Assessment of heavy metal concentration of two species of birds in Hor Al-Dalmaj, Southern Iraq

Ahmed Alaa kando1, Salwan Ali Abed 2 and Mudhafat A. Salim

1, 2 College of Science, University of Al-Qadisiyah, P.O. Box. 1895, Iraq
3 Arab Regional center for World Heritage, Bahrain
Salwan.abed@qu.edu.iq

Abstract

The study was carried out on Hor Al-Dalmaj in Al-Diwaniyah Governorate, this study included assessing the concentration of heavy elements (lead, cadmium and copper) in two types of birds, swamphens and moorhen (Gallinula chloropus and Porphyrio alleni). The results of measurement of the concentration of heavy elements are shown, the highest average concentration of elemental Lead in the bird samples it was 233.8 ppm in Liver samples of Gallinula chloropus during the summer season. For Cadmium concentrations, the highest concentration for bird samples the highest concentration reached 2.316 ppm in the muscles of a bird Porphyrio alleni during the winter season. The concentration of the copper element reached the highest significant concentration in birds reached 37.7 ppm in the muscles Porphyrio alleni during the summer season.

Introduction

Al-Dalmaj marsh is one of the ecologically significant marsh and the notable and the minimal studied in the Middle Euphrates, it is of huge importance at the national, regional and international levels, as the region is characterized by many advantages that make it unique and distinct from the environmental and recreational perspectives, despite the environmental importance of the Hor Al-Dalmaj region, It is exposed to several acute pressures and threats such as poor management of the hydrological planner, agricultural expansion, pollution and habitat demolition (Kadhum et al., 2018). Heavy metals play an important function in the life of living things and their different biological activities, even if they are in low concentrations, and the increase in the concentrations of these elements or their decrease below specific limits lead to physical damage or the death of living organisms, for example, zinc, copper and iron have enzymatic functions in cell metabolism, so iron has Known importance in the composition of blood as it enters the formation of hemoglobin (hemoglobin) and also enters in the synthesis of enzymes, and the elements of manganese, zinc and copper are enzyme catalysts, but they are toxic and dangerous in high concentrations although they are necessary for life in very low concentrations that may not exceed 0.05 mg / L, and any component may be of physiological importance to organisms at specific concentrations (Markert and Oehlmann, 1998). Pollution of the water environment with heavy elements results from its natural sources in the environment and from various human activities (Behra et al., 2002). The aquatic environment may be
polluted with heavy elements as a result of agricultural residues, such as the use of mercur y in fogging grains in the form of acetate mercury, human activities, port activities, wastewater discharged into the water, or from gold extraction and mining (Lau et al., 1995 and Soliman et al., 1998). What excess the risk of heavy elements in the environment is the disability to demolish them by bacteria and other natural processes, as well as their constancy that enables them to diffusion far distances from their sources, and perhaps the most dangerous thing in them is due to the capability of some of them to bio-accumulation in the tissues and organs of living things (Al-Saadi, 2002).

The current study aims to Assessment of the environmental reality in Hor Al-Dalmaj, via Detecting the concentrations of some heavy elements in tow species of birds in Al-Hor Al-Dalmaj.

Materials and Methods
Description of the study area and stations
The study area, illustrated in Figure (1), located between Wasit and Diwaniyah governorates, is a wet swamp area, and its water is stagnant or slowflowing, and some strategic crops such as wheat, barley, corn and sunflower are grown in it, as the source of irrigation is the third river, which is water Salty, as it includes many natural plants that grow in abundance, such as reeds, golan, shimplan, homera and sedge, and the region also has a weight in raising buffaloes, so it has economic importance as buffaloes are released there without supervision, in order to graze on the grass that is there, and there are many breeders Camels detecting the concentrations of some heavy elements (lead, cadmium and copper), during the summer and winter seasons two types of birds swamphens and moorhen (Gallinula chloropus and Porphyrio alleni).

Fig (1) :Study area and site distribution
Collecting bird samples

The studied birds (Gallinula chloropus and Porphyrio alleni) were collected from hunters, where the adult birds were taken and the feathers were removed, then the flesh was separated and the required parts were taken for examination (liver and muscles) and mashed by hand mortar each separately, then the analysis samples were taken and kept in paper Aluminum is marked and preserved at -20 °C until extraction and analysis (Paruk et al., 2014).

Extraction of Bird Samples

Extraction was done according to the following method (Mittendorf et al., 2010):

**Heavy metals measurement**

Conducting the measurement of the proportions of heavy elements in birds by taking the necessary steps for measurement with the Flame Atomic Absorption Spectrophotometer, depending on (Haswell, 1991), as follows:

1. A quantity of pre-prepared samples was taken and placed in a watch bottle in an electric oven at 105 °C until dehydration.
2. two gm of the dry form was taken in glass beakers, and 40 ml of concentrated nitric acid HNO₃ (70%) was added to it to carry out the digestion process and left the form covered with an hour bottle for a day.
3. The sample was heated using a hotplate at a temperature of 60 °C until the sample was melted.
4. After letting the model cool down, 3 ml of pyrochloric acid HClO₄ (60%) was added and the heating process was repeated at a low temperature of 40 °C until it dried.
5. The sample was lifted from the hot plate and then it was cooled. 3 ml of HCl and 3 ml of distilled water were added to it and returned to the preheater at a low temperature for the purpose of dissolving the sediments.
6. Whatman 0.45 filter paper was filtered and the resulting solution was placed in a 50 mL glass volumetric flask and complete the volume with distilled water to the mark.
7. The Blank reference solutions were prepared in the same way, without using a sample.
8. Standard element solutions are dispensed by Fluka.
9. The element concentrations in the models were estimated with the English made Flame Atomic Absorption Spectrometry Buck 210 VGP.

Results and discussion

**Lead concentration Pb (ppm).**

For the concentration of lead in the bird samples, it appears from the figure (2) that the liver samples of Gallinula chloropus during the summer season recorded the highest means significantly with a concentration of 223.11 ppm, while the muscle samples in Porphyrio alleni birds achieved the lowest average of the lead concentration, reaching 0.014 ppm.
Frantz et al. (2012) and Gushit et al. (2016) reported that some bird species have the ability to accumulate heavy elements in feathers and then discard them during periods of molting. An assessment was conducted in the Danube Delta Biosphere Reserve to detect heavy metal remains in the feathers of the native wild bird species that depend on wetlands for all or part of their life cycle which are iron ducks, white stork, common little stork, great white heron, great white swan, the dwarf cormorant, common tern and western Marsh-harrier were found to have lead element concentrations between 3.474 ppm in Western Marsh-harrier and 0.426 ppm (iron duck), while the other studied species were at concentrations of 0.9 ppm (Marinov et al., 2019).

![Figure (2): Means of lead concentrations in bird samples during summer and winter seasons (ppm).](image)

The values attend by the identical letter dont diverge significantly from each other according to the Duncan Multiple –Range- Test (Pr≤0.05).

**Cadmium Concentration Cd (ppm)**

bird samples, figure (3) shows that the highest concentration of cadmium was recorded in the muscles of *Porphyrio alleni* during the winter season, as it reached 2.316 ppm, with a obvious difference from the averages of the rest of the models, while the liver samples for the same bird and during the winter season also recorded the lowest average, which reached 0.013 ppm. Pakusina et al. (2018) in their evaluation study of the Gilchlin River in Russia for the period 2014-2015 that the highest concentration of cadmium was 0.1 ppm in samples of *Anas crecca*. 
Figure (3): Means of cadmium concentrations in bird samples during summer and winter seasons (ppm).

The values attend by the identical letter don’t diverge significantly from each other according to the Duncan Multiple Range Test (Pr≤0.05).

**Copper Concentration Cu (ppm)**

Figure (4) shows the copper element concentrations in the studied bird samples in Al-Dalmaj marsh during the summer and winter seasons. The highest concentration was 37.7 ppm in *Porphyrio alleni* muscles during the summer season, with a significant difference from the rest of the averages, while the muscles of *Gallinula chloropus* achieved the lowest concentration, which reached 3.402 ppm.

Waterfowl are the effective custodians of pollution in aquatic environments, and their feathers are a wide range used as non-destructive biological instruments for vital monitoring of pollutants. The condensation of lead, copper, and zinc in bird feathers were measured and evaluated for three species, *Fulica atra*, *Anas crecca* and *Anas platyrhynchos* in the wetland National Park Boujagh. Levels of lead (Pb) and Copper (Copper) were below the threshold causing near-lethal and sexual effects. Significant differences were found in metal concentrations between bird species, and the results indicated that the greatest condensation of lead and zinc were noted in the common Coot. The effect of sex on heavy metals in lead was noticed in *Anas platyrhynchos* while copper in *Anas crecca*. Mineral concentrations were significantly higher (P <0.05) in resident birds than in migratory birds. High standards of these heavy metals show that these birds can be used to detect pollution in wetlands (Solgi et al., 2020). The recording of bird samples with the highest concentrations of heavy elements may be attributed to their being higher in the food chain, as they feed on plants and fish together, which leads to an increase in the concentrations of these elements.
Figure (4): Means of copper concentrations in bird samples during summer and winter seasons (ppm).

The values attend by the identical letter dont diverge significantly from each other according to the Duncan Multiple Range Test (Pr≤0.05).

**Conclusions**

The results of detection of heavy elements in bird samples gave significant concentrations. The causes of pollution are due to the population groups and different agricultural practices. It was found that the element lead is the highest among the measured elements , and it is one of the most toxic elements and has direct effect on living organisms . During this study and compared to other local and global regions, found a remarkable increase in measurements that may pose a great threat to the biological diversity and the functions of living organisms.

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