

nanotechnology-assisted approaches—will be essential. Finally, strengthening the linkage between scientific research and environmental policy through standardized monitoring frameworks and risk assessment tools will be critical for effective management and long-term protection of aquatic ecosystems.

Conflict of Interest

Author declares that there is no conflict of interest.

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References

- Ali H., Khan E., and Ilahi I., 2019, Environmental chemistry and ecotoxicology of hazardous heavy metals, *Chemosphere*, 218: 442-457.
<https://doi.org/10.1155/2019/6730305>
- Aus der Beek T., Weber F.A., Bergmann A., Hickmann S., Ebert I., Hein A., and Küster A., 2016, Pharmaceuticals in the environment-Global occurrences and perspectives, *Environmental Toxicology and Chemistry*, 35(4): 823-835.
<https://doi.org/10.1002/etc.3339>
- Authman M.M.N., Zaki M.S., Khallaf E.A., and Abbas H.H., 2015, Use of fish as bio-indicators of the effects of heavy metals pollution, *Ecotoxicology and Environmental Safety*, 112: 1-10.
- Daughton C.G., and Ternes T.A., 1999, Pharmaceuticals and personal care products in the environment: Agents of subtle change?, *Environmental Health Perspectives*, 107(Suppl 6): 907-938.
<https://doi.org/10.1289/ehp.99107s6907>
- Diamanti-Kandarakis E., Bourguignon J. P., Giudice L.C., Hauser R., Prins G.S., Soto A.M., Zoeller R.T., and Gore A.C., 2009, Endocrine-disrupting chemicals: an endocrine society scientific statement, *Endocrine reviews*, 30(4): 293-342.
<https://doi.org/10.1210/er.2009-0002>
- Fent K., Weston A.A., and Caminada D., 2006, Ecotoxicology of human pharmaceuticals, *Aquatic Toxicology*, 76(2): 122-159.
<https://doi.org/10.1016/j.aquatox.2005.09.009>
- Gavrilescu M., Demnerová K., Aamand J., Agathos S., and Fava F., 2015, Emerging pollutants in the environment: Present and future challenges in biomonitoring, ecological risks and bioremediation, *New Biotechnology*, 32(1): 147-156.
<https://doi.org/10.1016/j.nbt.2014.01.001>
- Jaishankar M., Tseten T., Anbalagan N., Mathew B., and Beeregowda K.N., 2014, Toxicity, mechanism and health effects of heavy metals, *Interdisciplinary Toxicology*, 7(2): 60-72.
<https://doi.org/10.2478/intox-2014-0009>
- Jobling S., Nolan M., Tyler C.R., Brighty G., and Sumpter J.P., 2003, Widespread sexual disruption in wild fish, *Environmental Science and Technology*, 37(6): 1053-1061.
- Kumar V., Parihar R.D., Sharma A., Bakshi P., Sidhu G.P.S., Bali A.S., Karaouzas I., Bhardwaj R., Thukral A.K., and Gyasi-Agyei Y., 2023, Heavy metal contamination in aquatic ecosystems and associated human health risks, *Science of the Total Environment*, 857: 159369.
- Kumar V., Parihar R.D., Sharma A., Bakshi P., Sidhu G.P.S., Bali A.S., Karaouzas I., Bhardwaj R., Thukral A.K., and Gyasi-Agyei Y., 2019, Global evaluation of heavy metal contamination in aquatic ecosystems, *Chemosphere*, 216: 561-576.
- Livingstone D.R., 2001, Contaminant-stimulated reactive oxygen species production and oxidative damage in aquatic organisms, *Marine Pollution Bulletin*, 42(8): 656-666.
[https://doi.org/10.1016/S0025-326X\(01\)00060-1](https://doi.org/10.1016/S0025-326X(01)00060-1)
- Luoma S.N., and Rainbow P.S., 2015, Why is metal bioaccumulation so variable? Biodynamics as a unifying concept, *Environmental Science and Technology*, 49(4): 1936-1943.
- Lushchak V.I., 2011, Environmentally induced oxidative stress in aquatic animals, *Aquatic Toxicology*, 101(1): 13-30.
<https://doi.org/10.1016/j.aquatox.2010.10.006>
- Monteiro D.A., Almeida J.A., Rantin F.T., and Kalinin A.L., 2010, Oxidative stress biomarkers in fish exposed to environmental pollutants, *Comparative Biochemistry and Physiology Part C*, 151(3): 356-364.
- Moore M.N., Depledge M.H., Readman J.W., and Leonard D.R.P., 2004, An integrated biomarker-based strategy for ecological risk assessment, *Marine Environmental Research*, 58: 351-356.
- Noyes P.D., McElwee M.K., Miller H.D., et al., 2009, The toxicology of climate change, *Environment International*, 35(6): 971-986.
<https://doi.org/10.1016/j.envint.2009.02.006>
- Qu X., Alvarez P.J., and Li Q., 2013, Applications of nanotechnology in water and wastewater treatment, *Water Research*, 47(12): 3931-3946.
<https://doi.org/10.1016/j.watres.2012.09.058>
- Rai P., Kumar V., Lee S., and Kim K., 2021, Environmental fate and ecotoxicology of heavy metals in aquatic ecosystems, *Environmental Chemistry Letters*, 19: 343-357.