International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Effect of Aquatic Pollution on Fish in Libya: A Review

Mona I. Saad[1], Huwaida M. Doma[2], Issam A. Alfaghi[3], Amani fitori[4]

[1]Department of Biology, Faculty of Education, Tobruk University, Libya.
[2,3]Marine Biology Research Centre, Benghazi, Libya
[4]Department of Marine Resource, Faculty of Natural Resource, Tobruk University, Libya.

Abstract

Aquatic pollution has a serious negative influence on Libya's vast coastline, endangering both human health and marine ecosystems. This paper highlights the main contaminants, their sources, and the biological effects of water pollution on fish species in Libyan waters. Heavy metals (mercury, lead, arsenic, and cadmium), microplastics, polycyclic aromatic hydrocarbons (PAHs), and artificial detergents such as sodium lauryl sulphate (SLS) are important contaminants. Industrial discharges, untreated wastewater, petrochemical operations, and agricultural runoff are the sources of these contaminants.They cause genetic harm, physiological changes, and ecotoxicological concerns in fish species, which may cause cancer in humans who consume them. Food security and marine biodiversity are at risk because elevated pollutant levels frequently surpass global safety criteria established by the FAO and WHO. In order to protect Libya's marine ecosystems and coastal communities, this report emphasises the urgent need for stronger legislation, improved environmental monitoring, and efficient mitigation strategies.

Keywords: Aquatic pollution, Fish species, Physiological changes, Libyan coastline

Introduction

Libya is not an exception to the global problem that aquatic pollution poses to marine ecosystems. With its vast coastline, the Libyan coastal region is especially susceptible to several types of pollution, which have a significant impact on the local fish populations. Chemical pollutants, untreated wastewater, and industrial discharges are some of the sources of pollution that affect Libya's coastal waterways. A thorough analysis of the Libyan coastline reveals that marine sediments include polycyclic aromatic hydrocarbons (PAHs) and heavy metals such as arsenic (As) and mercury (Hg), nickel (Ni) and zinc (Zn). With a 20% chance of toxicity for heavy metals and PAHs, these contaminants, which are mostly man-made, provide ecotoxicological hazards to the marine environment [1]. Concerns regarding possible health hazards for human populations consuming fish contaminated with these hazardous metals are raised, including the possibility of cancer from arsenic consumption [1].

Libyan waters are contaminated by heavy metals as well as artificial detergents , It is well recognised that these detergents, which are present in both residential and commercial wastewater, are harmful to fish and other aquatic life. Fish species may have DNA alterations as a result of SLS exposure in the marine environment, suggesting genome toxicity and possible long-term effects on fish populations [2].The complex character of water pollution in the area is highlighted by the way SLS interacts with other pollutants to intensify its harmful effects [2].

Another an urgent problem is the presence of heavy metal contamination in local fish species. According to studies, several fish from the Libyan coast have different levels of heavy metals like copper (Cu), lead (Pb), and cadmium (Cd). These levels directly endanger consumers' health because they are frequently above the guidelines established by the Food and Agriculture Organisation (FAO) and the World Health Organisation (WHO) [3]. These metals' buildup in fish not only compromises their survival and well-being but also jeopardises the security of the local population's food supply [3, 4].Microplastic pollution is a growing issue throughout the Mediterranean region, particularly Libya. Fish and aquatic invertebrates' nutrition, growth, and reproduction has been discovered to be impacted by microplastics, which may have an impact on the entire food chain [4, 5].

Fish that consume microplastics may limit their intake of natural prey and may also be more susceptible to other pollutants and diseases [4].This emphasises how better waste management techniques are required to lessen the negative effects of microplastics on Libya's marine resources [5, 6]. Although the negative impacts of pollution on fish have received most of the attention, it is also critical to take into account the possibility of aquatic habitats recovering and being restored through efficient management and pollution control techniques. Knowing how resilient fish populations are and how they may adjust to shifting environmental conditions may help reduce the negative effects of pollution in Libya's aquatic ecosystems [7, 8, 9]. Reviewing the effects of water pollution on fish in Libya while emphasising the primary causes of pollution, the consequences for the environment, and the main obstacles and possibilities for enhancing water quality is the goal of this study.

Overview of Aquatic Pollution in Libya

Aquatic pollution is a severe environmental issue in Libya that has an impact on both marine environments and human health. The Libyan coastline is particularly vulnerable due to the discharge of industrial and urban waste, particularly petrochemical pollutants, into the ocean. It has been discovered that a variety of pollutants, including as heavy metals, petrochemicals, and microplastics, damage the Libyan coastline, putting both human populations and marine life at risk [1, 10, 11, 12].

The extraction of crude oil in the Libyan region of Ajdabiya has resulted in high levels of radioactive elements and heavy metals in the water, exceeding local irrigation limits [10]. Similar to this, the Tobruk Bay area is heavily polluted by municipal, agricultural, and industrial effluent, which has affected aquatic life, the water's suitability for human consumption, and the water's quality [11, 13]. Mercury and other heavy metals from industrial processes, such those from the chlorine-alkali plant in Abo-Kamash, exacerbate the environmental problem. Human health may be negatively impacted by mercury levels in fish and sediments [14]. Furthermore, the presence of oil residues in coastal lagoons and microplastics in marine ecosystems highlight Libya's ongoing challenges in reducing aquatic pollution [14, 5]. Overall, the consequences of Libya's water pollution on marine biodiversity, human health, and the wider Mediterranean ecosystem demonstrate how serious the issue is. These pollution issues need to be fixed in order to manage Libya's marine and coastal resources responsibly.

Along the Libyan coast, heavy metals such mercury, lead, copper, chromium, cadmium, nickel, and zinc have been discovered; in certain places, their concentrations are higher because of industrial activity[15,1,16] . In areas like Ajdabiya and Jalo, where untreated trash is discarded into the environment, petrochemical waste especially that from the production of crude oil is a major source of pollution [10,17,4] .Water pollution is a result of the usage of pesticides, especially organochlorine pesticides (OCPs). In northeastern Libya, these have been found in both surface and groundwater, with surface water

exhibiting greater levels of contamination [18]. Anthropogenic contamination is indicated by the presence of arsenic, mercury, nickel, zinc, and polycyclic aromatic hydrocarbons (PAHs) in marine sediments close to petrochemical plants [1,4]. Heavy metals such as Mercury, lead, copper, chromium, cadmium, nickel, and zinc are among the heavy metals that are frequently detected. varied inland and coastal water bodies contain these metals in varied amounts [1,4,16,19].Polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) have been found in coastal regions; the former have a combination of pyrolytic and petrogenic origins [15,1].The quality of water is greatly impacted by crude oil waste, with areas such as Ajdabiya having high concentrations of nitrates and other chemical markers of oil contamination. [10,17].Water sources have been discovered to contain organochlorine pesticides, especially 2,4-D, suggesting that agricultural runoff is a source of pollution[18].

Impact of Aquatic Pollution on Fish Health

Fish health is seriously threatened by aquatic pollution, especially in places like Libya where the coastal ecosystem is essential to the local population. Numerous contaminants, such as synthetic detergents, heavy metals, and microplastics, have been found to be significant causes of aquatic environment deterioration, which impacts fish health and, in turn, human health via the food chain.

With major effects on aquatic life, microplastic (MP) pollution is a global issue that is becoming more and more problematic. Microplastics have been identified in significant amounts in African waterways, notably those near Libya. They have a particular negative impact on fish health in the Mediterranean region. Inadequate waste management techniques, which are prevalent in underdeveloped nations, worsen this contamination. Since fish are a major source of protein for many coastal communities, the presence of microplastics in fish not only endangers fish populations but also poses health hazards to humans[5,7]. Industrial operations, especially those of petrochemical facilities, pollute Libya's coastal regions. According to studies, heavy metals including arsenic (As) and mercury (Hg), which come from human sources, are abundant in the marine sediments in these regions. These contaminants endanger marine life ecotoxicologically and may be harmful to human health if consumed by fish. These harmful elements' presence in fish can cause cancer and other illnesses, underscoring the need for improved environmental management and monitoring[1].

It has been demonstrated that artificial detergents, including sodium lauryl sulphate (SLS), seriously harm the aquatic ecosystem in Libyan coastal waters. Fish and other aquatic life are poisoned by these detergents, which are frequently present in household and commercial wastewater. In fish species like *Sardine aurita*, they can result in DNA changes that harm fish populations over time and impair their survival and well-being[2].

Another serious problem influencing fish health in Libya is heavy metal contamination. High concentrations of heavy metals, such as cadmium (Cd), lead (Pb), and nickel (Ni), have been discovered in a variety of fish species. These levels surpass the guidelines established by the Food and Agriculture Organisation (FAO) and the World Health Organisation (WHO). Haematological measures, which are markers of toxicant impact, are among the physiological changes brought on by these metals' accumulation in fish tissues. Consuming infected fish puts human health at risk in addition to having an adverse effect on fish health[3,21,4].Fish health in Libya is affected by water pollution in a variety of ways, including synthetic detergents, heavy metals, and microplastics. Aquatic ecosystems and human health are seriously threatened by these pollutants. Stricter restrictions, better waste management techniques, and extensive environmental monitoring are needed to address these problems and safeguard the wellbeing of fish popu-

lations and the communities that depend on them.

Physiological and behavioral effects of pollutants on fish species

Numerous types of pollution affect Libya's coastal waterways, which has a major physiological impact on the local fish population. These contaminants, which cause a variety of physiological and biochemical abnormalities in fish, include synthetic detergents, heavy metals, and endocrine-disrupting chemicals (EDCs).Significant amounts of heavy metals, including copper, lead, zinc, cadmium, and mercury, have been discovered in Libya's marine environment, especially along the Khomse Coast. These metals cause oxidative stress and possible cellular structure damage when they build up in the tissues of fish species such as *Sarpa salpa*, *Liza saliens*, and *Pagellus acarne*. To determine the degree of heavy metal contamination in these fish species, biomarkers such malonyldialdehyde (MDA), glutathione peroxidase (GSSG P), catalase (CAT), and superoxide dismutase (SOD) are employed[21].Aquatic life in Libya is seriously threatened by the presence of artificial detergents like sodium lauryl sulphate (SLS) in the maritime environment. Fish species may have DNA mutations as a result of these detergents, which are frequently present in household and commercial wastewater. By causing DNA mutations, these detergents demonstrate their genetic toxicity, which may have long-term consequences for fish populations and the general well-being of the aquatic ecosystem[2].Elevated levels of heavy metals, including copper, lead, zinc, cadmium, and mercury, have been discovered in fish and seawater along Libya's Khomse coast. These metals cause oxidative stress and possible liver injury when they build up in the liver tissues of fish species [21].

Pollutants from petrochemical factories that release arsenic, mercury, nickel, zinc, and polycyclic aromatic hydrocarbons (PAHs) into the marine environment also impact the Libyan coastline. By potentially harming the ecosystem and human health through fish consumption, these pollutants provide ecotoxicological hazards. The increased target hazard quotients and possible carcinogenic risks linked to arsenic ingestion suggest that the presence of these contaminants in fish can cause liver damage and other health problems.[1]

Because of environmental pollutants, fish liver is more vulnerable to oxidative stress and genotoxic consequences. Fish from polluted locales had higher DNA damage and lower antioxidant enzyme activity than fish from cleaner areas, according to studies done in similar Mediterranean settings, like Tunisia's Bizerte Lagoon. Significant changes are seen in liver histology, such as lipid vacuolation and membrane disruption, which are signs of stress brought on by pollution.[22].

The petrochemical sector is the main cause of pollution in the coastal region of Libya. Chemicals including arsenic (As), mercury (Hg), nickel (Ni), zinc (Zn), and polycyclic aromatic hydrocarbons (PAHs) have been determined to be important contaminants in marine sediments by a thorough evaluation. These contaminants, especially anthropogenic mercury and arsenic, have been detected at high concentrations and are derived from industrial discharges.The kidneys of fish are essential for waste product elimination and osmoregulation. The fish's capacity to maintain homeostasis may be impacted by kidney impairment brought on by exposure to heavy metals and other contaminants[1,4]. Fish health is at risk due to the prevalence of harmful metals like arsenic and mercury in the marine environment, which can cause kidney dysfunction. Fish survival and reproduction may be impacted as a result of compromised filtration and excretion systems. With a likelihood of toxicity for the ecosystem of less than 9% for heavy metals and less than 20% for PAHs1, these pollutants are regarded as having a low to moderate ecotoxicological risk. Mercury and arsenic enrichment in surface sediments, however, suggests a substantial human influence

that may have long-term consequences for fish kidneys and other marine organisms.[1]
Consuming fish that has been contaminated with harmful metals could be harmful to human health. Life time cancer risk values imply a possible carcinogenic danger from consuming arsenic, while target hazard quotients show a possible risk linked to exposure to these harmful metals. This emphasises how crucial it is to keep an eye on and control pollution levels in order to safeguard human populations and marine life[1,4].

Conclusion

The ecology and human health are seriously threatened by aquatic pollution in Libya, especially along its lengthy coastline. It has been reported that fish and marine sediments contain heavy metals , with possible ecotoxicological hazards noted. Concentrations of these metals, which are frequently man-made, have been discovered that may endanger human health by contaminating fish, Furthermore, it has been demonstrated that fish species have DNA alterations when synthetic detergents are present in Libyan coastal waters. The harmful effects of these detergents on aquatic life are exacerbated by their interaction with other contaminants and their difficulty in biodegradation. This draws attention to the larger problem of untreated wastewater flow into marine ecosystems, which has the potential to cause serious ecological harm.
This is especially problematic for areas like Libya, where residents mostly depend on marine resources for protein in their diets and waste management procedures may not be at their best., fish populations and human health are at risk from Libya's aquatic pollution, which is typified by heavy metals, artificial detergents, and microplastics. Better waste management procedures and further study are needed to fully comprehend the effects and create practical mitigation plans in order to address these problems.This is especially problematic for areas like Libya, where residents mostly depend on marine resources for protein in their diets and waste management procedures may not be at their best. In conclusion, fish populations and human health are at risk from Libya's aquatic pollution, which is typified by heavy metals, artificial detergents, and microplastics. Better waste management procedures and further study are needed to fully comprehend the effects and create practical mitigation plans in order to address these problems.

References

1. Bonsignore, M., Manta, D. S., Sharif, E. A. A. T., D'Agostino, F., Traina, A., Quinci, E. M., ... & Sprovieri, M. (2018). Marine pollution in the Libyan coastal area: environmental and risk assessment. *Marine pollution bulletin, 128*, 340-352.
2. Habib, T. N., El-Sayed, M. F., Ali, F. M., & Almsatar, T. M. (2019). RAPD-Contaminant Indicative Bands Induced by Sodium Lauryl Sulfate of Economic Fish (Sardine Aurita) from Libyan Coasts. *Journal of Biotechnology Research, 5*(8), 69-76.
3. Gazett, M. A. (2017). Heavy Metals Poisoning in Some Local Fish. EPH-International *Journal of Applied Science, 3*(2), 27-31.
4. Fitori, A., Abdulnabi, B. M., Ali, R. A., & Ali, S. M. (2020). Effects of some heavy metal pollutants on liver and kidney performance of mullet captured from Tubruk harbor comparing to Umm Hufayan lagoon. *DYSONA-Life Science, 1*(2), 83-90.
5. Masiá, P., Mateo, J. L., Arias, A., Bartolomé, M., Blanco, C., Erzini, K., ... & Garcia-Vazquez, E. (2022). Potential microplastics impacts on African fishing resources. *Science of the total environment, 806*, 150671.

6. Hamid, I., Mahjoub, A. M., Masoud, A. N., Ishag, I. A., Fitori, A., & Abd Alhafeed, M. O. (2023). Microplastic contamination in Gills and Gastrointestinal Tract of Fish Collected from the Tobruk Coast, Eastern Libya.
7. Fitori, A. A., Ishag, I. A., Al-Shobaki, K. F., Balal, D. M., Jaballah, A., Khaled, S. A., & Alkhawaja, H. (2021). Microbial contamination in the Tobruk Bay basin. *International Journal of Multidisciplinary Sciences and Advanced Technology Special*, (1), 663-667.
8. Fitori, A. F., Al-Mismari, A. A., Mahdy, A. A., Said, R. E., & Masoud, A. N. (2022). Water Quality Assessment of Lakes (Ain Al-Ghazala and Umm-Hufayn) for Fish Culture in the Eastern Coast of Libya.
9. Fitori, A. (2021). Assessment of some heavy metals using sediments and bivalvia (Mytilus galloprovincialis) samples collected from Tobruk coast. *Scientific Journal for Faculty of Science-Sirte University*, *1*(2), 25-31.
10. Alzwi, S. A., & Belghyti, D. (2017). Description of waters pollution by crude O il at Ajdabiya, Libya. *Journal of Water Science & Environment Technologies*, *2*(2).
11. Saleh, H. N., Amin, H. A., Omar, M. Y., Mostafa, A. R., & Ebraham, Y. E. (2020). Environmental assessment of water quality and heavy metals pollution of seawater in Tobruk Bay-Libya. In Advanced Intelligent Systems for Sustainable Development (AI2SD'2019) Volume 3-*Advanced Intelligent Systems for Sustainable Development Applied to Environment, Industry and Economy* (pp. 306-318). Springer International Publishing.
12. El-Adl, M. F., El-Katony, T. M., & Saleh, A. M. (2022). Pollution and substrate characteristics are correlated with intertidal macroalgal community structure on the eastern Libyan coast. *Phycologia*, *61*(5), 528-538.
13. Jalgaif, G. G. A., Idris, S. A. M., Maarouf, R. A. M., Attia, A. M., & El-Naggar, M. M. (2018). Determination of the Sea Waters Quality of Tobruk-Libya Gulf. *International Journal of Environmental Chemistry*, *2*(1), 1.
14. Al-Asadi, M. K. K. (2018). Evaluation of marine pollution by mercury from petrochemical hot spot, west of Libya. *Mesopotamian Journal of Marine Sciences*, *33*(1), 49-56.
15. Galgani, F., Chiffoleau, J. F., Barrah, M., Drebika, U., Tomasino, C., & Andral, B. (2014). Assessment of heavy metal and organic contaminants levels along the Libyan coast using transplanted mussels (Mytilus galloprovincialis). *Environmental Science and Pollution Research*, *21*, 11331-11339.
16. Hamouda, M. S., & Wilson, J. G. (1989). Levels of heavy metals along the Libyan coastline. *Marine pollution bulletin*, *20(*12), 621-624.
17. Saad, A., Hamdaoui, F., Atmani, A., Alemad, A., Almagbari, M., Elsakran, S., Ztit, G., Hassan, A., Ipeda, A., Aljadidi, M., Kharrim, K., & Belghyti, D. (2018). Assessment of irrigation water pollution by oil waste at Jalo- Libya.. , 4.
18. Khreit, O. I., El Awamy, I. O., & Abduljalil, O. A. (2020). Development, validation, and application of a method based on reverse-phase HPLC for the simultaneous determination of six organochlorine pesticides in surface and groundwater samples collected from northeast Libya. *Al-Mukhtar Journal of Sciences*, *35*, 116-129.
19. Nour, H. E. S. (2015). Distribution of hydrocarbons and heavy metals pollutants in groundwater and sediments from northwestern Libya.
20. Ahmed, I., Zakiya, A., & Fazio, F. (2022). Effects of aquatic heavy metal intoxication on the level of hematocrit and hemoglobin in fishes: a review. *Frontiers in Environmental Science*, *10*, 919204.

21. Metwally, M. A. A., & Fouad, I. M. (2008). Biochemical changes induced by heavy metal pollution in marine fishes at Khomse Coast, Libya. *Global veterinaria*, *2*(6), 308-311.
22. Ameur, W. B., de Lapuente, J., El Megdiche, Y., Barhoumi, B., Trabelsi, S., Camps, L., ... & Borràs, M. (2012). Oxidative stress, genotoxicity and histopathology biomarker responses in mullet (Mugil cephalus) and sea bass (Dicentrarchus labrax) liver from Bizerte Lagoon (Tunisia). *Marine pollution bulletin*, *64(2)*, 241-251