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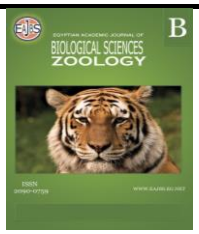

Assessment of Some Heavy Metals Concentration in Slender-Billed Gulls (*Larus genei*) From Lake Quaron Protected Area, Fayoum, Egypt

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ABSTRACT

Wild birds play an important role as a bio-indicator for heavy metals pollution in the environment due to its wide distribution and its higher trophic level in the food chain. In the present study, 46 Slender-billed Gulls (*Larus genei*) were collected during the breeding season from Lake Quaron protected area, Fayoum governorate, Egypt. Levels of Cadmium (Cd), Lead (Pb), Copper (Cu) and Zinc (Zn) were estimated in different tissues of slender-billed gulls (liver, breast muscle, heart and breast feathers). The aim of the current study is to determine the best tissue which can be used as a bio-indicator for each metal. Also to assess the environmental pollution with heavy metals in Lake Quaron. The result revealed that the higher concentration of Cd was estimated in the heart and liver ($P<0.05$) while the lower concentration was observed in feathers and muscle. The higher level of Pb and Zn were observed in feathers ($P<0.05$) and the lower level were observed in muscle. The major site of Cu accumulation in the examined tissue was liver ($P<0.05$) and the minor site was muscle and heart. Generally, the liver can be used as a good indicator for both Cd and Cu while feathers are a good indicator for Pb and Zn. The level of all the examined metals was relatively decreased in Lake Quaron except Zn was increased in comparison with a previous study.

INTRODUCTION

Wild birds are considered a mirror for environmental health (Erwin and Custer, 2000). They are widely distributed and occupied a higher trophic level of the food chain (Barbieri *et al.*, 2010). Wild birds are exposed to a wide range of heavy metals pollutants through contaminated food, water, and physical contact (Burger and Gochfeld, 2004; Bostan *et al.*, 2007). The amount of the toxic pollutant increase as a rise in the food chain so, most of the pollutant are bio-accumulated in the species of the higher trophic level (Ullah *et al.*, 2014). Therefore, wild birds can be used as a suitable method for assessing metal pollution in the environment (Boncompagni *et al.*, 2003).

The toxic effects and long persistence of heavy metals in environment threat ecosystems and cause its degradation (Zhang *et al.*, 2018) also it have an adverse effect

on the physiological performance of birds (Martin *et al.,* 2003) and may cause reproductive failure (Dauwe *et al.,* 2004).

The toxic levels of Cadmium cause kidney and testicular damage, reduction of egg production, and alteration of the behavior responses (Furness, 1996). Toxicity with lead was contributed to reducing the body weight, plasma calcium level, egg production, and reproductive success (Mateo *et al.,* 2003). Moreover, lead poisoning may cause kidney and nervous system problems and inhibit the synthesis of heme (Berny *et al.,* 1994). Copper and zinc are essential metals for a bird's life but their excessive amounts have a toxic effect on the kidney and impair the reproduction (Carpenter *et al.,* 2004).

Lake Qaroun is a closed saline basin lying in the lowest-northwest part of El-Fayoum depression. It has an elongated rectangular shape with average dimensions 45 km length, 5.7 km width, and 4.2 m depth (Gohar, 2002). It was declared as a nature reserve by the virtue of the Prime Minister decision No. 348 in 1989 with a view to protecting and conserving the biological, archaeological and geological diversity of the area. This area is rich with biological diversity, about 88 bird species, 5 kinds of Egyptian mammals, 10 kinds of fish, rare reptiles, and plant species were reported (Hussein *et al.,* 2008).

Lake Quaron is a wetland of international importance for water birds and declared as a Ramsar site in 2012 (Ramsar Convention Manual, 2013). More than 10,000 individuals of breeding adult Slender-billed Gull (*Larus genei*), and 500 individuals of Little Tern (*Sterna albifrons*) were counted in addition to chicks of Slender-billed Gulls have been observed in Lake Quaron protected area (Ibrahim, 2007).

The current study aimed to determine the best tissue which can be used as a bio-indicator for each metal and also assess the environmental pollution with heavy metals in Lake Quaron protected area.

MATERIALS AND METHODS

A total of 46 slender-billed gulls were collected from Golden Horn Island, Lake Quaron protected area, El-Fayoum governorate. Birds were hunted a life by net trapping during the breeding season (May, June, and July 2017) All the examined birds are apparently normal.

The examined tissues were liver, breast muscle, heart, and breast feathers. Each of the liver, muscle, and heart samples was digested according to (Al Ghais, 1995) by using highly concentrated nitric acid and perchloric acid (4:1) respectively. Feathers samples were digested according to (Adout *et al.,* 2007) by using high purity concentrated nitric and hydrogen peroxide.

This study was approved by the Scientific Research Ethics Committee of Faculty of Veterinary Medicine, Suez Canal University.

Samples were analyzed for their heavy metals content by using (PERKIN ELMER A Analyst 100) atomic absorption spectrophotometer in Marine Pollution Laboratory, Marine Ecology Department, Suez Branch, National Institute of Oceanography and Fisheries. All heavy metals concentration (ppm) in tissues was estimated on a dry weight basis.

The statistical analysis of data was carried out using SPSS 17.0 version (Chicago, USA) programs one-way ANOVA at a significance difference ($P<0.05$) according to (Snedecor and Cochran, 1989) to compare the level of heavy metals in each tissue.

RESULTS AND DISCUSSION

The concentration of the heavy metals (ppm dry weight) in tissues of slender-billed gulls was summarized in (Table 1).

Table 1: average of heavy metals (Mean ± SE) concentration (ppm dry weight) in Slender billed gulls tissues

Heavy metals	Liver	Muscle	Heart	Feather	*P* Value
Cd Mean ± SE Min. Max.	$0.385^{a} \pm 0.016$ 0.265 0.555	$0.114^{b} \pm 0.006$ 0.063 0.17	$0.398^{a} \pm 0.023$ 0.224 0.593	$0.312^{c} \pm 0.014$ 0.217 0.453	0.00
Pb Mean ± SE Min. Max.	$0.856^{a} \pm 0.049$ 0.494 1.549	$0.615^{a} \pm 0.033$ 0.289 0.917	$1.500^{b} \pm$ 0.132 0.782 2.761	$2.212^{c} \pm 0.271$ 1.283 7.676	0.00
Cu Mean ± SE Min. Max.	$7.472^{a} \pm 0.513$ 4.519 12.16	$4.773^{b} \pm 0.170$ 3.608 7.156	$4.751^{b} \pm$ 0.218 2.364 6.442	$6.0917^{c} \pm 0.172$ 4.858 7.835	0.00
Zn Mean ± SE Min. Max.	$52.252^{a} \pm 3.056$ 30.033 80.477	$19.066^{b} \pm 0.909$ 10.805 30.14	$24.011^{b} \pm$ 0.992 20.283 30.988	$86.541^{c} \pm 2.778$ 70.176 110.79	0.00

Within the same row, means carrying different superscript are significant at (P<0.05)

The average Cd level in the tissues of slender-billed gulls was found in the order of heart > liver > feathers > muscle as 0.398, 0.385, 0.312, and 0.114 ppm dry weight respectively. Statistically, there was a significant difference (P< 0.05) in Cd concentration between liver and muscles and also between liver and feather while there was no significant difference between liver and heart.

The average concentration of Pb in the different tissue of slender-billed gulls was found in the order of feather > heart > liver > muscle as 2.212, 1.500, 0.856, and 0.615 ppm dry weight respectively. Statistically, feathers were showed a significant difference (P< 0.05) in the Pb concentration with liver, heart, and muscle while no significant difference was observed between liver and muscle.

The concentration of Cu in the different tissues of slender-billed gulls were found in the order of liver > feathers > muscle > heart as 7.472, 6.0917, 4.773, and 4.751 ppm dry weight respectively. A significant difference (P< 0.05) in Cu concentration was showed between liver and muscle, liver, and heart and also between liver and feathers while there was no significant difference between muscle and heart.

The average of Zn level in the different tissues of slender-billed gulls was found in the order of feathers > liver > heart > muscle as 86.541, 52.252, 24.011, and 19.066 ppm dry weight respectively. Statistically, there was a significant difference (P< 0.05) in Zn concentration between liver and muscle, liver and heart, and also between liver and feathers while no significant difference was observed between muscle and heart.

Seabirds are commonly used as a bio-indicator for environmental pollutants because they are widely distributed, occupy higher level in the food chain, long-lived and sensitive to the environmental changes (Alleva *et al.,* 2006).

In the current study, the higher concentration of Cd was estimated in the heart and liver ($P< 0.05$). This result is agreed with (Naccari *et al.,* 2009; Lucia *et al.,* 2010; Medani *et al.,* 2015) while the lower levels of Cd concentration was observed in feathers and muscle as previously reported by (Nam *et al.,* 2005; Lucia *et al.* 2008).

The higher Cd concentration in the liver may be related to the role of these organs in detoxification and storage of nonessential elements (Lucia *et al.,* 2010).

The major site of Cu accumulation in the examined tissues was liver ($P<0.05$) and that agreed with results obtained by (Deng *et al.,* 2007; Lucia *et al.,* 2010; Malinga *et al.,* 2010) while the lower accumulation of Cu was observed in muscle and heart, that disagreed with (Naccari *et al.,* 2009; Medani, 2015) who estimated a lower accumulation of Cu in the feathers.

The highest level of metals accumulation in the liver may give an indication about the chronic exposure to these metals (Naccari *et al.,* 2009) therefore, from our study, detection of both Cd and Cu in the liver of birds can reflect the long time pollution with these metals in their environment.

On the other hand, the highest concentration of Pb was observed in feathers ($P<0.05$) and the lowest concentration in muscle and that previously reported by (Medani, 2015) and also with (Lucia *et al.,* 2010) who recorded the highest concentration of Pb in the feather of wader birds.

Also, the highest accumulation of Zn was estimated in the feather ($P< 0.05$) and the lowest accumulation in muscle, that agreed with results of (Medani, 2015) and with (Lucia *et al.,* 2010) in wader birds and also with (Salah-Eldein *et al.,* 2012) in Little tern and disagreed with (Naccari *et al.,* 2009) who reported the highest concentration of Zn in the liver of common buzzards.

Feathers are a perfect indicator of heavy metals accumulated inside birds and reflect the pollution status of the environment (Jaspers *et al.,* 2004). As the feathers grow, heavy metals were deposited inside it till the growth stope, and the content of heavy metals remain inside feathers, become an archive for the period of exposure during its growth (Walsh, 1990). For this, feathers can be used as a monitor for the recent exposure of heavy metals and reflect the pollution inside the ecosystem. Moreover, it can be collected without the need to kill birds and can be stored for a long time at room temperature without deterioration (Berg *et al.,* 1966). Therefore, from our study, using feathers of slender-billed gulls for the detection of Pb and Zn is recommended.

In comparison with the study of (Medani *et al.,* 2015) who examined 45 slender-billed gulls in Lake Quaron for detection of heavy metals accumulation in their tissue (Table 2), we can conclude that the level of Cd, Cu and Pb were decreased in 2017 (current study) from that estimated in 2015. The lower level of such metals indicates a relative improvement of the environmental status of Lake Quaron. While the level of Zn was increased in comparison with that in 2015. So, further attention is required to avoid the adverse effects of such metals on birds and the whole ecosystem of Lake Quaron, which considered the most important site for breeding of slender billed gulls in Egypt.

Table 2: Comparison between the tissues that were showed the higher levels of metals in the current study and that reported by (Medani et al., 2015)

	Cd in liver	Cu in liver	Pb in feathers	Zn in feathers
The present study	0.385	7.472	2.212	86.541
Medani *et al.*, 2015	0.408	16.741	3.432	25.276

The present study concludes that the liver can be used as a good indicator for both Cd and Cu while the feather is a good indicator for Pb and Zn. The level of Cd, Cu, and Pb in Lake Quaron protected area was relatively decreased in comparison with a previous study while the level of Zn was increased. Lake Quaron protected area needs further attention to decrease the levels of heavy metals pollution.

REFERENCES

Adout, A.; Hawlena, D.; Mamana, R.; Paz-tal, O. and Karpas, Z. (2007). Determination of trace elements in pigeon and raven feathers by ICPMS. *International Journal of Mass Spectrometry* 267: 109–116.

Al Ghais, S. M. (1995). Heavy metals concentration in the tissue *sparus sebra* from United Arab Emirates. *Bulletin of Environmental Contamination and Toxicology* 55: 581.

Alleva, E.; Francia, N.; Pandolfi, M.; De Marinis, A. M.; Chiaretti, F. and Santucci, D. (2006). Organochlorine and heavy metal contaminate in Wild mammals and birds of Urbino–Pesaro provinces, Italy: an analytic overview for potential bio-indicators. *Archives of Environmental Contamination and Toxicology* 51: 123–134.

Barbieri, E.; Passos, E. A.; Filippini, A.; Santos, I. S. and Garcia, C. A. B. (2010). Assessment of trace metal concentration in feathers of seabird (*Larus dominicanus*) sampled in the Florianópolis, SC, Brazilian coast. *Environmental Monitoring and Assessment* 169: 631–638.

Berg, W.; Johnels, A.; Sjostrand, B. and Westermark, T. (1966). Mercury content in feathers of Swedish birds from the Past 100 Years. *Oikos* 1**7**: 71–83.

Berny, P. J.; Cote, L. M. and Buck, W. B. (1994). Relationship between soil, dust lead and blood lead concentrations in pets and their owners: Evaluation of soil lead threshold values. *Environmental Research*, 67: 84.

Boncompagni, E.; Muhammad, A.; Jabeen, R.; Orvini, E.; Gandini, C.; Sanpera, C.; Ruiz, X. and Fasola, M. (2003). Egrets as monitors of trace-metal contamination in wetlands of Pakistan. *Archives of Environmental Contamination and Toxicology* 45: 399–406.

Bostan, N.; Ashrif, M.; Mumtaz, A. S. and Ahmad, I. (2007). Diagnosis of heavy metal contamination in agro-ecology of Gujranwala, Pakistan using cattle egret as bioindicator. *Ecotoxicology*, 6: 247– 251.

Burger, J. and Gochfeld, M. (2004). Metal levels in eggs of common terns (*Sterna hirundo*) in New Jersey: temporal trends from 1971 to 2002. *Environmental Research*, 94: 336–343.

Carpenter, J. W.; Andrews, G.A. and Nelson, B. W. (2004). Zinc toxicosis in a free-flying Trumpeter Swan (*Cygnus buccinator*). *Journal of Wildlife Diseases* 40: 769–774.

Dauwe, T.; Janssens, E.; Kempenaers, B. and Eens, M. (2004) The effect of heavy metal exposure on egg size, eggshell thickness and the number of spermatozoa in blue tit *Parus caerulens* eggs. *Environmental Pollution*, 129: 125–129.

Deng, H.; Zhang, Z.; Chang, C. and Wang, Y. (2007). Trace metal concentration in Great Tit (*Parus major*) and Greenfinch (*Carduelis sinica*) at the Western Mountains of Beijing, China. *Environmental Pollution*, 148: 620–626.

Erwin, M. and Custer, T. W. (2000). Herons as indicators. In: "Heron Conservation." Kushlan, J. A. and Hanfer, H. (Eds.). Academic Press, San Diego.

Furness, R. W. (1996). Cadmium in birds. In: "Environmental contaminants in wildlife." Beyer, W. N.; Heinz, G. H. and Redmon- Norwood, A. W. (Eds). CRC Press, Boca Raton, FL, pp. 389–404.

Gohar, M. E. M. (2002). Chemical studies on the precipitation and dissolution of some chemical elements in Qaroun Lake (Ph. D. thesis). Egyptian Faculty of Science, AL-Azhar Univ. Cairo. 359.

Hussein, H.; Amer, R.; Gaballah, A.; Refaat, Y. and Abdel-Wahab, A. (2008). Pollution monitoring for Lake Qarun. *Advances in Environmental Biology*, 2:70–80.

Ibrahim, W. A. (2007). Rapid breeding waterbirds survey In Egypt, summer / autumn 2007. Nature Conservation Egypt.

Jaspers, V.; Dauwe, T.; Pinxten, R.; Bervoets, L.; Blust, R. and Eens, M. (2004). The importance of exogenous contamination on heavy metal levels in bird feathers. A field experiment with free living great tits, *Parus major*. *Journal of Environmental Monitoring*, 6: 356–360.

Lucia, M.; Andre´, J.; Bernadet, M. D.; Gontier, K.; Guy, G. and Davail, S. (2008). Concentrations of metals (zinc, copper, cadmium, and mercury) in three domestic ducks in France: Pekin, Muscovy, and Mule ducks. *Journal of Agricultural and Food Chemistry*, 56: 281– 288.

Lucia, M.; Andre´, J.; Gontier, K.; Diot, N.; Veiga, J. and Davail, S. (2010). Trace Element Concentrations (Mercury, Cadmium, Copper, Zinc, Lead, Aluminium, Nickel, Arsenic, and Selenium) in Some Aquatic Birds of the Southwest Atlantic Coast of France. *Archives of Environmental Contamination and Toxicology*, 58: 844–853.

Malinga, M.; Szefer, P. and Gabrielsen, G. (2010). Age, sex and spatial dependent variations in heavy metals levels in the Glaucous Gulls (*Larus hyperboreus*) from the Bjørnøya and Jan Mayen, Arctic. *Environmental Monitoring and Assessment*, 169: 407–416.

Martin, M. B.; Reiter, R.; Pham, T.; Avellanet, Y. R.; Camara, J.; Lahm, M.; Pentecost, E.; Pratap, K.; Gilmore, B. A.; Divekar, S.; Dagata, R. S.; Bull, J. L. and Stoica, A. (2003). Estrogen-like activity of metals in Mcf-7 breast cancer cells. *Endocrinology*, 144: 2425–2436.

Mateo, R.; Beyer, W. N.; Spann, J. W.; Hoffman, D. J. and Ramis, A. (2003). Relationships between oxidative stress, pathology and behavioral signsof lead poisoning in mallards. *Journal of Toxicology and Environmental Health*, 66: 1371–1389.

Medani, G.G.; Gamal-Eldien, M. M.; Mohamedeen, L. I. and Hammad, M. H. (2015). Wild birds as bio indicator for heavy metals pollution in lake Quaron protected area (Ramsar site), Fayoum, Egypt. *Suez Canal Veterinary Medicine Journal*, 20:139–154.

Naccari, C.; Cristani, M.; Cimino, F.; Arcoraci, T. and Trombetta, D. (2009). Common buzzards (*Buteo buteo*) bio-indicators of heavy metals pollution in Sicily (Italy). *Environmental International*, 35: 594–598.

Nam, D. H.; Anan, Y.; Ikemoto, T. and Tanabe, S. (2005). Multielemental accumulation and its intracellular distribution in tissues of some aquatic birds. *Marine Pollution Bulletin*, 50: 1347–1362.

Ramsar Convention Manual (2013). A guide to the convention on wetlands (Ramsar, Iran 1971), 6th ed.

Salah-Eldein, A. M.; Gamal-Eldien, M. M. and Mohamadeen, L. I. (2012). Resident wild Birds as Bio-indicator for some heavy metals' pollution in Lake Manzala. *Suez Canal Veterinary Medicine Journal*, 17: 109–121.

Snedecor, G.; Cochran, W. and Cox, D. (1989). Statistical methods, eighth ed. The Iowa state university press.

Ullah, K.; Hashmi, M. Z. and Malik, R. N. (2014). Heavy-metal levels in feathers of cattle egret and their surrounding environment: a case of the Punjab province, Pakistan. *Archives of Environmental Contamination and Toxicology*, 66: 139–153.

Walsh, P. M. (1990). The use of seabirds as monitors of heavy metals in the marine environment. In: "Heavy metals in the marine environment." Furness, R.W. and Rainbow, P. S. (Eds.), CRC Press, Boca Raton, FL.

Zhang, J.; Han, L.; Ji, Y.; Wei, J.; Cai, G.; Gao, G.; Wu, J. and Yao, Z. (2018). Heavy metal investigation and risk assessment along the Le'An River from non-ferrous metal mining and smelting activities in Poyang, China. *Journal of Environmental Biology*. 39: 536–545.

ARABIC SUMMARY

تقييم تركيز بعض المعادن الثقيلة في النورس القرقطي بمحمية بحيرة قارون، الفيوم، مصر.

أحمد محمد صلاح الدين[1]، نهال محمد العاصي[1]، محمد حماد محمد حماد[2]، إيناس محمد سعد[1]

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تلعب الطيور البرية دور مهم كمؤشر حيوي لتلوث البيئة بالمعادن الثقيلة وذلك لإتساع مدى انتشارها ولإحتلالها مكانة عالية في السلسلة الغذائية. في هذه الدراسة تم تجميع عدد 46 طائر من النورس القرقطي في موسم التزواج من محمية بحيرة قارون بالفيوم. تم قياس تركيزات عناصر الكادميوم، النحاس، الرصاص والزنك في أنسجة الطائر المختلفة (الكبد، عضلات الصدر، القلب وريش الصدر). وتهدف الدراسة الي تحديد أفضل نسيج يمكن استخدامه كمؤشر حيوي عن التلوث بالمعادن الثقيلة وكذلك تقييم تلوث بيئة بحيرة قارون بالمعادن الثقيلة. وقد خلصت الدراسة الي أن أعلى تركيز لعنصر الكادميوم ظهر في القلب والكبد وأقل تركيز ظهر في الريش والعضلات. وأعلى مستوى لعنصري الرصاص والزنك ظهر في الريش بينما أقل مستوى لهما ظهر في العضلات. أما عنصر النحاس فقد تم تسجيل أعلى تركيز له في الكبد وأقل تركيز في العضلات والقلب. بشكل عام يعتبر الكبد مؤشر حيوي جيد لعنصري الكادميوم والنحاس بينما يعتبر الريش مؤشر حيوي جيد لعنصري الرصاص والزنك. اما عن وضع بحيرة قارون البيئي فقد قلت مستويات التلوث نوعا ما بكل المعادن الثقيلة محل الدراسة ماعدا الزنك وذلك بالمقارنة مع دراسة سابقة.