

# Seasonal Variation of Heavy Metal Distribution in Ennore Sea Shore, Chennai

Siji Thomas <sup>1</sup> and J.Abbas Mohaideen <sup>2</sup>

<sup>1</sup> Research Scholar, Sathyabama University, Chennai, India

<sup>2</sup> Principal, Maamallan Institute of Technology, Chennai, India

**Abstract.** The objective of the study is to reveal the seasonal variations of heavy metal concentrations in fish, water and sediment collected near seashore of Bay of Bengal in Ennore located in North Chennai, Tamilnadu. The concentrations of 5 heavy metals (Arsenic (As), Cadmium (Cd), Chromium (Cr), Lead (Pb) and Mercury (Hg)), were determined in water, sediment and marine species Indo-Pacific king mackerel popularly known as Spotted Seer fish (*Scomberomorus Guttus*) from Ennore in 4 different seasons. The concentrations of heavy metals in each sample were determined using AAS method. The study shows that the concentrations of most of the heavy metals in fish are higher in summer season and that in water and sediments are higher in monsoon and post-monsoon seasons respectively.

**Keywords:** Heavy metals, concentration, Atomic Absorption Spectrophotometer(AAS), Chennai, spotted seer fish, Ennore, sediment, water

## 1. Introduction

Heavy metals occur naturally in the ecosystem with large variations in concentration. Living organisms require varying amounts of "heavy metals". Iron, cobalt, copper, manganese, molybdenum, and zinc are required by humans, but excessive levels can be damaging to the organism.[1] Other heavy metals such as mercury, plutonium, and lead are toxic metals and their accumulation over time in the bodies of animals can cause serious illness. Heavy metal toxicity can result in damaged or reduced mental and central nervous function, lower energy levels, and damage to blood composition, lungs, kidneys, liver, and other vital organs. Long-term exposure may result in slowly progressing physical, muscular, and neurological degenerative processes that mimic Alzheimer's disease, Parkinson's disease, muscular dystrophy, and multiple sclerosis. Fish is a valuable food item and source of protein. The concentration of heavy metals in aquatic organisms is higher than that present in water through the effect of bio concentration and bio magnification and eventually threaten the health of human by sea food consumption [2]. Fishes are widely used as bio indicators of marine pollution by metals [3]. So determination of heavy metal concentration in fishes is very important as far as human health is concerned.

## 2. Methodology

### 2.1. Study area

The samples were collected from the fish catchment area nearby Ennore sea shore of Bay of Bengal in North Chennai, India. Ennore is situated on a peninsula and is bounded by the Korttalaiyar River, Ennore creek and the Bay of Bengal. The creek separates Ennore from the Ennore Port. Ennore creek carries high load of heavy metals. [4] [5] [6] The treated effluents of the Madras Refinery Ltd, through the Buckingham canal and the Madras Fertilizers Ltd, through the Red Hills surplus channel, reach the Ennore backwater[7] .

### 2.2. Materials and methods

The water, sediment and spotted seer fish samples were collected during the period March 2012 to February 2013 in 4 seasons; Summer, Monsoon, Post-Monsoon and Winter within 500 meters from the seashore.[8][9] The physiochemical parameters like Temperature, pH, Salinity and Dissolved oxygen are measured. The fish samples were washed thoroughly with distilled water to remove the sediments and debris. The length and weight of each sample were measured. Then the edible parts were separated and frozen at -20° for the analysis. The fish samples were thawed, and then dried in a hot air oven at 60°C. After removing the moisture content, the weight was taken again. 15 gm of fish sample was taken and the ashing was done at 500°C for 16 hours. After cooling, 2 ml of Nitric Acid (HNO<sub>3</sub>) and 10 ml of 1 molar Hydrochloric Acid (HCl) were added. After digestion, samples were filtered using Whatman filter paper No. 41, and the filtrate is made up to 25 ml with distilled water.

100 ml water sample was taken in a beaker and 0.5 ml Nitric Acid (HNO<sub>3</sub>) and 5 ml Hydrochloric Acid (HCl) were added. Then it is kept in a hot plate for digestion. After digestion, it was made up to 10 ml. Heavy Metal concentrations were determined by Atomic Absorption Spectrophotometer (AAS).

2 gm of dry sediment was taken in a digestion vessel; 10 ml of 1:1 Nitric acid (HNO<sub>3</sub>) was added and covered with watch glass. It was heated at 95±5 degree C for 10-15 min without boiling. After cooling, 5 ml concentrated HNO<sub>3</sub> was added and refluxed for 30 minutes. The step was repeated until no brown fumes come. The solution was allowed to evaporate to nearly 5 ml by heat without boiling. After the sample has cooled, 2 ml of water and 30% H<sub>2</sub>O<sub>2</sub> were added. Heated until effervescence subsides and vessel was cooled. 30 % H<sub>2</sub>O<sub>2</sub> was added in 1 ml aliquots with warming until the effervescence is minimal. The sample was covered with a ribbed watch glass and continued until the volume has been reduced to 5 ml. 10 ml HCL was added and refluxed for 15 min at 95±5 degree C. The digestate was filtered through Whatman filter paper No.41 and was collected in 100 ml standard flask. Heavy Metal concentrations were determined by Atomic Absorption Spectrophotometer (AAS) [10].

### 3. Results and Discussions

#### 3.1. Fish

The concentrations of heavy metals in spotted seer fish caught in 4 different seasons are given in table 1 and the graphical representation of the maximum concentration in Figure 1. It is observed that the maximum concentration of Arsenic (As), Cadmium (Cd), Chromium (Cr), Lead (Pb), and Mercury (Hg), are in summer (0.523 mg/kg), post-monsoon (0.441 mg/kg), monsoon (0.713 mg/kg), summer (0.722 mg/kg) and summer (0.082 mg/kg) respectively.

TABLE I. MINIMUM AND MAXIMUM CONCENTRATIONS OF H.M. IN FISH CAUGHT IN DIFFERENT SEASONS (MG/KG)

Season	As		Cd		Cr		Pb		Hg	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Summer	BDL	0.523	0.042	0.383	0.036	0.631	0.08	0.722	BDL	0.082
Monsoon	BDL	0.429	0.034	0.418	0.112	0.713	BDL	0.716	BDL	0.078
Post-Monsoon	BDL	0.247	BDL	0.441	BDL	0.463	BDL	0.375	BDL	0.06
Winter	BDL	0.304	BDL	0.364	0.035	0.605	BDL	0.524	BDL	0.063

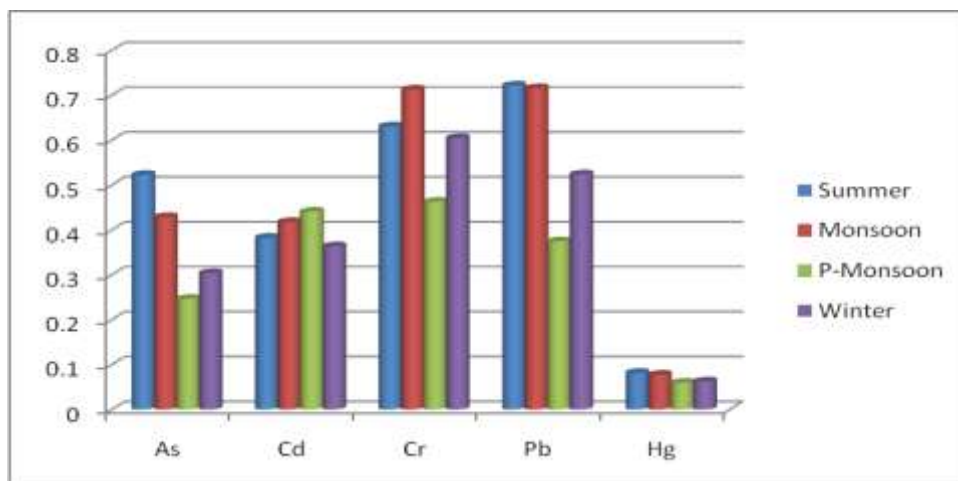


Fig 1. Maximum concentration of H.M. in fish collected in different seasons (mg/kg)

### 3.2. Water

The concentrations of heavy metals in water collected in 4 seasons are given in Table 2 and the graphical representation in Figure 2. The maximum concentration of Arsenic (0.043 mg/l) is observed in summer season. The Maximum concentration Cadmium (0.027 mg/l), Chromium (0.063 mg/l), Lead (0.015 mg/l) and Mercury (0.009 mg/l) are observed in monsoon season.

TABLE II. CONCENTRATION OF H.M. IN WATER COLLECTED IN DIFFERENT SEASONS (MG/L)

Seasons	As	Cd	Cr	Pb	Hg
Summer	0.043	0.02	0.048	0.011	0.006
Monsoon	0.034	0.027	0.063	0.015	0.009
Post-Monsoon	0.029	0.022	0.046	0.014	0.007
Winter	0.025	0.018	0.041	0.013	0.008

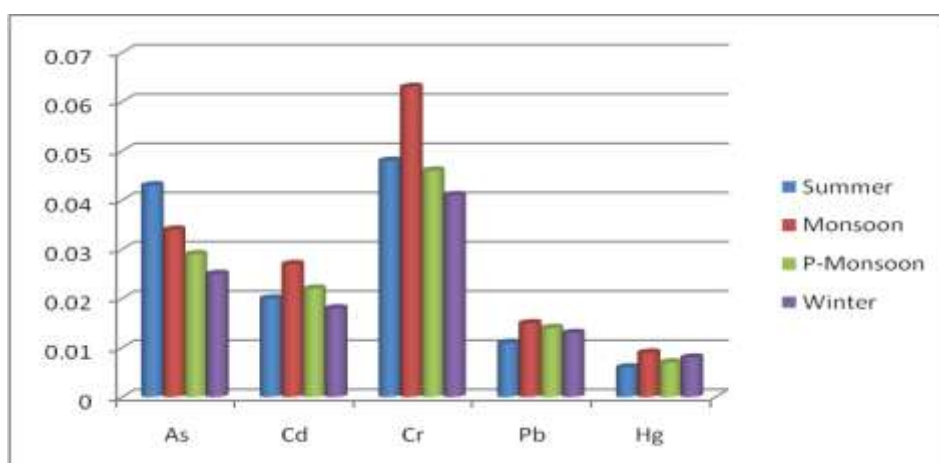


Fig 2. Concentration of H.M. in water collected in different seasons (mg/l)

### 3.3. Sediment

The concentrations of heavy metals in sediments collected in 4 seasons are given in Table 3 and the graphical representation in Figure 3. The maximum concentration of Arsenic (2.518 mg/kg), Cadmium

(1.815 mg/kg) Chromium (3.082 mg/kg) and Mercury (0.483 mg/kg) are observed in post-monsoon. Maximum concentration of Lead (1.481 mg/kg) is observed in monsoon season.

TABLE III. CONCENTRATION OF H.M. IN SEDIMENT COLLECTED IN DIFFERENT SEASONS (MG/KG)

Seasons	As	Cd	Cr	Pb	Hg
Summer	1.526	1.12	1.492	1.034	0.382
Monsoon	1.841	1.374	1.157	1.481	0.394
Post-Monsoon	2.518	1.815	3.082	1.273	0.483
Winter	1.218	1.613	1.494	1.123	0.256

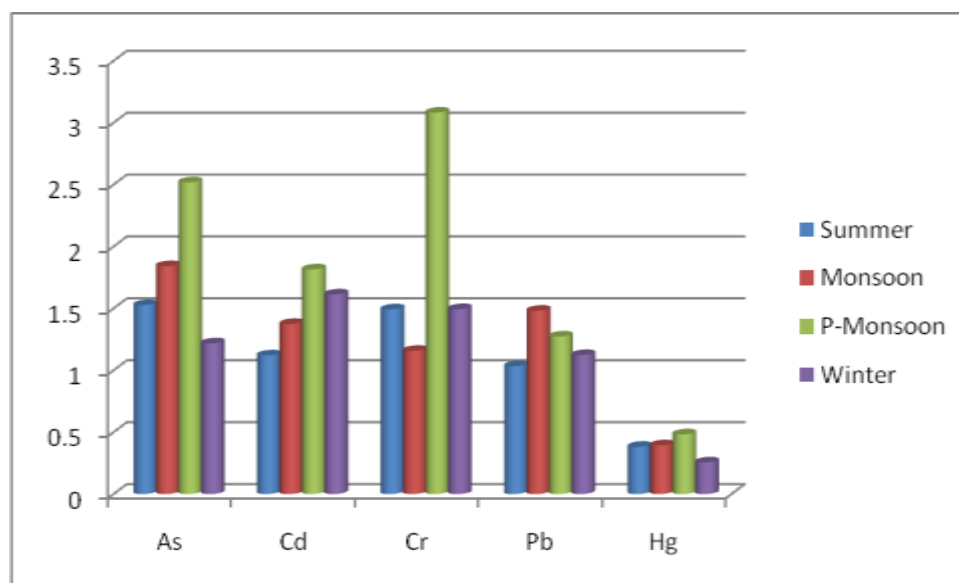


Fig 3. Concentration of H.M. in sediment collected in different seasons (mg/kg)

#### 4. Conclusion

It is observed from this study that there is no much seasonal variation in concentrations of the heavy metals in fish samples, however the concentration of some metals are higher in summer season. The concentrations of most of the heavy metals in water are observed in monsoon season. This may be mainly due to the addition of heavy metals by run off during the monsoon. The concentrations of most of the heavy metals in sediment are observed in post-monsoon season and this may be due to the settlement of H.M. from the water.

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