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Call for Input: Microbiology and the EU Water Framework Directive (WFD) Revision

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For the longest time, microbiology has not been well recognised in water policy, based on the various parameters used for assessments under the Water Framework Directive. A gap has been created, since microbiology is recognised in water policy chiefly from a human health perspective, but not clearly from an ecosystem and environmental health perspective.

These reflections address the challenge stated above:

Ecological status is currently being assessed using biological elements such as:

- Aquatic flora
- Phytoplankton
- Benthic invertebrates
- Fish

These biological elements are very necessary but not sufficient for a comprehensive ecological assessment. They are more or less macro-biologically focused, with only the phytoplankton representing just a part of the microbial world. Life essentially consists of three main domains: Bacteria, Archaea, and Eukarya. Based on the current assessment, the biological elements are primarily focused on Eukarya, although phytoplankton is a functional category that includes both Eukarya and Bacteria. The assessment failed to include other domains of life that are fundamental ecological drivers of the ecosystem. These domains form the basis of all life on Earth, governing nutrient cycling, energy flow, and habitat modification, which are essential for ecosystem functioning (McNichol et al., 2025). They do not operate in isolation; they are highly interconnected.

Waterborne pathogenic microorganisms, including bacteria, viruses, parasites, and fungi, pose risks beyond human health, serving as important agents of ecological change that can degrade habitats, diminish biodiversity, and disrupt trophic interactions. Frequently introduced through sewage discharge, agricultural runoff, or

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wildlife excreta, these pathogens function as environmental stressors capable of modifying ecosystem structure and altering functional dynamics (Banerji et al., 2024).

Hence, microbial indicators should be considered alongside the biological quality indicators currently outlined in the WFD for assessing ecological status.
The indicators I therefore recommend include:

- Prokaryotic communities (bacteria, archaea, cyanobacteria) as part of a more holistic, real-time assessment.
- Faecal coliforms such as *Escherichia coli*, intestinal enterococci.
- Total coliforms
- Bacteriophages
- Soil protozoa, particularly testate amoeba, are used to monitor ecological changes in terrestrial environments.
- The archaea community, such as ammonia-oxidizing archaea (AOA).
- Antimicrobial Resistance (AMR): This indicator should be included for AMR monitoring in surface and groundwater

At present, microbiology is too narrowly confined within EU water legislation, where it is largely restricted to human health–focused directives. It should instead be explicitly and more broadly integrated into ecosystem-based frameworks such as the Water Framework Directive (WFD). Such recognition would be transformative, given that microorganisms are fundamental drivers of ecosystem processes; without decomposers or methanogenic microbes, essential biogeochemical cycles would not be sustained. This gap must be addressed to ensure a more balanced and scientifically grounded perspective.

References

McNichol, J., Williams, N. L. R., Raut, Y., et al. (2025). Characterizing organisms from three domains of life with universal primers from throughout the global ocean. *Scientific Data, 12*, 1078. https://doi.org/10.1038/s41597-025-05423-9

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