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Short Communication

Heavy metals accumulation in fish, a growing threat in the Caspian Sea

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A B S T R A C T

Water Pollution is a great concern all over the world specially in closed or semi-closed ecosystems like the Caspian Sea. Among the huge array of anthropogenic pollutants heavy metals have been responsible for several disastrous event damaging for aquatic biota and the man. Heavy metals enter the Caspian Sea through land-based oil exploration with over 100 years of history and offshore oil exploration which started 1950. Major rivers of the Caspian Sea watershed also have their share in ever increasing pollution in this unique water body. Fish are the main suspects of the pollution and sadly some of the unique specie of the Caspian Sea have already been vanishes extinct regionally or even globally and some are on the brink of extinction. Several studies conducted by authors and other researchers in the riparian countries of the Caspian Sea shows an increasing trend in heavy metal load via bioaccumulation and biomagnification in various tissues of sturgeons arguably the most valuable fish on the planet and also other bony fishes of great importance for local people and fishermen which rises health concern for fish itself and human. Strict measure should be taken and implemented to control and reduce heavy metal loads into water bodies in general and the Caspian Sea in particular. Strict measures should be taken and implemented under the observation of international organization to control od reduce heavy metal pollution in the Caspian Sea.

Introduction

Heavy metals are known hazardous environmental pollutants with long environmental persistence, posing substantial health risk to human through the various routes in food chain (Tang et al., 2010; Alturiqi et al., 2012; Vajargah et al., 2021; Sattari et al., 2020) They are characterized by quick dissolution in water and relatively rapid absorption by aquatic organisms and their transmission through the aquatic food web shows a clear pattern of bioaccumulation and eventual biological amplification (Chowdhury et al., 2018; Gwimbi et al., 2020; Sattari et al., 2020b; Sattari et al., 2020c). In general, heavy metals may be divided into two different categories based on their biological activities as essential and non-essential elements. Essential elements are those elements (Zn, Cr, Co, Cu) necessary for several metabolic activities of living organisms in small concentrations. Even these elements can pose toxicity threats by hampering biochemical functions of the target organism. On the other hand, non-essential elements (Pb, Cd, Hg, As) are extremely toxic and cam impose severe damages to the living organisms. Figure 1 shows Aquatic ecosystems in the northern parts of Iran have been subject of increasing levels of heavy metals load for several decades. In this paper we will focus on the Caspian Sea and briefly discuss its importance from biological, diversity and health aspects and highlight the dangers posed by heavy metal pollution. There are 17 families of fishes in the Caspian Sea (Poorbagher et al., 2017; Vajargah 2021; Vali et al., 2022; Yalsuyi et al., 2017) and sturgeons

are the most important of all with huge economic value for local people and government. Bony fishes of the Caspian Sea are also vital for people as food and source of income. These species have been under the pressure of pollution in general and heavy metal pollution in particular which have pushed some species to the brink of extinction and have also resulted in severe health issues with fish and people in the region.

Conclusion

The Caspian Sea is the largest inland water body renowned for diversity of aquatic fauna (Zenkevitch, 1963; Karpinsky, 2005). Nevertheless, over the past few decades, several unique members of its unique species assemblages have progressively impaired from environmental (e.g., global warming, ice melting and salinity changes in the northern basins and, water-level fluctuations). However, the biggest comes from human mediated pressures e.g., oil extraction with over 1oo years of history with severely outdated technology in some regions, overfishing, introduction of invasive species and heavy metal pollution. Volga is by far the largest river flowing into the Caspian Sea. It is responsible for the stability of water level and also counterclockwise circulation of water in the Caspian Sea. Interestingly Volga is responsible for most of the pollution received by the Caspian Sea spreading pollutants including heavy metals originating form industrial infrastructures located in vicinity of the river into the whole Caspian Sea. These events altogether have resulted in the deterioration of overall ecosystem health regional or global extinction of many endemic species (Dumont, 1995; Weaseling et al., 2019, Lattuada et, 2019).

Oil exploration and extraction in the Caspian Sea has changed the spatial pattern of chemical pollution as well (Kosarev and Yablonskaya, 1994). The first offshores wells were drilled off the coast of Azerbaijan in 1950 (Lauttada, et al., 2019) although land-based oil production is already operating for a century (Zhiltsov et al., 2016). Considering the low environmental standards at that period and the fact that several wells were abandoned later on a persistent leakage of oil compounds including heavy metals into the water has been apparent (Bickham et al., 1998; de Mora et al., 2004). Since then, the Pollutant concentrations increased and reached an alarming level in the 1980's and 1990's, when heavy metal residuals originating from mining activities augmented chemical pollution (de Mora et al., 2004). Figure 1 shows tow most toxic heavy metals and share of each country in addition of these elements in to the Caspian Sea. Although in the recent years hazardous chemicals show a decreasing pattern along the Caspian Sea coasts (Nemirovskaya, 2016) which is not the same in different countries However, pollutants are progressively being accumulated in the deepest parts of the sea basin due to water cycles (Tolosa et al., 2004; Nemirovskaya, 2016). These loads of heavy metals have strongly influenced the fish health in the basin and consequently human welfare. Since fish are recognized biomarkers of aquatic ecosystem health, whether fish are being impacted by these environmental changes is not fully examined and requires investigation. In the recent years the authors have carried out several studies on the impacts of heavy metals on various fish species and reached sound results (Foly et al., 2022). We have reviewed the results of these studies in table 1and 2.

Table 1. Results of study

Location (Species)	Pb	Cr	Zn	Cu	Ni	Cd	References
Caspian Sea (*Rutilus kutum*)	0.30	0.16	4.34	1.04	0.09	0.15	Forouhar Vajargah *et al*.2022
Gorgan coast (Corpus corpino)	0.16	0.05	-	-	-	0.09	Tabari *et al*.2010
Gorgan coast *(Mugila auratus)*	0.05	0.04	-	-	-	0.01	Tabari *et al*.2010
Caspian sea (*Rutilus frisii kutum*)	0.01	-	17.20	1.01	-	0.001	Anan *et al* 2005
Caspian sea (*Clupeonella delicatula*)	0.01	-	57.50	1.94	-	0.01	Anan *et al* 2005
Caspian sea (*Mugil auratus*)	-	-	43.46	3.14	-	-	Zeynali *et al* 2009
Fraser River, Canada (*White sturgeon*)	-	-	14.2	1.36	-	-	MacDonald *et al* 1997
Gulf and Gulf of Oman (*Spangled emperor*)	0.05	-	8.28	0.66	-	0.0008	De Mora *et al* 2004
Malabar, Australia (*pagrus auratus*)	0.02	-	4.8	0.18	-	0.001	Gibbs and Miskiewicz 1995

Table 2. Results of study

Location(Species)	Fe	As	Mn	Co	Li	Al	References
Caspian sea *(Rutilus kutum)*	14.12	0.22	0.46	0.06	0.05	3.08	Forouhar Vajargah & Bibak 2021
Anzali lagoon *(Perca fluviatilis)*	64.32	0.07	13.2	-	-	0.09	Noruzi 2017
Danube River (Acipenser ruthenus)	12.49	0.27	-	-	0.12	33.71	Jaric 2011
I¸sıklı Dam Lake (*Cyprinus carpio*)	0.37	-	9.15	2.46	21.24	-	Kalyoncu *et al* 2012
I¸sıklı Dam Lake (*Scardinius erythrophthalmus*)	2.62	-	9.29	2.37	21.51	-	Kalyoncu *et al* 2012
I¸sıklı Dam Lake (*Tinca tinca*)	3.01	-	8.85	2.58	21.37	-	Kalyoncu *et al* 2012
Danube River (Silurus glanis)	13.7	0.02	-	0.02	-	-	Pantelica 2012
Danube River (Acipenser ruthenus)	32.7	0.08	-	0.12	-	-	Pantelica 2012

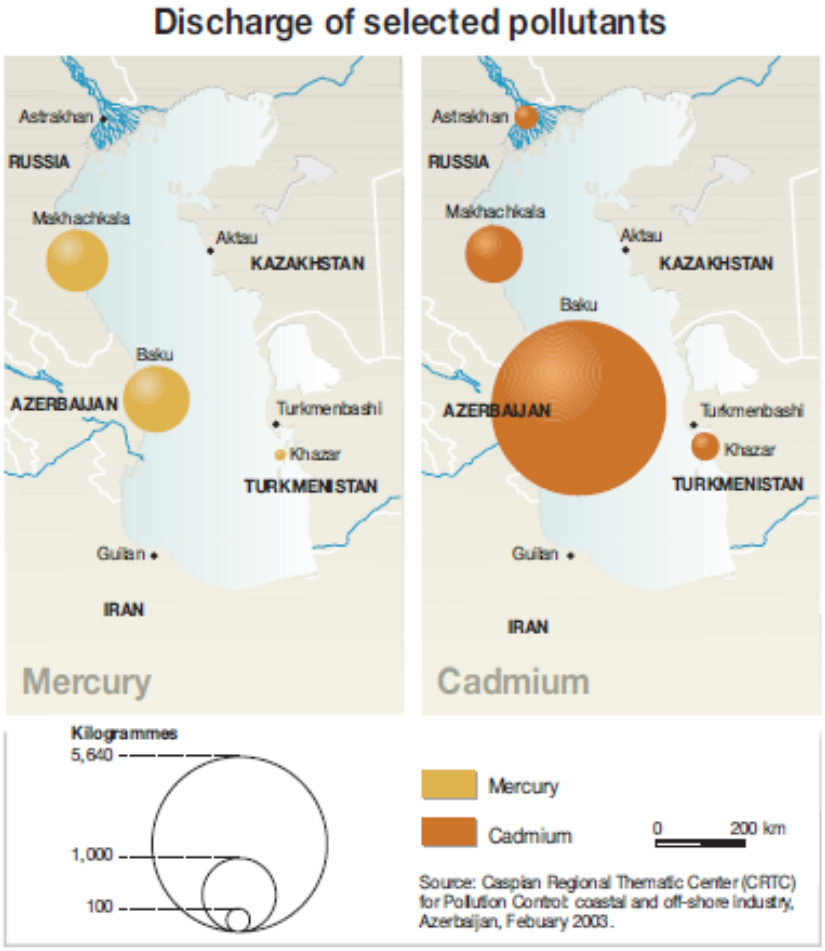

Figure 1. Discharge of selected pollutants

Conflict of interest

The authors declare that they have no conflict of interest.

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