclear wastes and oil pollution. Andaman and Nicobar archipelago is considered comparatively cleaner to the peninsular Indian Coasts as they are far away from the reach of industrial effluents from the mainland. However, the recent investigations reveal that these areas are contaminated with metals, hydrocarbons and pesticides. Even the pristine environment in polar regions is found contaminated with aerosols and hydrocarbonated polyethylene derivatives (Mabury *et al.*,2005).

## Metal Pollution

Among the pollutants, the heavy metal needs special mention as it is key indicator of the impact of industrialization. Metal content of water varies from place to place due to different geographical features, geochemical environment and industrial pollution. It is reasonable to assume that the variation of trace element content of water will definitely reflect in the trace element content of sediment and hence in the tissue living in the ambient column. The capacity of some marine animals and plants to accumulate toxic trace metals in their tissues, far in excess of ambient level is the topic of current interest. Information on the bioaccumulation of heavy metals in marine organisms from open sea (Barber *et al.*, 1972; Kureishy *et* al., 1981; Kureishy *et al.*, 1982) is not so common as is from coastal areas

( Lakshmanan and Nambisan, 1983; Krishnakumar *et al.*, 1990; Kaladharan *et al.*, 1999; Kaladharan *et al.*, 2005; Kaladharan *et al.*,2005a; Patel *et al.*, 1985; Prema *et al.*, 2006; Sankaranarayanan *et al.*, 1978).

Spatial and temporal monitoring of heavy metal is very much essential for identifying hot spots. Status of coastal pollution can be assessed with the three tier detection mechanism from water, sediment and tissue samples. Muralidharan and Ouseph (1989) have studied the distribution of certain major, minor and trace elements in the near shore sediment off south west coast of India and they noticed that the concentration of trace elements vary with sediment texture and organic matter content. Coastal marine pollution in Tamilnadu was reviewed by Ramachandran and Natarajan (1989). Sediments are indicators of the quality of water overlaying them and hence their study is useful in the assessment of environmental pollution. The nature and extent of fluctuation in the composition and organic matter content of sediments can indicate the extent of stress in an environment. Heavy metal concentration in various tissues of green mussel, *Perna viridis* from the intertidal waters of Kalpakkam, Chennai was studied by Wesley and Sanjeevaraj (1983). Senthilnathan and Balasubramanian (1999) have evaluated the extent of distribution of Cu, Cd, Zn and Pb in water, sediment and plankton from Pondicherry harbour.

Profile of Cadmium, Zinc, Copper and Lead from sediment and four species of fish tissue samples from estuarine and inshore regions of Cochin were analysed from the monthly data. collected during 1990 to 1998 aboard R.V.*Cadalmin* (Kaladharan *et al.*,2005). Annual mean levels of Zinc in *Nemipterus japonicus* registered gradually decreasing trend towards 1998 with a peak (35 ppm) during 1992. Similar trend was also observed in *Metapenaeus dobsoni* and *Sunetta scripta.* However, an increasing trend was noticed in *Otolithus ruber,* registering a peak (9 ppm) during 1995. Lead concentrations were higher in prawn followed by *Nemipterus japonicus* with an increasing trend. On the other hand, Cadmium and Copper levels showed a decreasing trend with peak levels in *Nemipterus* (Cd 0.58 ppm, Cu 10. 43 ppm) and prawn (Cd 1.16 , Cu 8.87 ppm) than the molluscs and the croaker species. Levels of these four metals in sediment were higher in inshore regions than in the estuarine areas. Copper, Lead and Cadmium content in sediments of estuarine as well as the inshore regions showed an increasing trend over the nine years study period. However, the levels of Zinc showed no significant variation in the inshore regions and a marked decreasing trend in the estuarine regions.

## Comparative account of metal concentration (ug/g dry wt) in marine sediment and tissues (Average from monthly values from 1990-1998)

| **Metals** | **Iyer, C.S.P** (1994) | **Long *et al* (1995)** Sediment | **WHO1987** Permissible levels in fish and seafood | **Kaladharan *et al* (2005)** Sediment | **Kaladharan *et al* (2005)** Tissue samples |
|---|---|---|---|---|---|
| **Cu** | - | 108 | 130 | Inshore 35.04<br>Estuary 33.08 | *Nemipterus* 7.524<br>*Otolithus* 0.592<br>*Metapenaeus*5.755<br>*Sunetta* 3.613 |
| **Cd** | 1- 6.7 | 4.2 | 9.0 | Inshore 01.74<br>Estuary 01.51 | *Nemipterus* 0.365<br>*Otolithus* 0.036<br>*Metapenaeus* 0.244<br>*Sunetta* 0. 671 |
| **Zn** | - | 271 | 217 | Inshore 135.43<br>Estuary 126.38 | *Nemipterus* 23.982<br>*Otolithus* 5.286<br>*Metapenaeus* 16.141<br>*Sunetta* 22.007 |
| **Pb** | 0- 90 | 112 | 9.0 | Inshore 31.49<br>Estuary 28.04 | *Nemipterus* 0.625<br>*Otolithus* 0.388<br>*Metapenaeus* 0.653<br>*Sunetta* 0.526 |

Trace metals in the muscle tissue of nine species of commercially important marine fishes collected from Port Blair

(Andamans) and at Kochi ( Kerala, south west coast) were compared to study the level of bioaccumulation with reference to the ambient water and sediment, aimed at whether these levels can be comparable as reference levels for the peninsular resources at the mainland. Except Mn and Zn, all other metals such as Cd, Cu, Fe, Ni and Pb were below detection levels in the samples collected from Port Blair. Compared to the same species and similar size from Kochi, Mn in *Saurida tumbil* (17.85 μg/g ) and Zn in *Epinephilis tauvina* (97.11μg/g) from Port Blair were at higher levels. Samples from Samples from Kochi recorded accumulation of 1.42 μg/g Cd and 271μg/g. Fe in *Rastrelliger kanagurta,* 11.3 μg/g Cu in *Sardinella gibbosa* and 83.3 μg/g Pb in *Sourida tumbil.* Baring Pb, the bioaccumulation of all other metals in the fish samples was within the WHO prescribed safe limits. Compared to the levels of Pb in sediment (59.76 μg/g) and water (1.8 μg/l) from Port Blair, lower value was recorded in the sediment (7.5 μg/g) and higher values in water (2.17μg/l) from Kochi. Significant correlation could not be established between the metal levels of Sediment and water samples neither from Port Blair nor Kochi. Significant correlation to 0.01level could be established positively between water and *L.Parsia, E. tauvina* and *S.longiceps* as well as *P.longimanus* and *R. kanagurta* with sediment from Kochi.

**Levels of metals in seawater (µg/l), sediment (µg/g dry wt) and fish muscle tissue (µg/g dry wt) collected from Port Blair and Kochi.**

| No. | Samples | Location | Cd | Cu | Fe | Mn | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|
| 1. | *Pentaprion longimanus* | PortBlair | 0.0 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 16.9 |
| | *Pentaprion longimanus* | Kochi | 0.0 | 0.0 | 68.8 | 0.0 | 0.0 | 0.0 | 28.8 |
| 2. | *Nemipterus japonicus* | Port Blair | 0.0. | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.8 |
| | *Nemipterus japonicus* | Kochi | 0.0 | 4.6 | 29.6 | 0.0 | 0.0 | 72.6 | 11.1 |
| 3. | *Sardinella gibbosa* | Port Blair | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 45.6 |
| | *Sardinella gibbosa* | Kochi | 0.0 | 11.3 | 35.2 | 0.0 | 0.0 | 0.9 | 31.8 |
| 4. | *Liza parsia* | Port Blair | 0.0 | 0.0 | 0.0 | 1.7 | 0.0 | 0.0 | 1.2 |
| | *Liza parsia* | Kochi | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 22.7 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 5. *Epinephelus tauvina* | Port Blair | 0.09 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 97.1 | |
| *Epinephelus tauvina* | Kochi | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 14.1 | |
| 6. *Saurida tumbil* | Port Blair | 0.0 | 0.0 | 0.0 | 17.8 | 0.0 | 0.0 | 39.7 | |
| ***Saurida tumbil*** | **Kochi** | **0.0** | **2.9** | **12.9** | **0.0** | **0.0** | **83.3** | **16.4** | |
| 7. *Rastrelliger kanagurta* | Port Blair | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.1 | |
| ***Rastrelliger kanagurta*** | **Kochi** | **1.4** | **0.89** | **271.0** | **0.0** | **0.0** | **0.0** | **46.1** | |
| 8. *Sardinella longiceps* | Port Blair | 0.0 | 0.0 | 0.0 | 4.1 | 0.0 | 0.0 | 54.8 | |
| ***Sardinella longiceps*** | **Kochi** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **0.0** | **49.6** | |
| 9. *Decapterus russelli* | Port Blair | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 14.9 | |
| ***Decapterus russelli*** | **Kochi** | **0.0** | **4.2** | | **25.4** | **0.24** | **0.0** | **75.3** | **33.3** |
| 10. Water | Port Blair | 0.22 | 3.89 | 0.0 | 0.0 | 0.0 | 1.8 | 0.0 | |
| **Water** | **Kochi** | **0.35** | **1.60** | **0.0** | **0.0** | **0.0** | **2.2** | **17.1** | |
| 11. Sediment | Port Blair | 3.78 | 5.53 | 2921 | 94.6 | 23.7 | 59.8 | 6.5 | |
| **Sediment** | **Kochi** | **5.33** | **19.0** | **9020** | **136.5** | **38.8** | **7.5** | **97.8** | |

levels ranging from 0.03 to 1.1 ug/l and the high levels are attributed to runoff from major rivers.

## Pesticide & PCB pollution

DDT was introduced in the 1940s as wonder chemical to fight against crop pests and Malaria. Twenty years before developed countries have banned the use of DDT. In 1996 marine pollution by DDT was shown to an extend to the remotest areas of the world. DDT and dieldrin were detected even in Antarctic fauna – Penguins (George & Frear, 1966; Sladder *et al.*, 1996). The effect of pesticides upon molluscs, particularly bivalves, owing to their economic value as food, is of considerable importance as they have the ability to concentrate the pesticide in their body. Pesticides can affect the organisms directly and indirectly by altering ecological relationships (Moore, 1976). Butler *et al.* (1960) found OCPs at concentrations as low as one part in 100 million was able to inhibit the activity and growth of oysters within 24 hours of exposure. Larval molluscs are much more vulnerable to pesticides as they are killed even at lower concentrations. Butler (1966) found that clams and oysters are able to concentrate pesticides from the medium by factors of 70,000 or greater. As a part of the national

## Mercury pollution

Mercury is a known neurotoxic and nephrotoxic metal. It can cause genotoxic damages in fish populations. India's mercury consumption is on the rise when global production of mercury falling drastically from 6900 metric tones per annum in 1981 to 1800 metric tones per annum in 2000. India's annual mercury import was between 170- 190 tonnes during 1998 – 2001 which was 10% of the total global consumption. When one gm of mercury is sufficient to contaminate a lake bigger than 8 hectares, an average hospital in Delhi releases (breakage of thermometers, dental amalgams etc) about 3 kg of the metal annually- reveals the recent study conducted by the Ministry of environment and Forests New Delhi. Chloralkali industry manufacturing caustic soda is one of the largest sources of mercury waste. Humans are exposed to mercury through dietary fish, since mercury is a trans-boundary pollutant. Eating seafood with high levels of mercury can affect the brain development of older children. Whales, dolphins and marlins accumulate high levels of mercury in their tissues. Dissolved mercury in the west coast of India ranged upto 0.058 ug/l during the pre-monsoon period. However, the levels increased during the SW monsoon and post monsoon period considerably along the coast with some hotspots (0.3 to 0.39 ug/l) adjoining off Veraval and in the Wadgebank (Kaladharan *et al*., 1999b). East coast of India registered