

Vertical distribution of Baikal endemic sponges (Fam. Lubomirskiidae)

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ABSTRACT. We analyzed the species diversity and vertical distribution of the species of Baikal endemic sponges by depths along the transects in Listvennichny Bay as well as near Varnachka Valley and Turali Cape. The analysis revealed that over 15 years there was no changes in the species composition in these places. The pattern of change in the species composition with depth was also preserved. However, we observe a decrease in the number of the branching sponge *L. baikalensis*, which no longer dominates other species as it was before.

Keywords: Lubomirskiidae, sponge disease, species diversity

1. Introduction

In Lake Baikal, there are two families of sponges, cosmopolitan Spongillidae (3 species) and endemic Lubomirskiidae (15 species) (Manconi and Pronzato, 2019; Bukshuk and Maikova, 2020). Among zoobenthos, sponges are one of the dominant groups, reaching the maximum abundance and species diversity at depths from 3 to 40 m (Efremova, 2004; Masuda, 2009). The same range of depths concentrates the main species diversity of other benthic organisms. Under the changes in the ecosystem over the past ten years, the study of species composition and vertical distribution of Baikal endemic sponges has become especially relevant now. In 2015, we laid transects in all three Baikal basins to monitor the state of sponge fauna. Methods for laying transects, their geomorphological characteristics and location were previously described (Khanaev et al., 2018). During 2015-2016, a quantitative collection of sponges was carried out along some transects in southern and northern basins of the lake to study the species composition of the Baikal endemic sponge fauna and its change with depth.

2. Materials and methods

Sponges were collected in 2015 at the polygon in Listvennichny Bay (transects 9-11) and in 2016 at the polygon near Varnachka Valley (west coast of Southern Baikal, the area of the Bolshiye Koty settlement, transects 1-3) as well as near Turali Cape (east coast of Northern Baikal, transect 8). For the samples from the transects 1-3 and 8, a relative species abundance at various depths was also determined. Within the

polygons, transects were located at the 150-m distance from each other.

Sponge samples were collected along the transects at a distance of 1-2 m from the marked halyard in a minimally traumatic way by taking a small piece of sponge from its edge with a test tube. We also made underwater photographs and depth referencing of the sampled sponges. For species identification of sponge, the following diagnostic characters were used: body shape, color, body consistency, shape and size of oscula, the morphology of spicules, and skeleton structure (Efremova 2004).

3. Results and discussion

Along the transects 9-11 (Listvennichny Bay), in 2015, we detected 11 sponge species: *L. baikalensis*, *L. abietina*, *L. fusifera*, *L. incrustans*, *B. bacillifera*, *B. fungiformis*, *B. intermedia*, *B. martinsoni*, *B. recta*, *R. echinata* and *S. papyracea* (Khanaev et al., 2018). *B. bacillifera* and *B. intermedia* were the most common (relative abundance was 28 % and 20 %, respectively). *L. fusifera* and *R. echinata* were the rarest (0.8 % each). The same species were collected in this area from 1996 to 2001 (Veinberg, 2005).

Near Varnachka Valley (transects 1-3), in 2016, we detected nine sponge species: *L. baikalensis*, *L. abietina*, *L. incrustans*, *B. bacillifera*, *B. fungiformis*, *B. intermedia*, *B. martinsoni*, *B. recta* and *S. papyracea* (Fig. 1A, Fig. 1B). E. V. Veinberg (2005) indicated ten species in the collection from 1996 to 2001 for the area of the Bolshiye Koty settlement: there was also *L. fusifera*. It is unlikely that the lack of *L. fusifera* in our collection reflects a real change in the species composition. Most

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likely, this rather rare species was not simply included in our collection. This may be also due to heterogeneity of the species composition in the study area, which is associated with the topography and geology of the bottom.

Along the transect 8 (Turali), in 2016, we detected only four sponge species: *L. baikalensis*, *L. abietina*, *B. bacillifera* and *B. intermedia*. There are no published data on the species composition near Turali Cape in the early 2000s. However, the collections of sponge fauna near east coast of the Northern Baikal basin from 1993 to 2001 included *L. baikalensis*, *L. incrustans* and *B. intermedia*, among which *B. intermedia* was the most common species (Masuda, 2009). In our collections from all stations of the transect 8, *B. intermedia* and *L. abietina* prevailed, whose relative abundance was 59 – 88 and 12 – 35 %, respectively.

Therefore, we may assume that over 15 years along the investigated transects in Listvennichniy Bay, near Varnachka Valley and Turali Cape, there was no significant change in the species composition of sponge fauna. The pattern of change in the species composition with depth was also preserved: *B. intermedia* and *L. incrustans* prevail at a depth of 3 m as earlier; the diversity gradually increases with depth (Bukshuk, 2014).

Due to the incomplete data and different methods of different researchers, it is difficult to discuss the proportion of species in the community. Nevertheless, it should be noted that *L. baikalensis* was one of the prevailing species in the collections of Y. Masuda (Masuda, 2009), whereas in our samples, only single specimens represent this species. Previously, it was repeatedly stated that branching *L. baikalensis* was the most susceptible to massive diseases that developed in the past decade (Timoshkin et al., 2016; Khanaev et al., 2018). It was shown that in Listvennichniy Bay,

the *L. baikalensis* with a height of more than 50 cm can completely degrade in five months (Suturin et al., 2016). Perhaps, the abundance of this species reduced due to epizooty. However, the data on the area coverage of the bottom with sponges per 1 m² are contradictory as evidenced by the stations and visual observations of divers. In particular, our collections based on the results of random sampling near Varnachka Valley almost lacked *L. baikalensis* (less than 2 % of the total number of sponges). At the same time, according to visual observations, the branching sponges were rather common, sometimes forming thickets. On the other hand, in the samples from Listvennichniy Bay, *L. baikalensis* was 8 %, whereas a visual assessment indicated a significant decrease in the number of the branching sponge: in the investigated area of 2400 m², we detected only eight specimens (the observation was carried out along the coastline at the site extending for 300 m, at depths from 6 to 10 m). These contradictions may be due to the patchy distribution of *L. baikalensis*.

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References

- Bukshuk N.A. 2014. Ecological features of endemic sponges of Lake Baikal: distribution and life cycles. Cand. Sc. Dissertation, Irkutsk State University, Irkutsk, Russia. (in Russian)
- Bukshuk N.A., Maikova O.O. 2020. A new species of Baikal endemic sponges (Porifera, Demospongiae, Spongillida, Lubomirskiidae). ZooKeys 906: 113-130. DOI: 10.3897/zookeys.906.39534

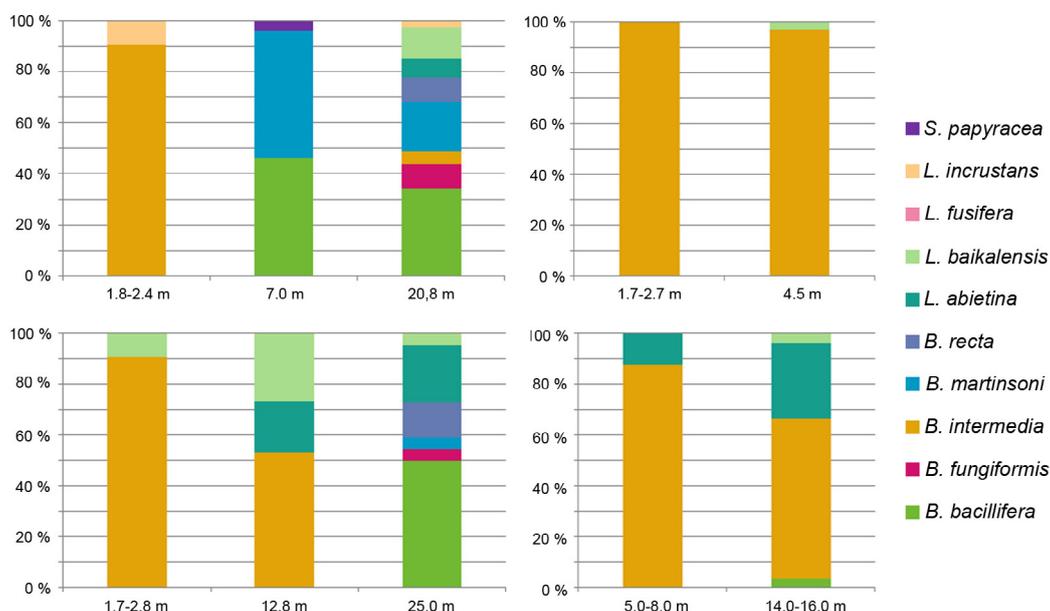


Fig.1. A – Varnachka, transect 1, B – Varnachka, transect 2, C – Varnachka, transect 3, B – Turali, transect 8.

Efremova S.M. 2004. Novel genus and novel species of the Lubomirskiidae Rezvoj, 1936 sponge family. In: Timoshkin O.A. (Ed.), *Annotirovannyi spisok fauny ozera Baikal i yego vodosbornogo basseyna* [Index of animal species of Lake Baikal fauna and its catchment area]. Novosibirsk, pp. 1261-1278. (in Russian)

Khanaev I.V., Kravtsova L.S., Maikova O.O. et al. 2018. Current state of the sponge fauna (Porifera: Lubomirskiidae) of Lake Baikal: sponge disease and the problem of conservation of diversity. *Journal of Great Lakes Research* 44: 77-85. DOI: 10.1016/j.jglr.2017.10.004

Masuda Y. 2009. Studies on the taxonomy and distribution of freshwater sponges in Lake Baikal. In: Müller W.E.G., Grachev M.A. (Eds.), *Biosilica in evolution, morphogenesis, and nanobiotechnology*. Berlin/Heidelberg, pp. 81-110. DOI: 10.1007/978-3-540-88552-8_4

Manconi R., Pronzato R. 2019. Phylum Porifera. In: Rogers D.C., Thorp J. (Eds.), *Keys to palaeartic fauna: Thorp*

and Covich's freshwater invertebrates, 4th ed. Amsterdam, pp. 45-87. DOI: 10.1016/B978-0-12-385024-9.00003-4

Suturin A.N., Chebykin E.P., Malnik V.V. et al. 2016. Rol' antropogennykh faktorov v razvitii ekologicheskogo stressa v litorali ozera Baikal (akvatoriya pos. Listvyanka) [The role of antropogenic factors in the development of ecological stress in Lake Baikal littoral (the Listvyanka settlement lakescape)]. *Geografiya i Prirodnyye Resursy* [Geography and Natural Resources] 6: 43-54. DOI: 10.21782/GiPR0206-1619-2016-6(43-54) (in Russian)

Timoshkin O.A., Samsonov D.P., Yamamuro M. et al. 2016. Rapid ecological change in the coastal zone of Lake Baikal (East Siberia): is the site of the world's greatest freshwater biodiversity in danger? *Journal of Great Lakes Research* 42: 487-497. DOI: 10.1016/j.jglr.2016.02.011

Veinberg E.V. 2005. Sponge fauna of Pliocene-Quaternary deposits of Baikal. Cand. Sc. Dissertation, Zoological Institute RAS, Saint-Petersburg, Russia. (in Russian)