

The Use of Morphological Diversity of Bacteriae for Ecological Monitoring*

Olga M. KOZOVA and Natalya V. DUTOVA

*Scientific Research Institute of Biology at State University of Irkutsk,
P. O. Box 24. Lenin str, 3. Irkutsk - 3, 664003, Russia*

Abstract: *The Institute of Biology investigations of morphological diversity of bacteriae with the aid of electronic microscopy are used for the purposes of ecological monitoring. The results obtained allow to recommend this method to be widely applied.*

It has been demonstrated that for oligotrophic lake Baikal microflora consists mainly from ultra-microscopic cocci. Where the river Selenga inflows into Baikal morphological diversity of bacteriae is much wider. Bacterioplankton of Irkutsk reservoir by morphological characteristics is very similar to one of lake Baikal In meso-eutrophic Bratsh reservoir bacterioplankton is more morphologically diversified. There are flexibacteriae, vibrios. Caulobacter sp. cells occurring in its water body.

In the places of waste waters' income to river. Angara morphological diversity of bacteriae is high and various forms with projections etc. can be observed.

Keywords: *aquatic ecosystems, bacterioplankton, morphological diversity, monitoring*

1. Introduction

The assessment of water bodies state and pollution control use different methods and tools of investigation, including parameters of morphological diversity of microorganisms (size composition, cell shape etc.). Investigations, concerning morphological diversity of bacterioplankton are occasional, standard criteriae of assessment of influence of pollution on morphological diversity are absent, though it is a topic of interest for indication of quality of waters and its prognosis. The use of electronic microscopy as one of tools of bacterial population of water in large degree has widened our knowledge of its morphological diversity and gave us new possibilities to improve our views on it. We have studied the bacterial population of some water bodies and flows and find great morphological diversity of it (Tab. 1). Microflora is represented as well by usual (cocci, bacilli) as rare forms (cells with fimbriae and projections etc.). The first are wide spread and are dominant. Rare forms occur in specific conditions (Kozhova and Dutova, 1989; Dutova and Kozhova, 1992).

* Received 1997-02-25; accepted 1998-03-27.

To estimate the main features of morphological diversity of bacteriae changes depending on the strength of anthropogenic influence we have fulfilled investigation in lake Baikal-Irkutsk reservoir Bratsk reservoir.

2. Material and Methods

The samples of water 1 L in volume have been taken from the surface layer and processed for 24 h at the temperature of 5 °C to obtain condensed bacterial sediment, than water was poured out, sediment was placed on electronic nets ($\Phi = 3$ mm) with collodium film and exposed to air for fixation. Dried samples were covered with chromium and were investigated with the use of electronic microscope Tesla BC-540.

Tab. 1 Composition of the morphological forms of bacteriae predominant in various types of ecosystems

Morphological typ. genus	Lakes		Reservoirs		Angara river
	Baikal	Khubsugul	Irkutsk	Bratsk	
Ultracocci ($\Phi = 0.07 - 0.14 \mu\text{m}$)	+	+	+	-	-
Cocci ($\Phi = 0.5 - 1 \mu\text{m}$)	+	+	+	+	+
Bacilli up to $1 \mu\text{m}$	+	+	+	+	-
more than $1 \mu\text{m}$	+	+	+	+	+
<i>Vibrio</i>	+	+	+	+	+
<i>Bdellovibrio</i>	+	+	+	+	-
<i>Microcycclus</i>	+	+	+	+	-
<i>Spirillum</i>	-	-	-	+	+
<i>Hyphomicrobium</i>	-	-	-	-	+
<i>Asticcacaulis</i>	-	-	-	-	+
<i>Caulobacter</i>	+	+	+	+	+
Spirally curved	-	-	-	-	+
Filamentous	+	+	+	+	+
Flexibacteriae	-	-	-	+	+
Cells with filamentous projections	-	-	-	-	+
Cells with coniform projections	-	-	-	-	+
Cells with fimbriae	-	-	-	+	+

3. Results and Discussion

Bacterioplankton in the region of Selenga Shallows is represented by 8 morphological types. The diversity of microorganisms in large extent is expressed in coastal zone in 10 km from the river Selenga inflow. Here bacilli of different size and shape, various filamentous bacteriae, stem forms, vibrios and spirillae are found. At deep water station the composition of microflora differs: there are cocci, bacilli, small vibrios (less than $1\mu\text{m}$), *Microcycclus*. The main shape in the region of Selenga Shallows belongs to ultracocci with $\Phi = 0.07 - 0.14 \mu\text{m}$. In spatial distribution the tendency of increase of number of ultracocci rewards the deep water zone.

In Irkutsk reservoir, as well as in Selenga Shallow, the main group in the structure of bacterioplankton is ultracocci. Among others morphological types there are some bacilli; filamentous,

vibrios, stem forms are insufficient.

In the region of Baikal Pulp & Paper the pollution of water was observed. The most part of net is covered with particles of suspended matter. Common microflora occurs here, including cocci and bacilli, no ultracocci are observed.

The most expressed effect of anthropogenic impact is found at Angara river down from Irkutsk. In the site of influence of- Angarsk Oil Processing waste waters the morphology of bacteriae is very diversified: filamentous, bud and stem forms. Also very specific forms are found here: bacteriae with filmberiae, various projections. These forms can be used as indicators of anthropogenic pollution. Similar morphological composition takes place for 1 km from the site of wast waters input. Some change in natural communities can be observed for 5 more km.

In Bratsk reservoir cocci, various bacilli, vibrios are predominant. Filamentous and stem forms are occasional. Specific forms, indicators of severe pollution are not observed.

4. Conclusion

Substantial changes are observed in the structure of bacterioplankton under the action of anthropogenic factors. Morphological composition of bacterioplankton in polluted or more eutrophic sites is substantially more rich with forms. This property can be used in aquatic ecosystems monitoring for estimation of their state and prediction of its changes under the anthropogenic impact.

References

- Dutova, N. V., and Kozhova, O. M. 1992. The study of bacterial morphology with the use of electronic microscopy in experiments with the water of different quality. *Hydrobiological Journal*, 28: 39-44. (in Russian).
- Kozhova, O. M., and Dutova, N. V. 1989. Morphological diversity of planktonic bacteriae as the indicator of water quality. *Hydrobiological Journal*, 25: 42-48. (in Russian).