ACCUMULATION OF HEAVY METALS IN FEATHERS OF WESTERN REEF EGRET EGRETTA GULARIS AT MITHIVIRADI, BHAVNAGAR COAST, GUJARAT

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Abstract: Human impact on the natural environment has increased as a consequence of rising human population and technological development. Metal levels in feathers may, however, change and increase with age due to exogenous contamination. In this paper the concentrations of Lead, Cadmium and Zink is examined in the feathers of Western Reef Egrets Egretta gularis, from coastal areas of Mithiviradi, Bhavnagar. The analysis of concentration of heavy metals at Mithivirdi reveals that, in feather among all heavy metals the lowest concentration was of Zinc 0.232 ppm, while highest concentration was recorded of Lead 3.475 ppm.

Keywords: Heavy Metals, Feathers, Accumulation, Western Reef Egret.

Introduction: Human impact on the natural environment has increased as a consequence of rising human population and technological development [1]. The presence of pollutants, such as heavy metals, in the environment presents great risks for all living organisms, including humans. To detect the occurrence and the effects of heavy metals, monitoring programs, which measure the concentrations in the different compartments of the environment and in biota, have been developed [2],[3]. Because it is very difficult to assess the impact on organisms by measuring concentrations in the environment only, using biomonitors is a commonly applied method [1]. This technique makes use of living organisms to measure the concentration of pollutants and to determine their effects on organisms and ecosystems.

Metal levels in feathers may, however, change and increase with age due to exogenous contamination. Exogenous contamination onto the feather surface may be caused by atmospheric depositions and/or may originate from secretion products of the uropygial gland smeared onto the feathers during preening. In order to be able to interpret metal levels in feathers accurately, it is important to assess the level of exogenous contamination. When metal concentrations in the feather represent mainly exogenous contamination, they are likely to reflect emission rates and the atmospheric concentrations.

In this paper the concentrations of Lead, Cadmium and Zink is examined in the feathers of Western Reef Egrets *Egretta gularis*, from coastal areas of Mithiviradi, Bhavnagar. The coastline of Mithiviradi is sandy and Intertidal zone is rocky and muddy.

As a group, egrets are especially useful bioindicators because of their range in diet, range in habitats, and longevity. Moreover, some species occur over most temperate and tropical regions of the world, nesting in inland and coastal regions, along rivers, and near other large bodies of water. Cattle egrets have become nearly cosmopolitan in their nesting range [4], and they often nest near human habitations. Moreover, these egrets are non-migratory and thus reflect local exposure to contaminants.

Material and Methodology:

Study Sites: *Mithivirdi* is a Village in Talaja Taluka of Bhavnagar District. *Mithivirdi* is 46.2 km southward from Bhavnagar City. *Mithivirdi* situated between 21º24′43″ N to72º12′10″ E. *Mithivirdi* have a quite long sandy shore and intertidal zone is muddy and rocky. It is quite near from Alang ship breaking Yard but still it is a quite undisturbed area. Long sandy coastal area with muddy intertidal zone attracts so many waders. Mithivirdi is a proposed site for a one of the largest nuclear power plant by Govt. of India.

Sampling of Feather: Feather sampling was conducted every month from the study area during August'2009 to July'2011. Sampling was also carried out during Breeding Period. Moulting is a routine phenomenon in birds. The dropped feathers were easily available from the feeding and breeding sites. Collected feathers were packed in polythene bags and labeled according to site, time and date of collection etc. The collected samples were shifted to laboratory for further analysis.

Method for analysis of Cd, Pb and Zn: Feathers were washed vigorously in deionized water alternate with acetone to remove loosely adherent external contamination.

After washing the specimens were digested in a mixture of super-pure nitric acid and perchloric acid (2:1 V). The volume of the digestion mixture is 10 times the sample's mass in gm. after soaking the specimens in acid mixture overnight at room temperature; the mixture was gradually heated to 200° C in a sand bath over a period of 3 hrs. Digestion was continued until the fumes disappear and the mixture became pale yellow. Mixture was then diluted to 25 ml with double distilled water then analyzed in AAS. Blank and reference material were run with sample.

The extraction and analytical methods were modified

from US EPA procedures (EPA, 1981).

Result and Discussion: The analysis of concentration of heavy metals at Mithivirdi reveals that, in feather among all heavy metals the lowest concentration was of Zinc 0.232 ppm, while highest concentration was recorded of Lead 3.475 ppm (Table No: 01). In feathers the result of metal accumulation shows the maximum concentration was of Zink followed by Cadmium and the lowest was of Pb.

The concentration of Zinc in feather was varied from 0.232 ppm to 0.987 ppm during the study period. In feather, minimum concentration 0.232 ppm was recorded in March'2011, while maximum concentration 0.987 ppm was recorded in April'2011(Table No: 01). The mean concentration of Zinc was 0.583±0.168 and standard error of mean was 0.028. The variance was 0.028 and coefficient of variance was 0.288 (Table No: 02). Zinc is an essential heavy metal required for normal feather formation and is essential for proper body functioning and provides protection against the renal toxicity of Cd. However, the results of the current study found no correlation between these two elements. Dauwe *et al.* [5] also stated that zinc contamination between the polluted and non-polluted sites is relatively low.

The concentration of Cadmium in feather was varied from 1.124 ppm to 1.967 ppm during the study period. In feather, minimum concentration 1.124 ppm was recorded in October'2011, while maximum concentration 1.967 ppm was recorded in April'2012 (Table No: 01). The mean concentration of Cadmium was 1.465±0.200 and standard error of mean was 0.033. The variance was 0.040 and coefficient of variance was 0.136 (Table No: 02). Cadmium also tend to bio-accumulate in food chain [6]. Toxicological effects of Cd in birds have been studied by Furness [7]. Though, it is toxic above certain concentrations, Cd is not an essential element for animals and may induces deficiencies of essential elements through competition at active sites in biologically important molecules. At higher concentrations it may causes kidney damage, altered behavior, suppression of egg production, egg shell thinning, and testicular damage [7]. At the population level, reduced growth rates of bones and fledgling success were correlated with exposure to elevated Cd concentration in feathers [8]. Cadmium causes sub-lethal and behavioral effects at lower concentrations than mercury or lead [9]. Cadmium concentration above 100 ppm in kidneys has been suggested as a threshold concentration, above which Cd poisoning can be expected [7]. Burger and Gochfeld [9] considered Cd concentration of 2,000 ppb (2 µg/g) as a threshold concentration in feathers that may have adverse effect in kidneys. The mean Cd concentration measured in egret feathers in the current study was above the threshold concentration of 2 µg/g which may cause potential adverse effects in birds.

The concentration of Lead in feather was varied from 1.345 ppm to 3.475 ppm during the study period. In feather, minimum concentration 1.345 ppm was recorded in September'2009, while maximum concentration 3.475 ppm was recorded in August'2011 (Table No: 01). The mean concentration of Lead was 2.438±0.314 and standard error of mean was 0.052. The variance was 0.099 and coefficient of variance was 0.129 (Table No: 02). Lead has been known for centuries to be a cumulative metabolic poison. Acute exposure to environmental lead (as opposed to exposure to lead shot) is seldom a current issue, but continuous exposure to low concentrations is still of concern [10]. Although lead is concentrated by biota from water, there is no evidence that environmental lead is transferred through the food web [10]. Lead concentrations tend to decrease with increasing trophic level in the aquatic food base.

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Table No: 01 Heavy metals recorded in Feather of Western reef Egret at Mithivirdi (ppm)

No.	Month	Pb	Cd	Zn
1	August'09	2.452	1.343	0.462
2	September'09	**1.345**	1.243	0.522
3	October'09	2.232	1.457	0.445
4	November'09	2.343	1.234	0.745
5	December'09	2.234	1.546	0.633
6	January'10	2.343	1.324	0.754
7	February'10	2.452	1.346	0.753
8	March'10	2.465	1.462	0.755
9	April'10	2.454	1.342	0.746
10	May'10	2.452	1.346	0.644
11	June'10	2.342	1.235	0.786
12	July'10	2.232	1.643	0.475
13	August'10	2.546	1.787	0.456
14	September'10	2.623	1.346	0.653
15	October'10	2.343	1.776	0.465
16	November'10	2.987	1.754	0.754
17	December'10	2.698	1.654	0.364
18	January'11	2.743	1.568	0.454
19	February'11	2.785	1.363	0.544
20	March'11	2.322	1.454	**0.232**
21	April'11	2.343	1.685	**0.978**
22	May'11	2.345	1.343	0.574
23	June'11	2.232	1.463	0.454
24	July'11	2.456	1.463	0.744
25	August'11	**3.475**	1.345	0.568
26	September'11	2.242	1.475	0.766
27	October'11	2.354	**1.124**	0.363
28	November'11	2.243	1.234	0.856
29	December'11	2.346	1.453	0.365
No.	**Month**	**Pb**	**Cd**	**Zn**
30	January'12	2.234	1.363	0.431
31	February'12	2.678	1.874	0.522
32	March'12	2.744	1.343	0.568
33	April'12	2.342	**1.967**	0.630
34	May'12	2.564	1.684	0.342
35	June'12	2.342	1.343	0.633
36	July'12	2.440	1.352	0.543

* Bold letters shows the minimum and maximum concentration of metals during the study period

Table No: 2 Biostatistical analysis of heavy metal contamination in Feathers of Reef Egret at Mithiviradi (N=36).

No.	Heavy Metal	Min.	Max.	Range	Median	AM	Se of Am	Mode	SD	Variance	Coefficient of Variance
1	Pb	1.345	3.475	2.130	2.350	2.438	0.052	2.343	0.314	0.099	0.129
2	Cd	1.124	1.967	0.843	1.408	1.465	0.033	1.343	0.200	0.040	0.136
3	Zn	0.232	0.987	0.746	0.568	0.583	0.028	-	0.168	0.028	0.288

Min.- Minimum, Max.- Maximum, AM- Arithmetic Mean, SE of AM- Standard error of Arithmetic Mean, SD- Standard Deviation

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