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Detection of Cadmium and lead metals contamination in the water and Liza Abu fish of Al- Delmj marsh

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Abstract

Samples were taken from the center of the AL-Dalamj Marsh using 10 various locations and techniques. Three components from the sample were tested: liver, gills and muscles). Together with the fishers, the combustion of fossil fuels and gasoline, refuse incinerators, mining, and volcanic eruption and weathering of metal-bearing rocks, among other things. These heavy metals' mobilization into the aquatic ecosystem changes the physicochemical characteristics of water, making it dangerous for aquatic life, Heavy metals primarily enter fish bodies through the gills, body surface, and digestive system when they consume food that has accumulated metals. According to the results of the current research, the concentration of cadmium (Cd) in the organs of Liza Abu fish was considerably higher than its seasonal mean, reaching (0.226 µg/gm) and second (0.33 µg/gm), respectively, while the fish's seasonal mean declined in the first season. Regarding the lead element (Pb), the research revealed that Liza Abu fish's organs had mean concentrations of Pb that were significantly higher than their mean concentrations during the first season (12.936 µg/gm), while their mean concentrations decreased during the second season (6.43 µg/gm). According to the findings of the analysis of the water samples, the highest mean Pb concentrations were found during the second season of the study (0.061 µg/gm), and the highest mean Cd concentrations were found during the first season of the study (0.016 µg/gm).The research found that the Dalmaj Marsh's fish were contaminated with heavy metals of all kinds and that their levels were higher than those recommended by public health organizations. According to the World Health Organization in 2003 (WHO), the percentage of cadmium in the water is (0.003µg/gm) and in fish is (0.5 µg/gm), whereas the percentage of lead in the water is (0.001 µg/gm) and in fish is (2.0 µg/gm), which calls for significant attention to the aquatic environment and support for that significant productive sector.

Keyword: Fish, Heavy metal, Contamination, Liza Abu, Lead, Cadmium

Introduction

Due to Iraq's relatively mild climate, abundant water environment, and wide variety of fish, fish wealth is a significant source of food security in the majority of nations around the globe. For this reason, the current study clarifies the extent to which fish are impacted by environmental pollutants resulting from industries, such as heavy metals, because of their detrimental effects on fish and Human health, and increasing knowledge of the extent of pollution of the water environment in AL-dalmaj marshes (1). Fish contains vitamins D and minerals like iodine and phosphorus. Fatty fish contains a lot of omega-3 polyunsaturated fatty acids, which can

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reduce "bad" (LDL) cholesterol by lowering levels of triglycerides and other compounds that are beneficial for fish. The two omega-3 fatty acids docosahexaenoic and eicosatetraenoic acids are the most significant cardiovascular disease preventive factors and crucial elements of a human diet (2). It is a worldwide concern because heavy metals can build up inside the bodies of aquatic organisms like fish. Because the levels of heavy metals in the environment, particularly in aquatic ecosystems, have been steadily rising at an alarming rate over the past few decades as a result of industry development, the rising concentration of heavy metals along the food chain poses a threat to both human health and the environment. A variety of environmental variables, such as temperature, pH, salinity, and others, influence bioaccumulation in fish tissues because it is now a significant regional and global problem (3). Heavy metals play an important role in life interactions; they accumulate in the organs of living organisms and have an impact on their function because they are not decomposed or susceptible to the environment in the natural cycle. This tendency of these elements to accumulate, especially in soft and hard tissues such as muscles and liver, has attracted attention in many parts of the world (4) Examples of natural sources of heavy elements include erosive processes, heavy rainfall, storms, and fires. Human sources, on the other hand, include everything human involvement in its makeup, such as waste. Heavy metals from fertilizers and pesticides used on rubber, textiles, and domestic waste that enters the water through sewers (5) . Heavy metals can build up in soil, human, and animal tissues as a result of accidents or inappropriate handling, as well as inhalation and absorption in some circumstances. Since the earth's creation, heavy metals have been prevalent through regular biogeochemical cycles (6). The varying living environments, feeding habits, and nutritional states of aquatic creatures contribute to their varying levels of heavy metal deposition. (7)(8). Numerous industries, such as those that produce pharmaceuticals, paper, preservatives, and agricultural products, as well as those that use caustic soda and chlorine, release mercury (Hg) into the atmosphere (9). Rocks and earth, including coal and mineral fertilizers, contain cadmium, which is frequently used in electroplating for a variety of purposes, including batteries, dyes, fabrics, and metallic coatings (10). The increase in environmental contamination with heavy metals can be attributed to these habits taken as a whole.

Methods

Gathering sample data

A. Fish samples: 50 Samples of Liza Abu io fish were taken during two separate seasons, the first of which lasted from October 21 to December 15, 2021, and the second of which lasted from April 25 to June 30, 2022. From the center of the AL-Dalamj Marsh, samples were taken from 10 different locations and methods. Testing was done on three components from each sample, which are (liver, gills and muscles). In conjunction with the fisherman, it was decided upon by the marsh's officials to take samples at several locations throughout the marsh

Preparation of fish samples

- The samples are washed and dried
- Weigh one gram of the dry sample
- Add HNO 3 (20 ml) then leave it overnight

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- Heat the sample of 5 ml of Perchloric acid then digest the samples near dryness
- Add an amount of distilled water
- Filter the samples then complete the volume to (25 ml) of Distilled water
- We put the samples in the atomic spectrometer, and the heavy elements are measured

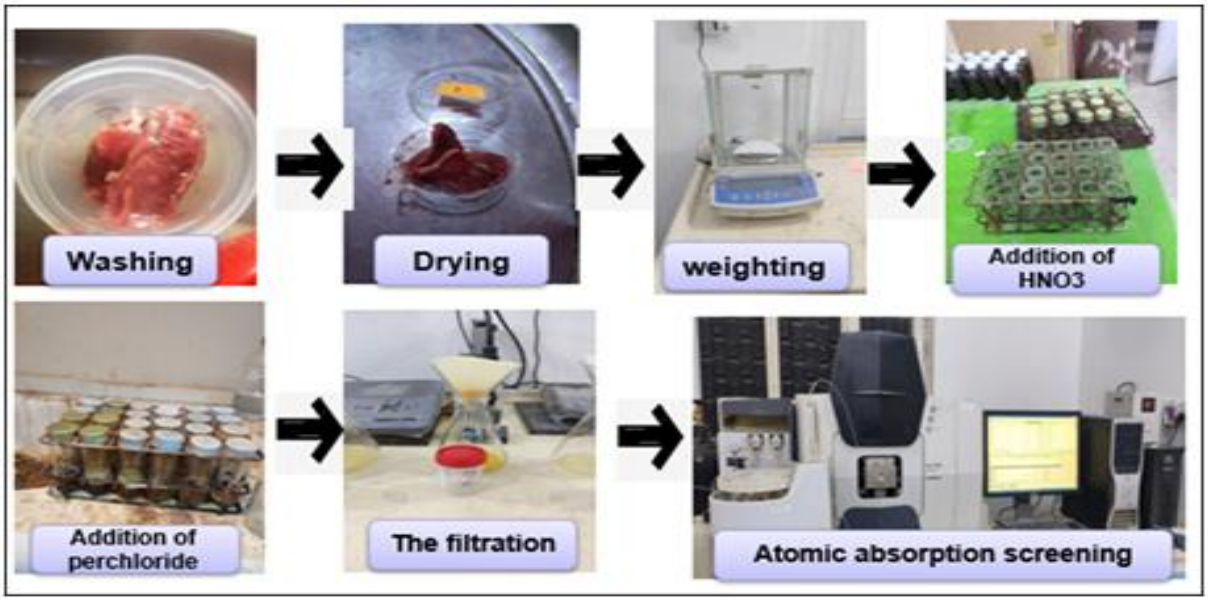

Figure (1) Displays the three components (liver, gills, and muscles) of the aforementioned fish samples

Figure (2): site of water samples

Water samples:

Fifty samples were taken each season. To determine the amount of heavy metals in the water, samples were taken 30 cm below the surface. Five-liter polyethylene bottles were utilized, and the bottles were rinsed with diluted hydrochloric acid (10%) and then washed with distilled water using clear and opaque 250-liter bottles (Winkler bottles).

Extraction of heavy metals from fish tissue:

Dry tissue samples of the liver, muscles, and gills were weighed to yield a weight of 1 gm. Overnight, 20ml of concentrated nitric acid was added. The samples were heated to (80 ^{o}C), and then (4 ml) of concentrated perchloric acid and hydrofluoric acid were added in a ratio of 1:1. (1:1). Before adding distilled water the digestion was finshed to the point of dehydration. After being treated with distilled water, the sample was weighed to (25 ml) (11).

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Extraction of heavy metals from water

After the sample had dried out in 1 liter of water at 80 degrees Celsius, it was digested by adding 6 ml of strong hydrochloric acid and 1:1 nitric acid. It was heated to (80 °C) and nearly dried off before receiving (4 ml) of a concentrated pro chloric and hydrofluoric acid combination in a 1:1 ratio. A near-dry phase of the solution was achieved through evaporation, and the precipitate was then dissolved in 20 ml of diluted (0.5) hydrochloric acid and allowed to sit for ten minutes. Centrifugation was used to separate the sample for 20/3000 rpm. The solution was drawn out and put into a volumetric vial (25 ml) In order to measure the samples with a Flame Atomic Absorption Spectrophotometer and express the results in g/g dry weight, the samples were maintained in polyethylene vials.

Dimensions of Large Items

Using a Flame Atomic Absorption model, heavy metals in the extracted samples were assessed (ASc, 7000-AA S). Once the standard solutions (solutions Standard) for the items under examination had been created using the techniques described in (13).

Calculation of heavy metals concentrations in fish tissues

$$E\ con = \frac{A \times B \times df}{D}$$

E con = the sample's elemental content, expressed as a dry weight concentration of (µg/g).

A= element's concentration (in mg/L) as determined by the calibration curve.

df = Dilution factor

D= Dry Weight of sample

Calculation of heavy metals concentrations in Water

$$E\ con = \frac{A \times B}{C} \times 1000$$

E con = the sample's elemental content, expressed as a dry weight concentration of (µg/g).

A= element's concentration (in mg/L) as determined by the calibration curve.

B= The filter sample's final volume (ml).

C=Filter sample initial volume (ml).

Statistical analysis: Statistical Analysis System version (SPSS) was used to do the data analysis. For identifying the significant differences between the two groups, one- and two-way ANOVA, least significant differences (LSD), and unpaired T-test were utilized. $p < 0.05$. (14).

Ethical approval: The researchers obtained ethical approval from the research Ethical Approval Committee of the College of Veterinary Medicine, University of Al-Qadisiyah.

Results

Comparisons between concentrations of heavy metals according to seasonal variations

Result of Cd contamination:

The findings of the current work revealed that the concentration of Cd was the highest value of cadmium was for Liza Abu in the first season (0.34 µg/gm) and the lowest percentage was (0.06 µg/gm). In the second season the highest percentage was (0.39 µg/gm), and the lowest percentage (0.21 µg/gm)

Result of Pb contamination:

The findings of the current work revealed that the concentration of Pb highest value of lead was for Liza Abu in the first season (17.33 µg/gm) and the lowest percentage was (8.38 µg/gm). In the second season the highest percentage was

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(7.91µg/gm), and the lowest percentage (0.74 µg/gm).

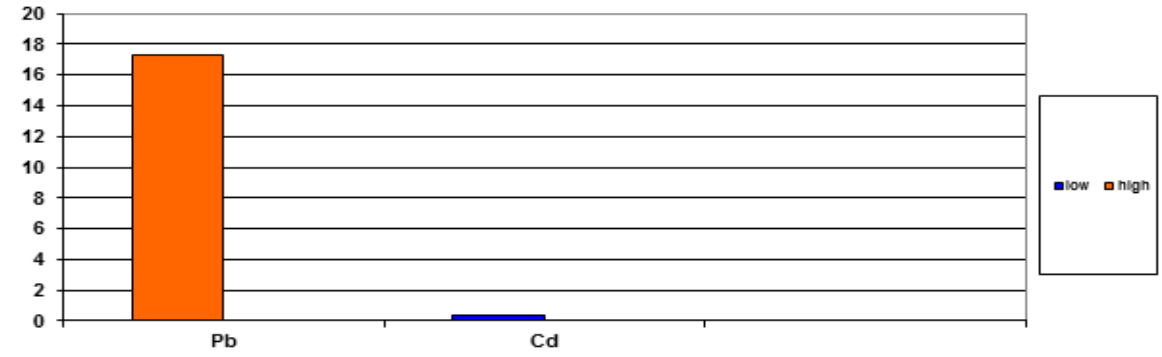
Table (1): Concentration of Pb and Cd in different organs

Liza Abu	Organs	First season	Mean	Second season	Mean
Concentration of Pb (µg/gm)ppm	Liver	17.33±7.56a	12.936	4.65±1.71Ab	6.43
	Gills	15.75±8.01a		8.38±2.23b	
	Muscles	5.73±2.11a		0.74±0.36a	
Concentration of Cd (µg/gm)ppm	Liver	0.34±0.24a	0.226	0.21±0.08a	0.33
	Gills	0.28±0.23a		0.39±0.16a	
	Muscles	0.06±0.06a		0.39±0.11b	

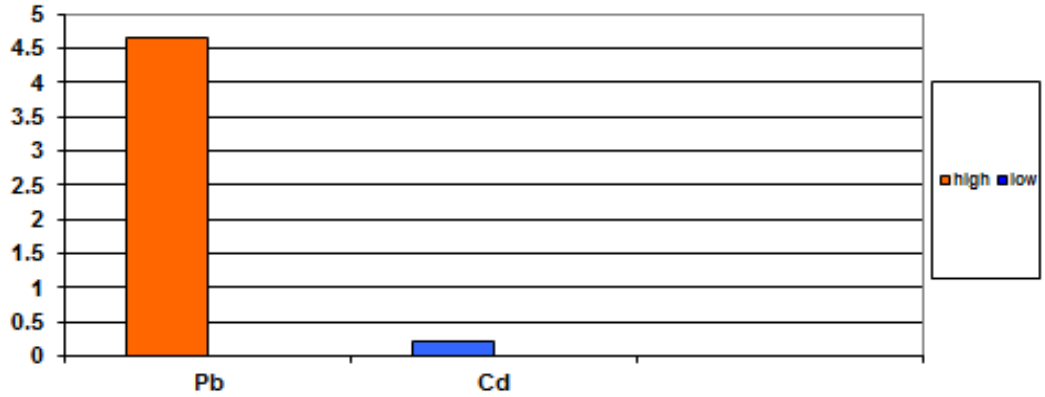
Comparisons between concentrations of heavy metals according to body organs

1-Liver

For the Cd, the 1st season based on the liver samples from the Liza Abu fish revealed potentially (p<0.05) higher levels (0.34±0.24 µg/gm), the 2nd season according to the liver samples from the Liza Abu fish demonstrated potentially (p<0.05) lower concentrations (0.21±0.08 µg/gm). For Pb, the 1st season for the liver samples from the Liza Abu fish uncovered potentially (p<0.05) higher concentrations (17.33±7.56 µg/gm), Moreover, the 2nd season for the liver samples from the fish detected significantly (p<0.05) higher levels of Liza Abu (4.65±1.71 µg/gm).



first season



Second season

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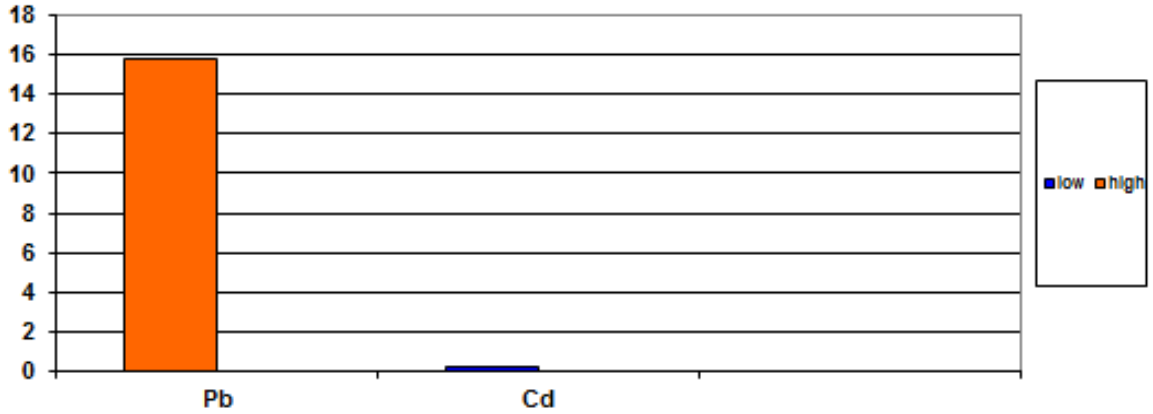
Figure (3): Levels of metals in the Liver of Liza Abu

2- **Gills**

In the case of Cd, the 1st season based on the gill samples from the carp fish revealed that the were slightly higher than in the second season, as they were in the first season (0.28±0.23µg/gm) and in the second) 0.39±0.16µg/gm (season For Pb, the 1st season for the gill samples from the Carp fish uncovered It was found that the levels were slightly lower than in the second season, as they were in the first season (5.73±2.11a) and in the second season(0.74±0.36µg/gm)



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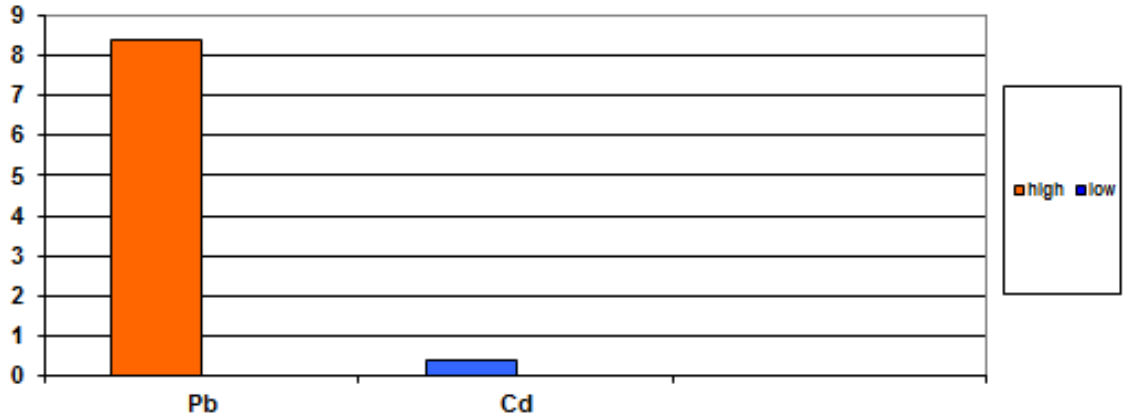

Second season

Figure (4): Levels of metals in the Gills of Liza Abu

3- **Muscles**

In the case of Cd, the 1st season based on the gill samples from the carp fish revealed that the levels were slightly lower than in the second, as they were in the first season (0.06±0.06 µg/gm) and in the second season (0.39±0.11 µg/gm).For Pb, the 1st season for the liver samples from the Carp fish uncovered It was found It was found that the levels were significantly higher than in the second season, as they were in the first season (5.73±2.1 µg/gm 1) and in the second season (0.74±0.36 µg/gm).

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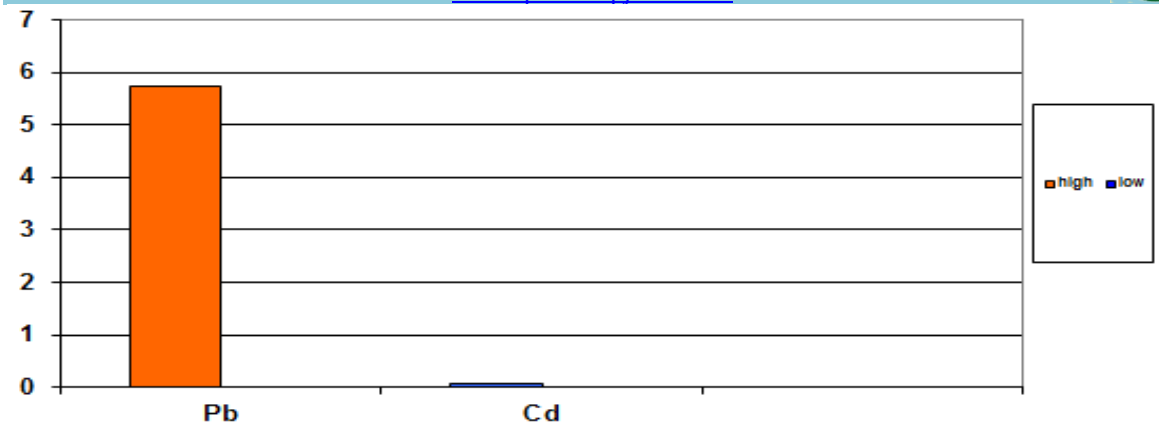
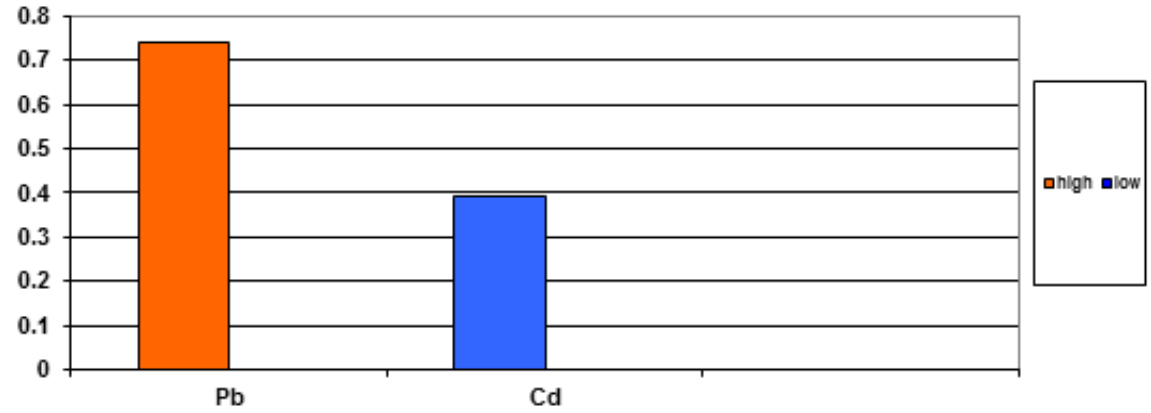


first season



Second season

Figure (5): Levels of metals in the Muscles of Liza Abu

Concentrations of heavy metals in water

The levels of Cd, and Pb in the marsh water where several fish species were retrieved and looked at in sample were found that the highest value of water was in the element lead (0.039) and the lowest percentage was in the element cadmium (0.015), that the concentrations of these heavy metals in the water were (0.0160.002 and 0.0140.004g/gm), (0.0350.01 and 0.0740.04g/gm), and (0.0160.01 and 0.0610.04g/gm), for the Cd, There were no significant (p0.05) variations in the Cd concentration (0.0140.004g/gm) during the second season and that (0.0160.002g/gm) during the first season. When compared to the concentrations in the water from the first season, the second season showed potentially (p0.05) greater values for Pb. The levels of heavy metals in the marsh water where the collected samples of the fish species under study were taken are shown in

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Tables (2) Concentration of heavy metals in marsh water.

Water	Concentration (µg/gm)		Mean	LSD
	First season	Second season		
Cd	0.016±0.002a	0.014±0.004a	0.015	0.031
Pb	0.016±0.01a	0.061±0.04b	0.039	

Discussion

Cd is one of the most toxic substances to living things, including fish. It is a non-essential component that has the ability to have a long-lasting negative impact even at low concentrations (8[b])According to the current study, Cd levels changed between the first and second seasons. This backs up previous literature that made the same point. High cadmium levels were discovered in the spring and summer, which were accompanied by a period of exceptionally high temperatures (mean of 35°C). The amounts of cadmium then dropped below the detection threshold of the analysis technique. Two temperature-related mechanisms that lead to cadmium bioaccumulation are alterations in muscle homeostasis and a rise in the concentration of cadmium in metallothionein-like proteins (15) It is likely that cadmium concentrations did not go above the maximum permissible limits of 1-50 g/kg set by the World Health Organization (16), given that cadmium buildup mostly takes place in the liver and kidney. The highest cadmium accumulation standards set by the WHO, however, were surpassed by some of the amounts discovered during the spring and summer. The levels were higher in the dry season, but the bioavailability of cadmium decreased during the wet season due to increased oxygenation and the abundance of organic and inorganic particles (17). The current investigation's findings also indicated that Pb might accumulate in fish organs differently depending on the season. Our results demonstrate that Cd and Pb concentrations differ considerably across seasons, indicating that human activities, including industrialization, are to blame for the collapse of these natural ecosystems, according to Rajeshkumar et al. (8). Our findings show that Cd and Pb concentrations vary significantly throughout seasons, Therefore, it is becoming evident that human activities, including industrialization, are to blame for the collapse of these natural ecosystems (18) as mentioned by Hashim et al. (19) during a study to identify the amounts of cadmium, nickel, and lead found in the bodies of fish caught in a Malaysian river. Gill nets were used to capture fish during the dry and wet seasons. There were 78 different fish, divided into 13 separate types. using a graphite furnace and an atomic absorption spectrometer to analyze the musculature The critical threshold limits set by the EC, WHO, and FAO were considerably exceeded by the average Cd level found in Chitala chitala (0.076 mg/kg). In comparison to the other species, Barbonymus gonionatus and Tachysurus maculatus had mean Cd amounts that were only marginally alarming. No fish samples had Ni concentrations above the 0.5–0.6 mg/kg WHO recommended limit. Osteochilus hasseltii (0.169 mg/kg) and T. maculatus (0.156 mg/kg) have extremely high Lead concentrations. Fish that eat everything had the greatest concentrations of Cd and Ni, while fish that are carnivorous had the highest levels of Pb. It

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was discovered that the amounts of heavy metals were significantly higher during the wet season. Fish weight and Cd and Pb tissue values showed a significant favorable correlation. cadmium has been found in the body's tissues and systems ,Dietary cadmium had an impact on the elevated tissue concentration The liver recorded the highest levels of cadmium, followed by the gills and the muscles, according to earlier research. Concentrations have been seen to rise directly in relation to the quantity of cadmium present in the animal's food or water supply as well as the length of time the animal was exposed to the pollutant, The amount of cadmium buildup also differs based on the organ, according to research. The stomach accumulated the most Cd, followed by the kidney, liver, gills, and muscles, according to Ng and Wood when rainbow trout, Oncorhynchus mykiss, were given the oligochaete, Lumbriculus variegatus, and exposed to various levels of Cd in the water (2008). (20). The mass balance between a substance's ingestion through food or water, elimination through feces or pseudo-feces, and preservation through physiological processes—including some that are thought to be protective detoxifying processes involving thiol molecules like metallothionein and glutathione—determines the residual content of a substance in all tissues (21). The bulk of heavy metals are absorbed by these organs. As a result of ingesting heavy metals through the gills, the lamella, which is engaged in the ion transfer process during osmoregulation, may suffer damage. Metals have been connected to negative impacts like the development of filament epithelium, lamellar fusion, and epithelial necrosis, claim Fonseca et al. (22), Since aquatic life frequently comes in touch with contaminated water bioaccumulation of heavy metals is used to assess the environmental situation. Metal concentrations in fish tissues are reliable markers of aquatic system metal pollution. Algae , that concentrates heavy metals, is consumed by both herbivorous and omnivorous fish (23), According to reports, the winter Cd content in the Korotoa River was 11 g/L and the summer Cd concentration was 8 g/L. (24). Ahmad et al. calculated that the Cd concentration in the water of the Buriganaga River was 9.34 g/L. (25). Numerous authors have demonstrated that the concentrations of cadmium in water decrease following a wet season. Rain and runoff's dilution effects were just one of the elements contributing to this occurrence. Reservoirs are able to hold a lot more water than normal during the rainy season. The amount of lake pollution brought on by priority chemicals is assessed as part of the government program "Monitoring of Surface Waters." Lead, cadmium, or nickel were never found in any reservoirs in the research in excess of the allowed limits. It emerges from the literature review that Gwodziski (26), analyzed the water quality of unscreened lakes in Bory Tucholskie, close to the park's southern perimeter, found identical Pb and Cd values in their samples as were reported in the studied waterways. When compared to the levels of heavy metals found in the water of the lakes Miedwie and Dbie in North-weste Poland, the values from the present study were significantly lower. (26)**.**We conclude from the findings that the summer season had a higher concentration of heavy metals than the winter season in all types of fish studied, almost all in water samples.

Conclusions

We conclude from the findings that the summer season had a higher concentration of heavy metals than the

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winter season in all types of fish studied, almost all in water samples.

Conflict of Interest: there is no conflict of interest.

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