

Distribution of Mercury in Some Organs of Anzali wetland Common cormorant (*Phalacrocorax carbo*)

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Abstract. A study conducted to screen mercury (Hg) level in the common cormorant (*Phalacrocorax Carbo*) of Anzali region to determine the biological behavior of this element and to assess the exposure of wild fish-eating birds, which are a bio-indicator to this pollutant. Mercury concentration was measured in liver, kidney and muscle organ. The mean concentration of mercury respectively was 8.32 ± 1.32 , 9.25 ± 1.71 and 2.064 ± 0.22 ppm in liver, kidney and muscle. Hg concentration was highest in the kidney and liver ($p < 0.01$). The amount of mercury accumulation obtained was as follows: Liver ~ Kidneys > Muscles. Hg concentration in the liver and muscle increased significantly with growth from juvenile to adult ($p < 0.05$). Comparison of Hg concentration between males and females indicated that Hg concentration in the muscle ($p < 0.05$) and kidney ($p < 0.01$) was significantly different

Keywords: Anzali, mercury, Common cormorant, liver, kidney, muscle

1. Introduction

The Increase of global mercury levels in the last decades is of concern because mercury is a persistent toxic heavy metal that both bio-accumulates and biomagnifies in wild life. Heavy metals are potentially toxic substances; their stability causes certain problems in the environment (Spalding et al., 1994). One of the outcomes is their vast biological existence in the food chain. Because of this process, the higher members of the food chain may contain higher amounts of metals several times more than the amount found in water or air. It will consequently endanger the plants and the animals that consume the food (Caldwell et al., 1999). Mercury is one of the most toxic elements in the environment, considered as the most significant among other heavy metal pollutants. Its terrible damages to humans' health and that of other creatures have already been investigated in detail. Mercury has the potential to cause many diseases and side effects in human beings directly or indirectly. It can also have toxic effects and damage on the wild life and may cause miscellaneous side effects (Boening, 2000). It has obviously been revealed that birds are quite sensitive to all pollutants and other damaging changes in the environment. The position of the carnivorous birds at the top of the food chain and their long lifespan indicate that they are more affected by the pollutants and by the changes in the various parts of the ecosystem through time (Furness and Greenwood, 1993). Among birds, fish eating birds will suffer more damages due to Hg pollution, since the toxic Hg compounds specially methyl mercury are solved in the water and taken to their food chain by planktons (Sundlof et al. 1994) revealed that the concentration of Hg in the liver of some wading birds collected from south Florida was so much that it caused some apparent nervous symptoms and some damages to their reproduction system and concluded that the reduction of some Ciconiforms in Florida might be partially due to the Hg pollution of their food resources. In another study it was noted that some of the great white herons infected by chronic

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liver and kidney diseases as a result of Hg pollution were dead and it was concluded that the Hg pollution is harmful for the wading birds' health and reproduction (Spalding et al., 1994).

Common cormorant (*Phalacrocorax Carbo*) is a species dependent on the aquatic ecosystems, which has been taken into consideration by the researchers due to its high population, its special fish eating habits and its damage to fisheries resources. The common cormorant belongs to the order Pelecaniformes, family Phalacrocoracidae and seabirds in taxonomy. Their predating position at the top of the aquatic ecosystem chain has made them sensitive to the environmental changes. The pollution and changes in climate in aquatic ecosystems, which make the habitats inappropriate to inhabit, have lead to a decrease in their population (Barati, 2003). Common cormorants live all over the world including Europe, Africa, Asia, Oceania and Northern America so that these species could be a potential global environmental monitor for toxic contaminants, such as mercury (Saeki et al., 2000). The mercury pollution has deteriorating effects on birds' breeding and survival and since these polluted birds may transfer the mercury pollution to other animals and human beings (Caldwell et al., 1999), the current study has been conducted on the amount of the mercury accumulation in common cormorants (*Phalacrocorax Carbo*). The amount of the mercury accumulation in their various organs, including liver, kidneys, muscles and feathers, was estimated and compared.

2. Materials and Methods

The Anzli region was chosen for sampling after a study on the common cormorant's biological habits and migrations that is located in 49° 25' E and 37° 28'N, in the southwest of the Caspian Sea in Iran. The sampling was done randomly in the fall-winter of 2006. Fifteen common cormorants were captured by net. The average weight and length of captured birds were 2.09 kg (1.26-2.51 kg) and 82.5 cm (71-88 cm), respectively. After collecting the samples (Table 1), they were transported to the laboratory and their biometrical measures were gathered. The growth stage of the birds was assigned based on their external characteristics such as their feather color. All the body feathers of an adult common cormorant were black, whereas a juvenile has some brown feathers among the black ones. The juvenile may also be distinguished from adults by the size of the Fabricius bile (Sacki et al., 2000). The samples were divided into two groups of the adults and the juveniles based on their physical characteristics. The birds were then stored in polyethylene bags and frozen. After being frozen, the birds were dissected and their gender was determined based on their genitals. The liver, kidneys and muscles, were dismantled and dried in the oven at 60°C for 48 hours. The samples were powdered and prepared for mercury analysis. Mercury was measured by the Mercury Analyzer Leco AMA254 at the laboratory of the Natural Resources department of Tarbiat Modares University. For the statistical analysis of the data, the SPSS program was applied performing Kruskal-Wallis, Mann-Whitney U, T-test and the Pearson Correlation.

Table 1: Gender and age of common cormorants hunted from Anzali region

Age	Gender	
	female	male
Adults	2	4
juveniles	4	5

3. Results and Discussion

The mean concentration of mercury in the liver, kidney and muscles were 8.36, 9.27 and 2.04 ppm, respectively (Table 2). There is a significant difference for concentration in the three organs (Fig. 1) and between sexes (Fig. 2). Mercury concentration in the common cormorants' tissues was as follows: Liver ~ Kidneys > Muscles. Mercury is a heavy metal that is present in the earth's crust and it is methylated by bacteria in aquatic environments to methyl mercury in anaerobic conditions (Boening, 2000). It is then concentrated by the food chain so predatory fish and other seafood animals may have the highest level (Hall et al., 1997). Today, the main source of exposure to chemical contaminants such as mercury is from methylation of inorganic mercury in bodies of fresh and ocean water (Khaniki et al., 2005). To evaluate mercury accumulation, birds are often used as a bio-indicator of mercury level in both the marine and freshwater environments.

Table 2: Mercury concentration (ppm) in studied tissues of common cormorants Fig concentration

Tissue	Hg concentration <u>Mean</u>	Hg concentration <u>Min.</u>	Hg concentration <u>Max</u>
Muscle	2.04	1.04	3.38
Liver	8.36	3.31	20.84
Kidney	9.27	3.35	23.96

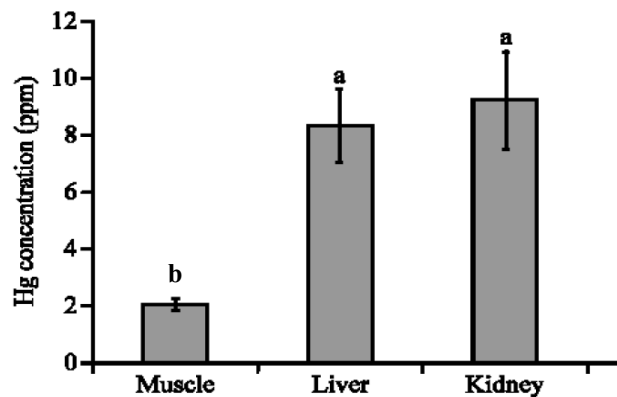


Fig. 1: The comparison of mercury concentration in muscle, liver and kidney of common cormorants (The different alphabet indicates significant differences at 99%)

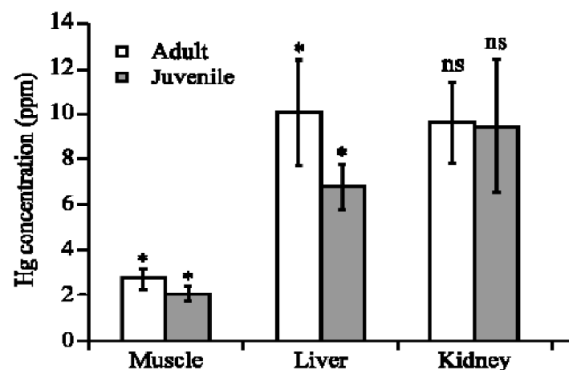


Fig. 2: The comparison of mercury concentration in muscle, liver and kidney between male adult and male juvenile cormorants, *significant difference of 95%, **significant difference of 99%, ns: No significant difference of 95%

(Evers et al., 2003; Cohen et al., 2000, Rumbold et al., 2001; Henny et al., 2002; Evers et al., 2005). Based on the findings in this study, the maximum mercury concentration in the common cormorants' organs was found in the liver and the kidneys. In a similar study estimation of the mercury and cadmium concentration in the common cormorants (*Phalacrocorax Carbo*) gathered from the Biwa and the Tokyo lakes in Japan (Saeki et al., 2000), revealed the maximum mercury concentration in the liver and the kidneys. Another researcher also showed that the highest concentration of methyl mercury is in the liver of sea bird species (Kim et al., 1996). In the present study, the mercury concentration in the males' muscles ($p < 0.05$) and kidneys ($p < 0.01$) was significantly higher than that of the females. This might be due to some defensive mechanism in the female such as laying eggs. Mercury concentration in the liver and muscles of the adult cormorants is significantly higher than that of the juvenile cormorants ($p < 0.05$) that indicated more exposure of adult birds to mercury.

In another study, determination of the mercury concentration in the liver of seven species of the wading birds in Southern Florida revealed that mercury concentration in the adults' livers was three times more than that of the chicks (Sundlof et al., 1994). The mercury concentration significantly increased as the birds grew up (from a chick into an adult) in all tissues except for the brain (Saeki et al., 2000). It obviously indicates

that the mercury is accumulated in the body as the birds grow up and feed. In marine mammals, it has been revealed that the amount of the mercury in their body increases as they grow older (Denton et al., 1980, Honda et al., 1986). Similarly, some other researchers have also reported that the mercury concentration in adult birds is higher than juvenile birds. In fact, nutritionally, mercury is a non-essential element in the body and has such a long biological half-life that it accumulates in the body with age and with increasing levels of exposure to the environment (Solonen and Lodenius, 1990). Although we must note that birds are equipped with a molting system for mercury removal (Saeki et al., 2000).

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5. References

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