Study Of Morphometric Characters And Heavy Metals Detection In Knifefish (Notopterous Notopterous) Sampled From River Ravi, Pakistan

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Abstract:
Background: *Notopterous notopterous* belongs to catfishes and are 2nd main group of freshwater fishes. **Objectives:** To measure morphometric characters and heavy metals in fish from River Ravi.
Methodology: Morphometric measurements was made by measurement tape and weight was calculated by digital balance. Heavy metals detection was also studied.
Results: It was found that, fish weight was 105.85±26.620 g, length with tail 21.03±1.60 cm, length without tail 19.30±1.5 cm. The distance in eyes was 1.47±0.30 cm, in nostrils 0.7±0.09 cm. Mandibles length was 2.59±0.30 cm, and maxilla 3.21±0.19 cm, diameter of eye 0.97±0.08 cm. Length of fins was also compared. The number of rays of different fins was also seen. The relationship between length and weight was discovered to be non-linear, and development was allometric. The concentration of Cd was more in Liver, Cr was more in Liver, Cu was more in Liver and Pb was more in Gills then other organs of the fish. **Conclusions**: Fish had large head region with various kinds of fins including dorsal fins and anal fins. Iron, cadmium, Copper, Chromium and lead in different organs were also seen and nickel was high in all organs of body except gills. Lead accumulates in the gills.

Keywords: Fishes, *Notopterous notopterous*, Ravi River, Heavy metals, Morphology, Morphometry

Introduction

Notopterous notopterous group belongs to catfishes. These are 2nd main group of freshwater fishes. Many people use these fishes but many groups like Jews have inflexible belief against these fishes. In India, it is common in tanks and flourish well in lentic water (Talwar, 1991). Economically this fish is highly valuable for food in southern and southeast Asia to Borneo and Sumatra and is grabbed on commercial scale by all kind of small scale fishing pitches. Pakistan is empowered with high fish potency (Kumar, Wanganeo, Wanganeo, & Sonaullah, 2011).
Morphometry is a subject related to the study of differences and changes in organism (Webster, 2006). The length weight relationship of fishes is applied by researchers for two major aims (Le Cren, 1951). Firstly, this relationship is applied to identify the weight from the whole length of fish. Secondly, to describe the situation of the species.
Heavy metals includes Iron, Copper, and Zinc are important metals, with significant functions in biology (Rutkiewicz & Namiesnik, 2009) while Cadmium, Chromium, and Lead are non-essential that are harmful in water. Lead is not required for any function in organisms even at very low concentration (Çiftçi, Cicik, Erdem, & Ay, 2008). Every organ of fishes have varied concentration of metals in it (Khaled, 2004) i.e., gills, muscles, kidneys, bones, liver, reproductive organs and other organs. In the body of fishes, gills indicate pollution in water. The present work describes the morphometric parameters and heavy metals accumulation in different organs of fish.

Methodology

Study site and sampling

The site was River Ravi of the Punjab, Pakistan. The fish sample was taken from the river Ravi of variable size in the Okara district of Pakistan, Punjab. The fish was taken from the site Mari Patan Bridge. About 41 fishes were taken from the river with the help of nets by fisher men. The morphometry i.e., length and weight of 41 fishes were taken from the different sites of river Ravi. The heavy metals detection was also performed on fishes. This study was conducted according to the declaration of Helsinki for animals study.

Morphometric measurements

The morphometry was done by measuring the total length of fish with tail, total length of fish without tail, length of anal fins with caudal fins and without caudal fins, pectoral fins length, pelvic fin length (PFL), length of the dorsal fins. The total rays were counted of the anal fins (AF), caudal fins (CF), pectoral fins (PF), pelvic fins (PF) and the dorsal fins (DF). The width of caudal fins, dorsal fins, and pectoral fins was also measured. The diameter of the eye was measured. The distance between the nostrils of the fish was also measured. The total weight of each taken fish was calculated by an electronic digital balance. After every 10 days the round to
river was made by me and fishes were collected from the river for the purpose of morphometry and for hematology. The duration of the research was from March 2018 to June 2018. Approximately 3 months were taken to do this research.

The length and weight relationship of fishes is generally explained by equation W = a Lb (Ricker, 1973). The, W is weight of body measured in (grams), L is the total length measured in (cm), a is intercept and b is slope (the fish growth rate). The index of body parts was estimated by the formula:

Index of body part = weight of body parts (g)/wet body weight (g) × 100.

Conditions factor was estimated by Weatherly and (M. Ali & Wootton, 1998) methods.

$K= W/L3 \times 100$

Heavy metals analysis

Heavy metals was analyzed in fish by following the method of (H. Ali, Khan, & Nasir, 2020).

Results

Results shows that the fishes had large head area then other fishes. The diameter of eyes was
average size 0.97±0.08cm, distance between eyes with average size 1.47±0.30 cm, distance between nostrils with average size 0.7±0.09 cm. The length of mandibles with an average size of 2.59±0.30 cm. Maxilla length was an average size of 3.21±0.19 cm (Table 1). Measurements containing mouth parts shows non-significance in distance between eyes and length of mandibles while others show significant difference.

Table 1: Measurements of mouth parts of *Notopterus notopterus*

Measurements n=41	Mean±S.D	T value	P value
Diameter of eyes (cm)	0.97±0.08	2.65144	0.01153
Distance between eyes (cm)	1.47±0.30	16.0116	9.6906
Distance between nostrils (cm)	0.7±0.09	4.21412	0.00014
Length of mandibles (cm)	2.59±0.30	13.9606	9.35
Length of maxilla (cm)	3.21±0.19	3.0356	0.00426

The fish also have many fins with variable shape and length. The dorsal fins length was in average size of 2.39 ± 0.34 cm, width average size 0.77 ± 0.11cm and others average size also given in (Table 2). The standard deviation and mean, the P value and T value of this fish is given in the table. If the P value is greater than 0.05 than this is known as non-significant value. If the P value is less than 0.05 than this is known as significant value. If the P value is less than 0.01 than this is known as highly significant value. This table consists of only measurements of fin. Some fins measurement shows significance while others show non-significance results. The mean and standard deviation also vary in fishes.

Table 2: Measurements of fins of *Notopterus notopterus*

Measurements n=41	Mean ± S.D	T value	P value
Length of dorsal fins (cm)	2.39 ± 0.34	0.46^{NS}	0.651
Width of dorsal fins (cm)	0.77 ± 0.11	0.78^{NS}	0.445
Length of anal fins (cm)	1.28± 0.33	0.93^{NS}	0.359
Width of anal fins (cm)	14.83 ± 0.91	1.33^{NS}	0.196
Length of tail (caudal fins) (cm)	1.76 ± 0.35	0.42^{NS}	0.682
Width of caudal fins tail (cm)	1.09 ± 0.16	0.03^{NS}	0.979
Length of pectoral fins (cm)	2.71 ± 0.31	-1.51^{NS}	0.151
Width of pectoral fins (cm)	0.71 ± 0.11	1.83^{NS}	0.079
Length of pelvic fins (cm)	0.83 ± 0.98	0.05^{NS}	0.963
Width of pelvic fin (cm)	0.34 ± 0.06	-0.05^{NS}	0.963
Rays of dorsal fin	7.54 ± 0.77	0.77^{NS}	0.460
Rays of anal fin	84.66 ± 8.26	0.01^{NS}	0.994
Rays of caudal fin (tail)	10.21± 1.41	2.32*	0.035
Rays of pectoral fin	12.44 ± 2.04	-0.99^{NS}	0.330
Rays of pelvic fin	3.61 ± 0.91	2.57*	0.017

NS = Non-significance (P>0.05); * = Significance (P<0.05); ** = Highly significance (P<0.01) SE = Standard error

The fish's weight was 105.85±26.62 g. The total length with tail was 21.03±1.60 cm. The total length without tail 19.30±1.54 cm. The length of tail was 1.75±0.35 cm. The girth/width of fish with anal fin was 6.74±0.63cm. The girth/width of fish without anal fin was 5.46±0.59 cm as shown in (Table 3). The length and weight of fishes also vary to some extent.

Table 3: Length and weight of body parts of *Notopterus notopterus*

Measurements	**A.M ±S.D**	**Range (Min-Max)**
Weight of fish (g)	105.85±26.62	79.23-132.47
length with tail (cm)	21.03±1.60	19.43-22.63
length without tail (cm)	19.30±1.54	17.76-20.90
Length of tail (cm)	1.75±0.35	1.40-2.10
Width of fish with anal fin (cm)	6.74±0.63	6.11-7.37
Width of fish without anal fin (cm)	5.46±0.59	4.87-6.05

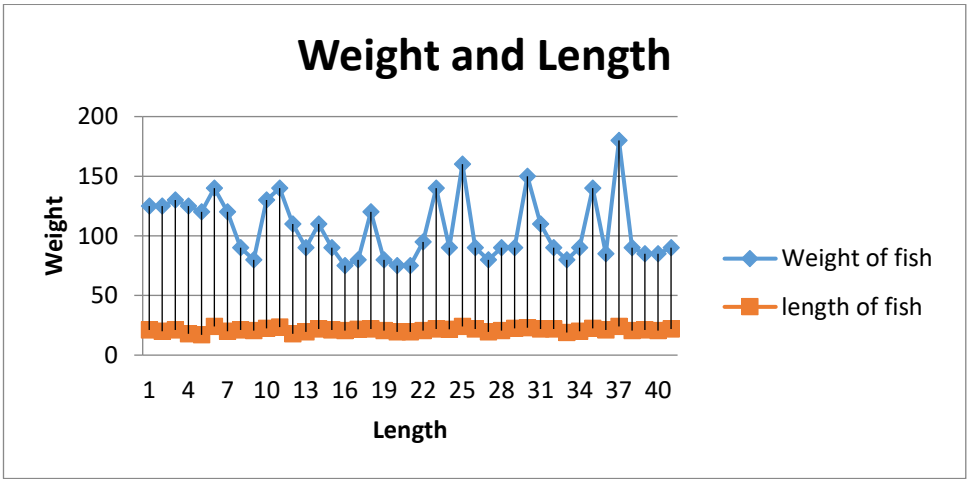

Fig 1: Weight length relationship of *Notopterus notopterus*

Heavy metals concentration

Concentration of different metals of fish liver, fin, muscle and gills is given in the table 4. Different metals include Ni, Fe, Cd, Cu, Cr and Pb shows different concentrations in the given factors. It was found that the concentration of Ni was more in Liver then other organs. The order of fish accumulation by nickel is Liver>Gills>Muscles>Fins. The concentration of Fe was more in Liver then other organs. The order of fish accumulation by Iron is Liver>Gills>Fins>Muscles. The concentration of Cd was more in Liver then other organs. The order of fish accumulation by Cadmium is Liver>fin>Gills >Muscles. The concentration of Cu was more in Liver then other organs. The order of fish accumulation by copper is Liver >Fins>Muscles>Gills. The concentration of Cr was more in Liver then other organs. The order of fish accumulation by chromium is Liver >Gills> Muscles>Fins. The concentration of Pb was more in Gills then other organs. The order of fish accumulation by chromium is Gills> Muscles> Liver>Fins.

Table 4: Shows the concentration of different metals of fish liver, fin, muscle and gills

Metal	**Liver**	**fin**	**Muscle**	**Gills**
Ni	2.10±0.510	$0.56±0.22^{C}$	$1.19±0.04^{B}$	$1.75±0.52^{B}$
Fe	$59.21±0.53^{A}$	$8.21±2.15^{C}$	$29.81±0.46^{D}$	$51.19±4.46^{B}$
Cd	$0.0026±0.002^{A}$	$0.0006±0.0002^{B}$	$0.0015±0.0003^{C}$	$0.0016±0.0003^{C}$
Cu	$4.11±0.03^{A}$	$0.71±1.043^{B}$	$3.92±0.05^{C}$	$3.88±0.41^{C}$
Cr	$2.53±0.31^{A}$	0.46±0.051	$1.99±0.66^{B}$	$2.22±0.63^{B}$
Pb	$0.95±0.66^{B}$	$0.27±0.03^{C}$	$0.65±0.84^{A}$	$0.85±0.02^{A}$

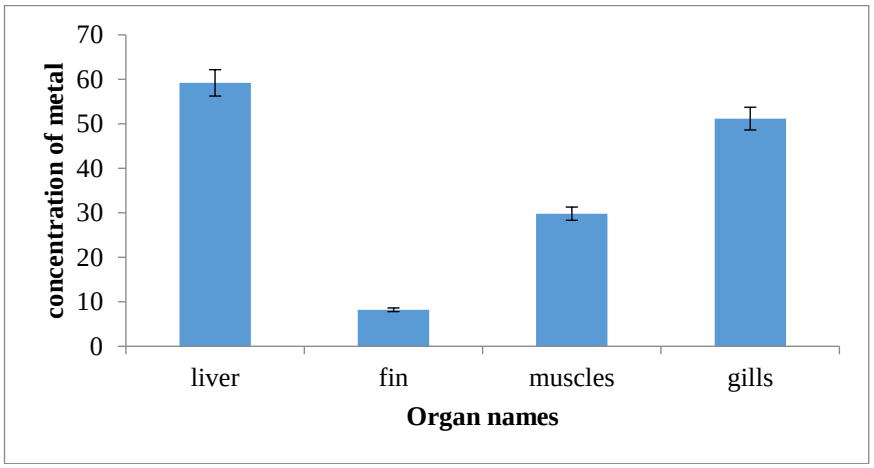

Fig 2: Shows the concentration of metal in liver of fish, in fins, in muscles and in the gills of fish

Discussion

This study was designed to measure the morphometry, hematological characters and heavy metals detection of *Notopterus notopterus* fish.

Length and weight relationship are of key importance in ichthyology. It tells the weight and situation of fish in water. They morphometry is beneficial as it compares the life history of fishes (Froese & Pauly, 2000; Moutopoulos & Stergiou, 2002). They reported an increased trend with increased length and weight. The information they provided according to morphometry shows that the length and weight relationship was significant (Bano, Salam, & Naeem, 2015). No more work was conducted on the morphometry of fish. In this study, the measurements containing mouth parts shows non-significance in distance between eyes and length of mandibles while others show significant difference. Some fins measurement shows significance while others show non-significance results. The fish's weight was 105.85±26.62 g. The total length with tail was 21.03±1.60 cm. The total length without tail 19.30±1.54 cm. The length of tail was 1.75±0.35 cm. The girth/width of fish with anal fin was 6.74±0.63cm. The girth/width of fish without anal fin was 5.46±0.59 cm. The length and weight of fishes also vary to some extent.

The heavy metals concentration varied in different organs of fish. They found the highest Cadmium (Cd) concentration in fish muscles (i.e.,2.95 mg/kg) is very high then standard values (i.e.,0.5 mg/kg). They found the order was Muscle> reproductive organs> liver> kidney> gills and bones (Budijono, Hasbi, & Sibagariang, 2020). It was observed that the concentration of Cd was more in Liver then other organs. The order of fish accumulation by Cadmium is Liver>fin>Gills >Muscles. Chromium (Cr) is a vital nutrient required for absorption (Farag et al., 2006). They found the maximum metals pollution in liver and kidneys of fish (Connell & Miller, 1984). In other studies, they observed the highest quantity of chromium in liver of fish (i.e.,95.62 mg/kg). They found the order of fish accumulation was Liver> bone> kidney> muscle> reproductive organs> gills (Budijono et al., 2020). In this study, I found that, the concentration of Cr was more in Liver then other organs. The order of fish accumulation by chromium is Liver >Gills> Muscles>Fins.

Lead (Pb) is very harmful metal found in different concentrations in organisms (Ahmed et al., 2013). It is found in different parts of fish body i.e., liver, kidney, and spleen also n digestive tract and gills (Sfakianakis, Renieri, Kentouri, & Tsatsakis, 2015). They observed the Pb concentration was high in gills of fishes (i.e.,35.62 mg/kg). in other studies (El-Moselhy, Othman, Abd El-Azem, El-Metwally, & sciences, 2014) also observed high concentration of lead in gills of fishes. They found the order of fish accumulation was Gills> kidney> bone> muscle> liver> reproductive organs (Budijono et al., 2020). It was found in this work that the concentration of Pb was more in Gills then other organs. The order of fish accumulation by chromium is Gills> Muscles> Liver>Fins.

The highest Iron (Fe) in the gills of small fish (2.35 mg/kg) and lowest in the bones of large fish (0.69 mg/kg) is above the 0.5 mg/kg quality standard. They found the order of fish accumulation was Gills> muscle> liver> kidney> reproductive organs> bone (Budijono et al., 2020). It was found that the concentration of Fe was more in Liver then other organs. The order of fish accumulation by Iron is Liver>Gills>Fins>Muscles.

Copper (Cu) is also an important element for absorption in organisms (Arifin, 2011). They found high copper concentration in fish bones is 15.83 mg/kg and the low in reproductive organs of fishes (i.e., 0.25 mg/kg) is beyond the quality standard i.e., 20 mg/kg (Arifin, 2011). They also observed the high concentration of Cu in gills, bones and scales (Monteiro, dos Santos, Calejo, Fontainhas-Fernandes, & Sousa, 2009). They found the order of fish accumulation was Bone> liver> kidney> muscle> gill> reproductive organs (Budijono et al., 2020). This study shows the concentration of Cu was more in Liver then other organs. The order of fish accumulation by copper is Liver >Fins>Muscles>Gills. They described that the concentration of lead, zinc and iron was more in gills then other organs of fish (Budijono et al., 2020). This study concluded that the concentration of metals was high in liver other than lead that is more in gills of fish. The figure 2 shows the concentration of metals in liver of fish, in fins, in muscles and in the gills of fish.

Conclusion

It is concluded that the fish had large head region with various kinds of fins including dorsal fins and anal fins. The morphometric parameters vary from fish to fish. The concentration of all metals was high in liver other than lead that is more in gills of fish. Furthermore, Ravi River is much polluted with different kinds of heavy metals and affected the blood profile of the fish.

Abbreviations

Ni: Nickel
Fe: Iron
Cd: Cadmium
Cu: Copper
Cr: Chromium
Pb: Lead

Conflict of interest

None

Authors Contribution

All authors contributed equally.

Data availability statement

Data will be online and available on the demand of authors.

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