Di Guardo. Top Ital. sci. j. 2024;1(4)
https://doi.org/10.62684/PGIT3881

Top Italian Scientists Journal

Open Access | Editorial | Biomedical Sciences

ISSN 3033-5132

Antibiotic-resistant bacteria, micro-nanoplastics and cetaceans: A lot of food for evidence-based thoughts

Giovanni Di Guardo

Retired Professor of General Pathology and Veterinary Pathophysiology at the Veterinary Medical Faculty of the University of Teramo, 64100 Teramo, Italy.

Correspondence to: gdiguardo@unite.it

Published: 26 Sep 2024

Abstract

The present Editorial takes into consideration, from a "One Health, One Earth, One Ocean" perspective, the complex interplay between micro-nanoplastics (MNPs), persistent environmental pollutants (PEPs) and antibiotic-resistant bacteria, representing a major concern not just for people but also for wildlife inhabiting terrestrial and marine ecosystems. This holds especially true for free-ranging cetaceans, with particular emphasis on whales, which due to their filter feeding activity may become highly susceptible to the toxic effects displayed by PEPs attracted and concentrated by MNPs.

Keywords: antibiotic-resistant bacteria, micro-nanoplastics, cetaceans.

Editorial

According to a recent study, antibiotic-resistant bacteria could be responsible for almost 40 million deaths between 2025 and 2050 [1].

In this respect, the World Health Organization (WHO) has already made a number of official statements, thereby defining antimicrobial resistance (AMR) as "a major threat to public health and society's development on a global scale".

Noteworthy, infectious disease conditions caused by antibiotic-resistant bacteria are being increasingly reported among both domestic and wild animals, including free-ranging cetaceans [2]. Within such context, showing an evidence-based planetary dimension and spread of the AMR phenomenon, the alarming and progressively growing contamination of terrestrial and aquatic ecosystems by micro-nanoplastics (MNPs) represents another major concern issue. This is clearly highlighted, among others, by a famous sentence pronounced some years ago by the "World Economic Forum": "By the year 2050 there will be more plastic than fish in seas and oceans across the globe" (World Economic Forum Report, 2016).

Unfortunately, these do not appear to be the only bad news. Indeed, MNPs are known to act as powerful attractors and concentrators for a wide range of persistent environmental pollutants (PEPs), including heavy metals like methylmercury (MeHg) and organic xenobiotics such as dioxins, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and perfluorinated alkylated substances (PFAS) [3].

One of the most relevant and impactful consequences arising from the well-established tendency of MNPs to attract and concentrate upon themselves the aforementioned (and many other) PEPs resides in a prominent destabilization of marine and oceanic trophic chains, with special emphasis on filter-feeding large vertebrates like whales. As a matter of fact, by ingesting such relevant amounts of PEP-loaded MNPs, whales would "suddenly" leave their traditional ranking of "secondary consumers" - given their usual diet made of zooplancton -, thus "jumping" to trophic chain positions commonly occupied by "top predators" like dolphins, orcas (Orcinus orca) and polar bears (Ursus maritimus) [4]. According to a recent study, an average of 43.6 kilograms of plastic would be eaten by a blue whale (Balaenoptera musculus) individual on a daily basis, including 10 million MNP fragments [5]. This certainly contributes to worsen the already threatened health and conservation status of free-ranging whales worldwide, especially in heavily polluted areas such as the North and the Mediterranean Sea basins [6]. Within this framework, the proven immunotoxicity and neurotoxicity displayed by many PEPs and, to a greater extent, also by their mixtures, along with their endocrine-disrupting activity, should be viewed as key factors responsible for the aforementioned negative effects on the already compromised health and conservation status of the whales inhabiting our Planet's seas and oceans [7]. Furthermore, adequate attention should be also paid to the documented role played by MNPs as carriers of several microbial pathogens, including antibiotic-resistant bacteria which could then exchange, by means of "horizontal transfer", their AMR genes with other bacterial agents colonizing plastic substrates [8].

In consideration of the above alongside the intrinsic relevance, complexity and mutual interconnection of the herein dealt issues, I strongly believe that a multidisciplinary, "One Health, One Earth, One Ocean"-based approach would undoubtedly represent the best strategy to adopt in order to properly assess the real "magnitude" of these alarming phenomena. This could additionally prove useful in mitigating the harmful effects due to the progressively increasing exposure to MNPs of whales and, more in general, of the wild fauna populating our increasingly fragile marine and terrestrial ecosystems.

Declarations

Conflict of Interest

The Author declares that there is no conflict of interest.

References

1. Naghavi, M., et al. (2024). Global burden of bacterial antimicrobial resistance 1990-2021: A systematic analysis with forecasts to 2050. Lancet
DOI: https://doi.org/10.1016/S0140-6736(24)01867-1.

2. Obusan, M.C.M., et al. (2021). Bacteriological and histopathological findings in cetaceans that stranded in the Philippines from 2017 to 2018. PLoS One 16(11):e0243691.
DOI: 10.1371/journal.pone.0243691.

3. Xiang Y., et al. (2022). Microplastics and environmental pollutants: Key interaction and toxicology in aquatic and soil environments. J. Hazard. Mater. 422:126843. DOI: 10.1016/j.jhazmat.2021.126843.

4. Berta A., Kienle S.S., Lanzetti A. (2022). Evolution: Killer whale bites and appetites. Curr. Biol. 32(8):R375-R377.
DOI: 10.1016/j.cub.2022.03.001.

5. Kahane-Rapport, S.R., et al. (2022). Field measurements reveal exposure risk to microplastic ingestion by filter-feeding megafauna. Nat. Commun. 13:6327. DOI: https://doi.org/10.1038/s41467-022-33334-5.

6. Concato M., et al. (2023). Detection of anthropogenic fibres in marine organisms: Knowledge gaps and methodological issues. Mar. Pollut. Bull. 191:114949. DOI: 10.1016/j.marpolbul.2023.114949.

7. Jeong, H., Ali, W., Zinck, P., Souissi, S., Lee, J.S. (2024). Toxicity of methylmercury in aquatic organisms and interaction with environmental factors and coexisting pollutants: A review. Sci. Total Environ. 943:173574. DOI: 10.1016/j.scitotenv.2024.173574.

8. Di Guardo, G. (2023). Flood-Associated, Land-to-Sea Pathogens' Transfer: A One Health Perspective. Pathogens 12(11):1348. DOI: 10.3390/pathogens12111348.