

Testate amoebae as bioindicators of environmental pollution

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In today's rapidly developing world, environmental pollutants are becoming increasingly prevalent, compounded by the accelerating effects of global climate change and biodiversity loss. As a result, ecosystems are facing unprecedented levels of impact and disruption. In light of these pressing issues, the study of bioindicators holds immense practical significance and special value [1].

Bioindication is a method of evaluating the condition of environmental objects by assessing the state of the biota. Bioindicators are organisms or communities whose presence, state, or behavior serves as an indicator of environmental processes or the presence of specific pollutants [2]. Bioindication provides a promising, potentially cost-effective approach to monitoring the effects of external factors on ecosystems and their long-term development, as well as distinguishing between uncontaminated and contaminated sites. Precision of bioindication assessment can be directly compared to instrumental measurement of environmental chemicals [3].

The testate amoebae are globally distributed single-celled protists. Due to their ability to live in various ecosystems, their extreme sensitivity to changes in environment, their short life cycle, and their accessibility, testate amoebae have been increasingly used as bioindicators to monitor changes in various environmental conditions, especially natural ones such as substrate humidity, pH, and water table depth [4, 5]. But application of testate amoebae as bioindicators of environmental pollution is not so broad.

It is worth noting, that currently there are no references summarizing bioindication values of testate amoebae for environmental pollution. Although a review by Freitas et al. [6] exists, it is inadequate for practical application due to its broad and loosely synthesized nature.

In the last decade, meta-analysis as a statistics-based approach to literature reviews became an extremely popular tool owing to development of accessible software [7]. However, at the beginning of our study, we revealed, that literature data about bioindication values of testate amoebae for pollution are sparse, inconsistent, and, in general, insufficient to carry meta-analysis out. Due to this reason, our aim in this study is to present a systematic review in the selected topic. As a main rule of our systematic review, we paid especial attention to community level of bioindication and species composition of testate amoeba communities where reported bioindicators dwell.

By present time, we have summarized literature evidences concerning 18 species of testate amoebae from terrestrial (soil, mosses biotopes) and aquatic (water column, bottom sediments) biotopes, which can be used as bioindicators of 5 types of pollutants (heavy metals, arsenic, road salt, atmosphere nitrogen oxides, organic pollution (eutrophication)). Totally 10 literature sources were processed.

Further perspectives of our study are related with extension of our review to the quantitative bioindication of saprobity basing on Sladeczek's water quality system.

In the further work, we will apply our results to published data and other accessible data on testate amoebae communities across various localities in Shenzhen as a means of testing the applicability of our review.

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