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# Analysis of Heavy Metal in Parangipettai and Pondicherry Coastal Waters, Southeast Coast of India

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***Abstract—*** *The presence of heavy metals in sea water causes hazardous impact on the marine organisms. There are number of toxic metals like Cd, Cr, Cu, Hg and Zn increasing levels in the sea water are of serious problem today. They are released in large concentration through effluent discharges from industries, metal processing, paints and pigment production, biocides production, and through domestic sewage from nearby villages. The present study deals with the heavy metals distribution Cd (0.26 to 1.78* µg $1^{-1}$*), Cr (0.11 to 3.23* µg $1^{-1}$*), Cu (1.08 to 1.96* µg $1^{-1}$*), Hg (0.02 to 0.11* µg $1^{-1}$*) and Zn (1.24 to 3.38* µg $1^{-1}$*) in water of Parangipettai, Pondicherry coastal waters, southeast coast of India. Five metals including Cadmium (Cd), Chromium (Cr), Copper (Cu), Mercury (Hg) and Zinc (Zn) were analyzed by microwave assisted digestion and Atomic Absorption Spectrophotometer (AAS). Concentrations of heavy metals such as Pb and Cd were well below the permissible limits proposed by the World Health Organization. These observations and ensuing inferences of this study are useful for managing pollution outfall from sewage and industrial sources into an aquatic environment. Hence, the coastal regions needed throughout impoundment.*

***Keywords—*** *Water quality, Season, heavy metals, Southeast coast of India.*

## I. INTRODUCTION

The presence of heavy metals in sea water causes hazardous impact on the marine flora and fauna. There are number of toxic metals like Cd, Cr, Cu, Hg and Zn increasing levels in the sea water are of serious problem today. They are released in large concentration through effluent discharges from industries, metal processing, paints and pigment production, biocides production, and through domestic sewage from nearby villages. Hence, the present study deals with the heavy metals distribution (Cd, Cr, Cu, Hg and Zn) in water of Parangipettai and Pondicherry coastal region. Metal concentration in aquatic organism may be significantly influenced by temporal variations in metal levels within the ecosystem Snehalata Dsa *et al.* (2001). The discharge of heated effluents in the coastal water by thermal plant and industries not only cal produces adverse effect on coastal water but also can affects the planktonic community and bottom fauna Kailasam (2004). Assessment of heavy metal concentration in the coastal water can be made by using indicator organisms such as marine algae Thangaradjou *et al.*, (2009) and Rajendra *et al.*, (1993). The study of toxic and trace metals in the environment is more important in comparison to other pollutants due to their non-degradable nature, accumulation properties and long biological half lives Sadasivan and Tripathi. The present study has been carried out so as to understand water quality and concentration of heavy metals in an ecologically important marine ecosystem like Parangipettai and Pondicherry coastal region. Hence, the present study deals with the monthly variations of Heavy metal analysis in Parangipettai, Pondicherry coastal waters, southeast coast of India.

Mohammed, (2009) have observed Copper is an essential trace element, which is widely distributed in nature and also widely used metal industries. Copper sulphate mixed with lime is used as a fungicide. Medicinally copper sulphate is used as an emetic; it is also used as an antiparasitic agent based on its astringent and caustic actions. Copper levels in human body vary with age. Copper levels in brain increase with age and Cu levels are high in new borns than in adults. Dara, (2004) have reported Cadmium contamination of water may also come from use of metallic and plastic pipes, while super phosphate fertilizers, sewage sludge and automobile tyres also contain some amount of this toxic metal. The main problem with Cd in human nutrition is that the body does not completely excrete whatever Cd is absorbed. Cd in water at 10ppm level can kill fishes in one day while at 2ppm level they will be killed in 10 days. Hardness and salinity of water provides some degree of protection. Human exposure to lead occurs primarily through drinking water, airborne lead-containing particles and lead based paints. Several industrial processes create lead dust and fumes.

Zinc is nutritionally an essential element and is required for the activity of a number of enzymes. Mining, processing and smelting of ores for the extraction of zinc constitutes the chief source of zinc pollution in the environment. Zinc content in aquatic invertebrates in fresh unpolluted water ranges between 25-200mg per litre. Above 40ppm level this metal imparts a faint but definite metallic taste and milky appearance to fresh water (Asthana and Meera Asthana, 2005). Increased loads of nutrients, heavy metals and other compounds like pesticides, fertilizers have resulted from changes in land use and anthropogenic development of the river basins. Since, rivers constitute the main inland water resources for domestic, industrial and irrigation purposes, it is imperative to prevent and control the river pollution and to have reliable information on the quality of water for effective management Farombi *et al.*, (2007).

## II. MATERIALS AND METHODS

Heavy metals in the water samples were analyzed by adopting the procedure of Brooks *et al*., (1967) Water samples were collected at monthly intervals (for a period of 12 months from July 2014 to June 2015) and were collected in pre-cleaned and acid washed polypropylene and acid washed polypropylene bottles of one litre capacity and were

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immediately kept in an ice box and transported to the laboratory to avoid contamination. Water samples were then filtered through a Millipore filtering unit using a Millipore filter paper (pore size 0.45µm). The filtered water samples were reconcentrated with APDC-MIBK extraction by following the procedure of Brooks et al., (1967). The heavy metals in water were analysed in air-acetylenemic Absorption Spectrophotometer (AAS-Model 802), undisturbed surface sediment samples were collected using a grab sampler placed in plastic containers for transport to the laboratory. Sample preparation for chemical analyses involved procedures for sub sampling during drying, sieving crushing and storage. All these steps were followed by adopting the methods Perkins and Altens Ga, (1979).

*Study Area*

The present study was carried out from the southeast coast of India in Parangipettai (Lat 11.12°N and Long 79.48°E) and Pondicherry (Lat 11.54°N and Long 79.52°E) Tamil Nadu. Surface water sample were collected at monthly interval from the Parangipettai, Pondicherry, for a period of one year from January 2016to December 2016 for the estimation of various Heavy metal analysis. Pondicherry coastal water area is polluted due to the discharge of industrial, domestic and agricultural waste through small tributaries and channels into the Bay of Bengal.

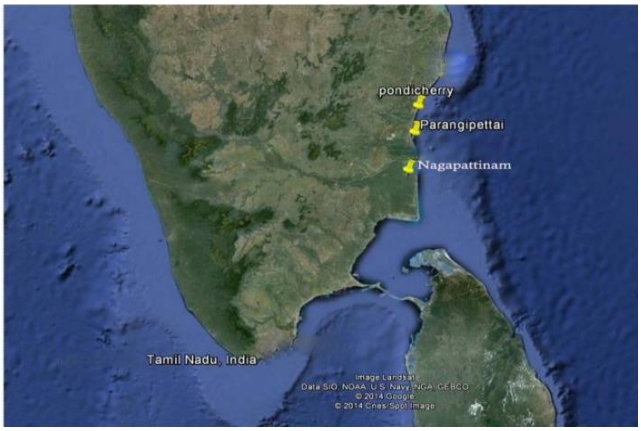


Fig.1. Study area map.

Pondicherry has an average elevation of about 15 meters above sea level and is intersected by deltaic channels of river Gingee and Poonaiyar and interspersed with lagoons, lakes and tanks. All the rivers remain dry in mat of their course except during rainy season. Among the two environments, Parangipettai coast is not polluted, receiving only the land drainage through the vellar estuary, parangipettai situated along the southeast coast of India has unique potential for marine and brackish water resources, being endowed with various aquatic biotopes viz., neritic, estuarine, backwaters and mangroves. The domestic sewages agricultural drainages and the other sewage effluents are carried out into the Bay of Bengal through the small canals and rivers.

## III. Results and Discussion

The heavy metal analysis of Parangipettai and Pondicherry coastal water was measured at two stations. The results showed that the maximum Cadmium (1.78 µg $1^{-1}$) was observed in Parangipettai coastal water during monsoon season and the minimum (0.26 µg $1^{-1}$) was recorded in Pondicherry coastal water during postmonsoon season.

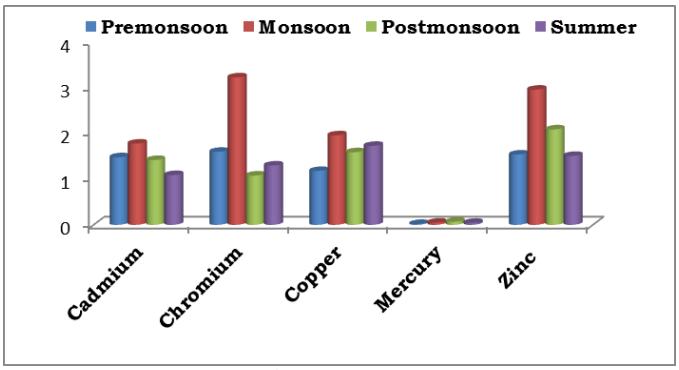


Fig.2. Season variation of heavy metal Parangipettai coastal water

The higher value of Chromium (3.23 µg $1^{-1}$) was observed in monsoon season at Parangipettai and lower value (0.11 µg $1^{-1}$) at Pondicherry during summer (Figure 2). The Copper were ranged from 1.96 to 1.08 and the utmost Copper was recorded during monsoon at Parangipettai but the lowest (1.08 µg $1^{-1}$) was recorded during pre-monsoon season.

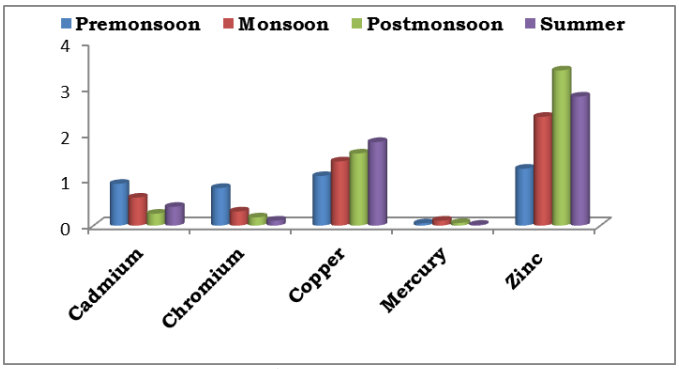


Fig.3. Season variation of heavy metal Pondicherry coastal water.

The higher values of Mercury 0.11 µg $1^{-1}$ were observed in Pondicherry during monsoon and the lower values (0.02 µg $1^{-1}$) were in Parangipettai at during pre-monsoon season. The zinc was highly found to be (3.38 µg $1^{-1}$) in Pondicherry during postmonsoon season and the lower value of Zinc (1.24 µg $1^{-1}$) was recorded during Pre-monsoon season at Pondicherry (Figure 3).

Table 1. Mean values of heavy metal recorded in station-1 at Parangipettai coastal water during the period from Jan 2016 to Dec 2016.

| Metals | Pre monsoon | Monsoon | Post monsoon | Summer |
|---|---|---|---|---|
| Cadmium (µg $1^{-1}$) | 1.48±0.05 | 1.78±0.08 | 1.42±0.05 | 1.09±0.05 |
| Chromium (µg $1^{-1}$) | 1.60±0.06 | 3.23±0.12 | 1.08±0.05 | 1.30±0.02 |
| Copper (µg $1^{-1}$) | 1.18±1.08 | 1.96±1.21 | 1.59±2.50 | 1.73±0.90 |
| Mercury (µg $1^{-1}$) | 0.02±0.01 | 0.05±0.02 | 0.068±0.03 | 0.045±0.008 |
| Zinc (µg $1^{-1}$) | 1.54±0.65 | 2.96±0.91 | 2.09±0.67 | 1.51±0.90 |

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Table 2. Mean values of heavy metal recorded in station – 2 at Pondicherry coastal region during the period from Jan 2016 Dec. 2016.

| Metals | Pre monsoon | Monsoon | Post monsoon | Summer |
|---|---|---|---|---|
| Cadmium (µg $l^{-1}$) | 0.91±0.03 | 0.61±0.02 | 0.26±0.01 | 0.41±0.02 |
| Chromium (µg $l^{-1}$) | 0.82±0.01 | 0.31±0.01 | 0.18±0.00 | 0.11±0.00 |
| Copper (µg $l^{-1}$) | 1.08±0.09 | 1.40±0.32 | 1.57±0.25 | 1.82±0.32 |
| Mercury (µg $l^{-1}$) | 0.05±0.013 | 0.11±0.06 | 0.059±0.02 | 0.02±0.01 |
| Zinc (µg $l^{-1}$) | 1.24±0.04 | 2.37±1.8 | 3.38±0.09 | 2.81±0.67 |

Mendil and Uluozlu, (2007) have reported that the concentration of heavy metals such as Copper, Zinc, Cadmium, Chromium and Mercury occur in marine seawater in different forms and in different concentrations. Heavy metals can enter a water supply by industrial and consumer waters or even from acidic rain, breaking down of soils and releasing heavy metals into streams Lakes, Rivers and ground water (Nayar, 2006) who reported that the Heavy metals such as copper, zinc, cadmium, Chromium, Mercury and Zinc occur in the marine water in different forms at different concentrations. Dural *et al*. (2006) have reported that the Copper concentration was maximum during the monsoon seasons and minimum during the pre-monsoon. Such a seasonal variation of Cu concentration in sediments perhaps was due to the presence of major sources of metal pollution, intensive of human activity. Fungicides and algalcides are used in the papers form mould developments, these Preparations contain copper compounds.

Rejomon *et al.* (2010) who reported that the Zinc concentration was high during the monsoon at both stations. High Zn concentration in water could have resulted due to the release of this metal from the sediments and abundant organic matter. Zn Concentration was low concentration during the summer season at both the stations. This would have resulted due to the utilization and uptake of Zn along with other nutrients by the biota including phytoplankton. (Gomez – Ariza *et al*., 2000) have also established that Zn could get strongly depleted from the surface waters as it has a nutrient type of distribution in seawater. Excessive intake of zinc may lead to vomiting, dehydration, abdominal pains, nausea, lethargy and dehydration. Cadmium concentration was more during the monsoon at the both stations less during the summer season at both the stations. According to Eaton (2005) Cd is released into the atmosphere by fossil fuel and by the burning of agricultural and municipal wastes, including dried sewage sludge. It is used in nickel cadmium batteries PVC plastic and Paint Pigments. Cadmium sulphide and selenide and are commonly used a pigments in plastics.

Rajappa *et al.* (2010) who observed that the Chromium is highly toxic and responsible for several cases of poisoning through food. Small quantities of cadmium cause adverse changes in the arteries of human kidney. It replaces zinc biochemically and causes high blood pressures, kidney damage *etc*. The sources of chromium pollution septic system industrial discharge and Geological mining sites both stations show chromium concentrations high in monsoon season. A number of toxic elements are introduced into the aquatic environment from the effluents coming from the large industries resulting biodiversity and changes in water quality. For example effluents from textile mills and electroplating contained as much as 20-40ppm of chromium (Asthana and Meera Asthana, 2005).

Concentrations of heavy metals in water in all the stations varied in nature. Variability in the distribution of metals appeared to be more related to hydrobiological conditions. Concentrations of dissolved metals especially of Cu and Zn were high during the summer season. Cd and Hg concentrations were high during the summer. Generally, the natural sources of heavy metals in coastal waters are through land and river runoff, and the mechanical and chemical weathering of rocks. The components also were washed from the atmosphere through rainfall, windblown dust, forest fire, and volcanic particles, adding to the distribution of heavy metals in water (Bryan, 1984). Low levels of Cu in the surface could be due to the adsorption of Cu on to the particulate matter and consequent settlement to the bottom. Levels of the metals observed in the present study are significantly higher or similar to the levels reported from the coastal and near shore waters in and around India especially from the Bay of Bengal. It is therefore concluded that the Tranquebar coastal area is getting polluted with these metals, thus substantiating the view of Ramachandran (1990) who reported that the coastal waters of Tamil Nadu state are likely polluted with heavy metals (Sankar *et al*, 2010).

The higher concentration of metals observed during monsoon could be attributed to the heavy rainfall and subsequent river runoff, bringing much industrial and land derived materials along with domestic, municipal, and agricultural wastes, which include residues of heavy metal containing pesticides (Bragatheeswaran *et al.,* 1986; Senthilnathan and Balasubramanian, 1997; Ananthan *et al.*, 2006; Karthikeyan *et al.* 2007). Zn and Cu always have a tendency to couple with organic carbon. Decomposition of the organic matter remain are found to release heavy metals back to sediments and accumulated; and this process might be responsible for the strong association of Zn and Cu with organic carbon (Bardarudeen *et al*., 1996). Zn and Cu are generally good indicators of anthropogenic inputs (Forstuer and Wittman, 1979). The extensive use of antifouling paints during the peak fishing season in postmonsoon would have released cuprous oxide which in turn enriches the Cu content in the water (Ananthan *et al.,* 2006). Eventually, it would be settled from the water column by flocculation and sedimentation (Karthikeyan *et al.,* 2007). In summer, these metals might slightly elevate in content because the low salinity and high pH water might have caused the adsorption of these metals, leading to their removal from the water column. Our findings also coincide with Sankar *et al*, 2010.

## IV. CONCLUSION

The present investigation suggests that the health of Parangipettai, Pondicherry coastal waters, southeast coast of India. Among the two areas selected for study, Pondicherry was highly polluted with Cd, Cr, Cu, hg and

Zn. This may be due to the industrial activities and anthropogenic introduction of pollution also resulted from local people. This study has enlightened the fact the persistent pollutants like metals should be regularly monitored and any variation from the normal distributional pattern can furnish an idea about the proper management of the coastal area. Presence of certain metals like Cd, Cr, Cu, Hg and Zn in Parangipettai, Pondicherry coastal water is not good indicator for fish production, if control measure are not followed then the fishery potential of Parangipettai, Pondicherry coastal area may decline and or may cause various diseases in human beings who consume fishes which the main food of people living in this coastal area. The present baseline information of the heavy metals in water would form a useful tool for further ecological assessment and monitoring of these coastal environments. The higher concentration of metals in this region could be attributed to the heavy rainfall and subsequent river runoff, bringing much industrial and land derived materials along with domestic, municipal, and agricultural wastes, which include residues of heavy metal containing pesticides. A competent monitoring programme is an essential adjunct to any attempt of managing the coastal areas in an ecologically sound and sustainable manner.

## REFERENCES

[1] Ananthan, G., Sampathkumar, P., Palpandi, C., and Kannan, L. Distribution of heavy metals in Vellar estuary, Southeast coast of India. *J. Ecotoxicol. Environ. Monit*, 2006, 16, pp. 185-191.

[2] Asthana and Meera Asthana, (2005). Environment problems and solutions in pollution of Earth surface: Land and water 3. Non-Degradable pollutants fifth edition, S. Chand and Company, New Delhi, pp. 166-181.

[3] Bardarudeen, T., Damodaran, K.T., Sajan, K., and Padmalal, D. Texture and geochemistry of the sediments of a tropical mangrove ecosystem, southwest coast of India. *Environ. Geol*, 1996, 27, pp. 164-169.

[4] Bragadeeswaran, S., Rajasegar, M., Srinivasan. M., and Kanagarajan, U. Sediment texture and nutrients of Arasalar estuary, Karaikkal, southeast coast of India. *J. Environ. Biol*, 2007, 28, 237-240.

[5] Brooks R.R., Presley B.J., and Kaplan, I.R. (1967). APDCMIBK extraction system for the determination of trace metals in saline waters by Atomic Absorption Spectroscopy, Talanta, 14: pp. 809-816.

[6] Bryan, G.W. Pollution due to heavy metals and their compounds. In: Marine Ecology (Ed.: O. Kinne). Vol. V. Part 3, John Wiley and Sons, 1984, pp 1289 – 1432, New York.

[7] Dara, S.S. (2004). Environmental Chemistry and Pollution control in Trace elements – Pollution and Control 7th edition. *S.Chand and Company*, New Delhi, pp. 177-216.

[8] Dural,M., Goksu, M.Z.L., Ozak A.A. and Baris,D. 2006. Bioaccumulation of some heavy metals in different tissues of Dicentrarchus labrax L, 1758, *Sparus aurata L*, 1758 and *Mugil cephalus L*, 1758 from the Camlik lagoon of the Eastern Cost of Mediterranean (Turkey). *Environmental Monitoring and Assessment*, 118 (1-3), pp. 65-74.

[9] Eaton AD (2005). Standard Methods for the Examination of Water and Waste Water, 21st Edn. *American Public Health Association*, Washington 21: pp343-453.

[10] Farombi, E.O., Adelowo, O.A., Ajimoko. Y.R. 2007. Biomarkers of oxidative stress and heavy metal levels as indicators of environmental pollution in African Cat fish (Clarias gariepinus) from Nigeria ogun river. *Int., J. Environ. Res. Public Health.,* 4(2), pp. 158-165.

[11] Forstuer, U. and Wittmann, G.T.W. Metal pollution in aquatic environment. *SpringerVerlag*, Berlin, Heldelberg. 1979, pp. 486.

[12] Gomez-Ariza J.L, Giraldez I, Sanchez-Rodas D, Moralesm E. 2000. Metal Sequential Extraction Procedure optimized or heavy metal polluted and iron-oxide rich sediments. *Anal Chim Acta*, 414, pp. 151-164.

[13] Karadede-Akin .H, Unlu .E (2007) Heavy metal concentrations in water, sediment, fish and some benthic organisms from Tigris River, Turkey. *Environ Monit Assess* 131, pp. 323-337.

[14] Karthikeyan, R., Vijayalakshmi, S., and Balasubramanian,T. Monthly variations of heavy metals and metal resistant bacteria from the Uppanar estuary (Southeast coast of India). *Res. J. Microbiol*, 2007, 2, pp. 50-57.

[15] M Kailasam (2004). "Effect of thermal effluent discharge on benthic fauna off Tuticorin bay, south east coast of India". *Indian Journal of Marine Science*, 33(2), pp. 194-201.

[16] Malik N. Biswas AK, Wureshi TA, Borana K, Virha R(2010).:267-Bioaccumulation of heavy metals in fish tissues of a freshwater lake of Bhopal. *Environ. Monit. Assess.* 160267.

[17] Mendil, D and Uluozlu, O.D. (2007). Determination of trace metals in sediment and five species from lakes in Tokat, Turkey. *Food Chemistry*, 101, 7396-745.

[18] Mohammed, A.A. 2009. Accumulation of Heavy Metals in Tilapia Fish *(Oreochromis niloticus)* from AL-Khadoud Spring, AL-Hassa, Saudi Arabia. *American Journal of Applied Science* 6 (12), pp. 2024-2029.

[19] Nayar. S. K. (2006). Tree canopies. Air pollution and plants. A state of the art Report. Ministry of Environment and Forests, New Delhi, India.

[20] Perkins, H., and Altens Ga, (1979). Soil Science and plant analysis 1:35, Association of official. Anal. Chem, 14th Edition.

[21] Rajendra K *et al.*(1993). "Level of trace metals (Mn,Fe,Cu and Zn) in some Indian seaweeds. *Mar,Pollut.Bull.*,5, pp. 283-285.

[22] Ramachandran, S. Marine pollution in Tamil Nadu – A status report. Proc. *Intl. Symp. Mar. Pollution*. 1990, pp. 143-150.

[23] Rejomon G., Nair M., Joseph, T, (2010), Trace metal dynamics in fishes from the southwest coast of India. *Environment Monitoring and Assessment.* Doi: 10.1007/s 10661-009- 1046-Y.

[24] S.Sadasivan and R.M.Tripathi, "Toxic and trace metal in Thane creek.Environmental Assessment division".

[25] Sankar. R., Ramkumar, L., Rajkumar, M., Jun Sun and Ananthan. G. Seasonal variations in physicochemical parameters and heavy metals in water and sediments of Uppanar estuary, Nagapattinam, India. *J. Environ. Biol.*, 2010, 31(5), pp. 681-686.

[26] Sankar. R., Ramkumar, L., Rajkumar, M., Jun Sun and Ananthan. G. Seasonal variations in physicochemical parameters and heavy metals in water and sediments of Uppanar estuary, Nagapattinam, India. *J. Environ. Biol.*, 2010, 31(5), pp. 681686.

[27] Senthilnathan, S., and Balasubramanian,T., Distribution of heavy metals in estuaries of southeast coast of India. Indian *J. Mar. Sci*, 1997, 26, pp. 9597.

[28] Snehalata Dsa *et al.*(2001). "Variation of residual mercury in penaeid prawn from Rushikulya estuary, east coast of India". *Indian Journal of Marine Science*, 30 (1), pp. 33-37.

[29] Thangaradjou *et al.*, (2009). "Heavy metal enrichment in sea grasses of Andaman islands and its implication to the health of the coastal ecosystem". *Indian Journal of Marine Science*, 32(1), pp. 85-91.