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ALIEN SPECIES AND THEIR ROLE IN WATER ECOSYSTEMS

THE FIRST RECORD OF CORBICULA CLAMS (BIVALVIA, CORBICULIDAE) IN NORTHERN-EUROPEAN RUSSIA

Y.V. Bespalaya, I.N. Bolotov, O.V. Aksenova, A.V. Kondakov, S.E. Sokolova

IBIGER – Institute of Biogeography and Genetic Resources, Federal Center for Integrated Arctic Research, Russian Academy of Sciences, jbespalaja@yandex.ru

Biological invasions are a serious threat to environmental protection and the biological diversity (Oliveira et al. 2015). Studies have shown that invasive species can significantly alter the habitat of native species and having a negative impact on them (Simberloff et al., 2013; Lopes-Lima et al. 2016). Contrariwise, some authors questioned the real importance of invasion impacts (Davis et al. 2011). Proportion of alien species is lower in high-latitude regions than elsewhere (Gollasch 2006; Alsos et al. 2015). However, increasing of human activity and climate change are expected to rise the number and impact of alien species in the northern regions (Alsos et al. 2015). Numerous published sources indicate that the clams in the genus Corbicula is a one of the most exotic and aggressive freshwater invaders and their invasion may lead to negative environmental and economic consequences (Simberloff et al. 2013; Oliveira et al. 2015). In this paper, we describe the first record of a well-established Corbicula population in Northern European Russia, which is actually the furthest northern record of corbiculids in Europe.

The studies were conducted in the Arkhangelsk Oblast, Northern European Russia. The specimens of Corbicula clams were collected in a technological channel of the Arkhangelsk thermal power plant (TPP). The TPP is located in the industrial zone on the right bank of the river Kuznechikha, a tributary of the River Severnaya Dvina. For each site, from 3 to 5 replicates were gathered, using a rectangular hand net (dimensions of 0.28×0.50 m, mesh size of 200 mm) covering a total sampling area of 0.14 m^2 at every sample. The present study includes new multi-locus molecular data for 20 Corbicula specimens. A total DNA was extracted from foot tissues using

a standard phenol/chloroform procedure (Sambrook et al. 1989). The three partitions, *i.e.*, the *cytochrome c oxidase* subunit I (*COI*), 16S ribosomal RNA (16S rRNA) and 28S ribosomal DNA (28S rDNA) genes, were amplified and sequenced using a set of universal primers.

Among a total sample of Corbicula clams, two distinct morphotypes were distinguished based on the shell characters, *i.e.*, the shell shape, size, external and internal coloration, sculpture and umbo position. They are correspond to the forms, which were described previously, namely the morphotype Rlc and the morphotype R (Pfenninger et al. 2002; Marescaux et al. 2010; Pigneur et al. 2011). According to certain taxonomic works (Araujo et al. 1993; Glaubrecht et al. 2003), both these morphotypes should be treated as *Corbicula fluminea* based on the morphological features.

In general, our sample contains 8 specimens of the *Corbicula* morphotype Rlc and 214 specimens of the Corbicula morphotype R (3.6 % and 96.4 % of a total number of specimens, respectively). The specimens of the *Corbicula* morphotype R has prevailed in the mollusc assemblage in the warm channel with mean density (±s.e.m.) of 23.8±4.3 ind./m^2 (ranges from 17.9 to 32.1 ind./m^2), while the Corbicula morphotype Rlc has rarely occurred with mean density <0.6 ind./m^2 (ranges from 0 to 7.1 ind./m^2). Six other mollusc species living together with Corbicula clams were found, *i.e.*, non-indigenous *Dreissena polymorpha* (Pallas, 1771), and native species *Radix baltica* (Linnaeus, 1758), *Valvata piscinalis* (Müller, 1774), *Lymnaea palustris* (Müller, 1774), *Bithynia tentaculata* (Linnaeus, 1758) and *Physa* sp. The density of these species was low (<1 ind./m^2).

It was establish that the reproductive period starting in spring. The specimens of the morphotype R with incubated larvae in gills were found in late May. Larvae were found in inner demibranchs and have D-shaped configuration. The size of larvae ranging between 96 mμ and 160 mμ (with average length 123.4±17.8 mμ, $N = 30$). Study of anatomical features of the sampled specimens from Northern European Russia supports the hypothesis that these clams should be treated as *Corbicula fluminea* (specimens of the morphotype Rlc) and *C. fluminalis* (specimens of the morphotype R) in accordance with taxonomic revisions, which were provided by Araujo et al. (1993) and Korniushin (2004).

New COI, 16S rRNA and 28S rDNA gene sequences from 20 specimens were obtained. The dataset contains two distinct mitochondrial (mtDNA) haplotypes, the R-haplotype and S-haplotype, with the mean *p*-distance of 2.1 %.

We discovered a mismatch between mtDNA haplotypes and morphotypes. The specimens that share the R-haplotype are correspond to the morphotype Rlc based on morphological and anatomical features. In contrast, the specimens, which are correspond to the morphotype R by the shell features,

show the S-haplotype of the mtDNA. This is probably in consequence of androgenesis and egg-capture between the different morphotypes, resulting in several distinct androgenetic species with distantly related mtDNA genomes and divergent morphologies (Hedtke et al. 2008; Pigneur et al. 2011). The cytonuclear mismatches were detected at some of the locations where different lineages occur in sympatry (Pigneur et al. 2014).

Consequently, the presence of cryptic hybrids between the R, Rlc and S lineages can be assumed. The possibility of a peculiar hybridization through androgenesis between forms suggests that invasive lineages of Corbicula may represent a polymorphic species complex (Glaubrecht et al. 2003; Pigneur et al. 2011). Future studies will include checking of distribution of the Corbicula species in the basin of the River Northern Dvina and estimating of possible ecological effects of these invaders on native biodiversity and ecosystem functioning. Additionally, the molecular genetic features of these clams need further investigations.

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THE IMPACT OF INVASIVE *ACER NEGUNDO* LEAF LITTER ON MICROBIAL CHARACTERISTICS IN THE COASTAL ZONE OF THE RIVER NERIS

A. Krevš, A. Kučinskienė

Nature Research Centre, Vilnius, Lithuania, alinakrevs@gmail.com

The invasive to Lithuania boxelder maple (*Acer negundo* L.) has become commonly distributed after its escape from cultivation in 1963 (Gudzinskas, 1998) and rapidly colonizes the rivers coasts, which are dominated by native black alder (*Alnus glutinosa* (L.) Gaertn.). The leaf fall of trees occur in different ways. *A. glutinosa* leaves fall gradually within approximately one–two month, while *A. negundo* almost at once with the occurrence of early autumnal frosts (our observation), forming a thick layer of leaf litter, which creates particularly favourable conditions for biodestruction. In this connection, the study of the impact of *A. negundo* habitats on the ecotones of rivers becomes relevant in terms of enrichment of the coastal zone by the substances from decomposing leaves of this tree.

During the ice-free seasons in 2013–2014, the physicochemical and microbial investigations were carried out in different coastal zones of the River