БИОЛОГИЧЕСКИЕ НАУКИ

К 594.3: 574.587

D.V. Manakov
Independent researcher and librarian
Immanuel Kant Baltic Federal University (IKBFU): Library
Kaliningrad, Russia

ECOLOGICAL AND FAUNISTIC CHARACTERISTICS OF MOLLUSCS OF THE ANGRAPA (ANGERAPP) RIVER, KALININGRAD REGION, RUSSIA

The Angrapa River (in Polish: Węgorapa or Wengorapa)) is a favorite place for fishing and rafting of Kaliningrad water tourists (Fig. 1). It begins in Poland in the Lake Mamry (Large Masurian Lakes) near town of Węgorzewo. In the middle of river extent, this transboundary watercourse flows in the Ozersky district of eastern part of the Kaliningrad region, Russia, where hydroelectric power plant is located in town of Ozersk.

There are only a single publication that dedicated to the zoobenthos of the mouth of the Angrapa River [1], where 16 species of molluscs were found. Other parts of the river have not been investigated. All this, as well as the fact that Angrapa River is associated with faunistically rich Mazurian Lakes, determines the actuality of this work.

The goal of given study is a preliminary characteristics of the malacofauna of the middle reaches of the Angrapa River, and in particularly to describe the mollusks species composition, their quantitative and biotopic characteristics, and the thanatocoenosis. Molluscs were collected from 19 to 24 August 2015 on the part of the river from the Stadium of Ozersk town to the point the Zhuchkovo village with use of a boat (Fig. 2). Three additional parts of the river were investigated from its bank: in the Mayakovsky village, in the village Veselovka near railway and automobile bridges. 29-30 September 2015 the mollusks were collected additionally in the part of the river in Ozersk above the dam of the hydroelectric power station and near it. In this paper we use one photo of thanatocoenosis of Angrapa river that was collected in spring of 2009. We are not investigated the species composition of this sample and it is us obvious fault because of loss of this sample by emergency reasons.

Standard methods of sampling have been used [2]: a hydrobiological scoop-net (13x15 cm frame, 1 mm grid mesh). We examined for the presence or absence of bivalve and gastropod molluscs on the shoals a variety of substrates, coastal and rooted in bottom sediments of aquatic plants with or without floating leaves. Typical parts of the river, varieties of river ground, extractable substrates and basic types of plant communities were photographed on a digital camera Nikon COOLPIX L29. In five places (Ozersk, the Stadium; 3 and 4 km, upstream the Zhuchkovo village; a dam in the village of Zhuchkovo; an automobile bridge in the village of Veselovka) river deposits

containing shells of died molluscs were found, i.e. they were the sampling sites for thanatocoenoses. After the identification of mollusc species immediately in field, the live mollusks were restored to the river. We selected some of specimens for photographing. For identification in the field, an identification key of the mollusks of Germany was used [3]. Some specimens of alive molluscs and samples from the thanatocoenoses were identified in the laboratory [4, 5, 6]. Generic and species names are given according to [7] and [8].

Figure 1. In the middle reaches of the Angrapa River
(The map of site location in the Kaliningrad Region)

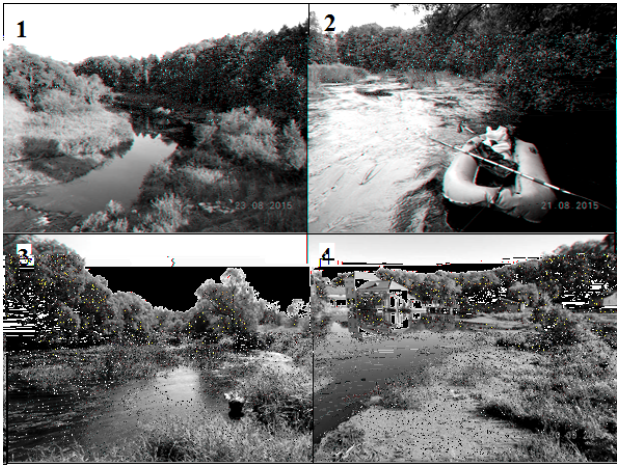

Figure 2. Some photos of the Angerapa River
(1 - Veselovka Village (in Railway Bridge); 2 - Kolhoznoje Vill.; 3 - Majakovskoje Vill.;
4 - Ozersk Town, above the dam of the hydroelectric power plant water vegetation)

We were totally found 32 species of molluscs (22 - Gastropoda; 10 - Bivalvia), that are presented in Table 1. From these molluscs: 17 species with presence only living examples are found (11 - Gastropoda; 6 - Bivalvia).

Of the bivalves, the unionid mussels predominate in the studied part of the Angrapa River. These were *Unio pictorum* (L., 1758) and *U. crassus* (Philipsson, 1788), which occur together or separately in the form of small settlements or isolated single specimens. In the samples, one of them usually prevails. Much less frequently and in smaller quantities *Pseudanodonta complanata* (Rossmässler, 1835) was found. Near Ozersk other large bivalves were represented by single findings of *U. tumidus* (Philipsson, 1788) and *Anodonta anatina* (L., 1758). Settlements of *A. anatina* were located in the slow flow zone near the dam in the village Zhuchkovo. In the river, single specimens of *Pisidium amnicum* (Müller, 1774) and *Sphaerium rivicola* (Lamarck 1818) were occurred (Table 1).

Of the Gastropoda, below the dam in Ozersk, *Theodoxus fluviatilis* (L., 1758), *Bithynia tentaculata* (L., 1758) and the small examples of *Radix* sp. were prevailed. From the point above the dam in the Zhuchkovo village in Angrapa *Viviparus viviparus* (L., 1758) was discovered. Single specimens of *Ancylus fluviatilis* Müller, 1774 and the rarest species *Gyraulus laevis* (Alder, 1837) were found in middle part of the river.

In autumn, the following species of molluscs of permanent water bodies were found in the Ozersk dam area near shoreline among water vegetation debris: *Planorbarius corneus* (L., 1758), *Lymnaea stagnalis* (L., 1758), *Physa fontinalis* (L., 1758), *Radix auricularia* (L., 1758), *B. contortus*, *Anisus vortex* (L., 1758), *Stagnicola corvus* (Gmelin, 1791), *Acroloxus lacustris* (L., 1758), *B. tentaculata*, *V. piscinalis*. On small stones and boulders in the area below the dam was found *Th. fluviatilis*.

Alive and died mollusks species composition of studied part in the Angrapa river in 2015

Species	Station №					
	1	2	3	4	5	6
1. *Viviparus viviparus* (L., 1758)					ж	
2. *Theodoxus fluviatilis* (L., 1758)	LV	LV	LV	LV	LV	LV
3. *Bithynia tentaculata* (L., 1758)	LV	LV	LV	LV	LV	●
4. *Valvata piscinalis* (Müller, 1774)	LV	●		●	●	●
5. *Valvata cristata* Müller, 1774		●			●	●
6. *Potamopyrgus antipodarum* (Gray, 1843)						●
7. *Ancylus fluviatilis* Müller, 1774		LV		LV	LV	●
8. *Acroloxus lacustris* (L., 1758)	LV			●	●	
9. *Lymnaea stagnalis* (L., 1758)	LV				LV	
10. *Stagnicola corvus* (Gmelin, 1791)	LV					
11. *Radix auricularia* (L., 1758)	LV	LV	LV	LV	LV	LV
12. *Radix ampla* (W. Hartmann, 1821)		●				
13. *Galba truncatula* (Müller, 1774)		●				
14. *Physa fontinalis* (L., 1758)	LV					
15. *Planorbarius corneus* (L., 1758)	LV					
16. *Bathyomphalus contortus* (L., 1758)	●	●				
17. *Anisus vortex* (L., 1758)	LV					
18. *Anisus vorticulus* (Troschel, 1834)		●				

The end of the table

Species	Station №					
	1	2	3	4	5	6
19. *Anisus leucostoma* (Millet, 1813)		●				
20. *Gyraulus albus* (Müller, 1774)		●				●
21. *Gyraulus laevis* (Alder, 1837)		●		●	●	
22. *Gyraulus crista* (L., 1758)						●
23. *Dreissena polymorpha* (Pallas, 1771)	●	●		●		
24. *Unio crassus* (Philipsson, 1788)	LV	LV	LV	LV	●	
25. *Unio pictorum* (L., 1758)		LV	LV	LV	●	●
26. *Unio tumidus* (Philipsson, 1788)		LV				
27. *Pseudanodonta complanata* (Rossmässler, 1835)		LV		●	●	●
28. *Anodonta anatina* (L., 1758)		LV			●	●
29. *Sphaerium rivicola* (Lamarck, 1818)	●	●		●		●
30. *Musculium lacustre* (Müller, 1774)	LV					
31. *Pisidium amnicum* (Müller, 1774)		●	●	●	●	●
32. *Pisidium sp.*	●	●	●	●	●	●
Species on station:	16	22	7	14	16	15
Species with live examples:	12	9	5	6	6	13
Empty shells only (species):	4	13	2	8	10	2

Explanations: LV - live examples; ● - empty shells. Stations: 1 - Ozersk Town(near (above) the dam); 2 - Ozersk (the Stadium); 3 - Zhuchkovo Village (of upstream 4 km); 4 - Zhuchkovo (of upstream 3 km); 5 - Zhuchkovo (the Dam); 6 - Veselovka Village (automobile bridge).

Shells of 26 species (18 - gastropods, 8 - bivalves) were found in the thanatocoenosis of the Angrapa River (Table 1). Species that were typical only for thanatocoenosis: *Valvata piscinalis* (Müller, 1774), *Valvata cristata* Müller, 1774, *Potamopyrgus antipodarum* (Gray, 1843), *Galba truncatula* (Müller, 1774), *Bathyomphalus contortus* (L., 1758), *Anisus vorticulus* (Troschel, 1834), *Anisus leucostoma* (Millet, 1813), *Gyraulus albus* (Müller, 1774), *Gyraulus crista* (L., 1758) and *Dreissena polymorpha* (Pallas, 1771). Here it should be noted that the samples taken in 2015 were no so rich comparing with these sampled in 2009 (Figure 3). This allows us to conclude that the results (2015) obtained here are preliminary.

Figure 3. Thanatocoenosis of the Angerap River near the Veselovka village, spring of 2009

Below there are the obtained data on the intervals of the values of the species abundance density for one square meter. Bivalves: *U. crassus* (1-25 spec. / m^2); *U. pictorum* (1-16); *U. tumidus* (up to 1), *Ps. complanata* (1-5), *A. anatina* (1-2). Gastropods: *Th. fluviatilis* (1-400), V. viviparus (1-50), *B. tentaculata* (1-8), *Pl. corneus* (1-5), *L. stagnalis* (1-2), *A. lacustris* (1-5 spec. / per one plastic bottle, on rubbish), *V. piscinalis* (up to 5). The other molluscs mentioned in this work were found as single specimens.

In Angrapa many substrates were not inhabited by mollusks. The majority of gastropods (*Th. fluviatilis*, *B. tentaculata*, *R. auricularia*) had lived on the stones of the shallow river banks. These snails are lithoreophilous. B*. tentaculata* formed settlements on anthropogenic objects. *R. auricularia* located on the stems of aquatic plants at the shore line. *V. viviparus* were found on overgrown, covered with silt substrates: stones, shallow boulder banks, on silted boulders, on dam metal and concrete. *A. fluviatilis*, sometimes, were found on empty shells of bivalve molluscs.

Figure 4. The one of natural places in Angrapa River middle reaches (near shoreline water vegetation)

Th. fluviatilis were collected from the stones, where they were located on a "circle" between the upper part of the stone and the part that is not immersed in the bottom (without periphyton layer). On objects of anthropogenic origin, not immersed in the bed, molluscs were found on their side facing the bottom sediments.

The most numerous aggregations of the *Th. fluviatilis* were found on small stones that were free from overgrowth layer of periphyton and with a typical black colour. The stones were located in the shallowest zone (up to 5 cm in depth) and were shaded by the alder's trees. There were no abundant water plants in the river. The stones of these shallows were dotted with the egg-capsules of the *Th. fluviatilis*, which indicates favourable conditions for its reproduction.

Large bivalve molluscs were most abundant in Ozersk area. Downstream of the river, they became less abundant, but the presence of the dominant species was constant. *Ps. complanata*

were absent in the studied places that were located downstream of the river. Rare species are not found in the same places. At some distance from Ozersk, *U. crassus* were found in swallow bolder banks, on the water current, between boulders in the bottom. *U. pictorum* located in the same habitats, but in zones without extreme water flow and in the sand.

Common bottom sediments in the river are not suitable for formation of settlements of large bivalves because of their hard (solid) characteristics. Large-scale streaming zones were characterized by too strong current for the existence of bivalves. Most of the shallows have dense ground, often "armored" with small stones and large gravel particles. In these places were found empty shells of these mollusks usually connected by a ligament because they belongs to recently died mollusks.

As a result, it can be concluded that the Angrapa mollusks were distributed as follows.

1. Most of the mollusks were found at a depth of 50-80 cm, substrates at great depths are silted and not suitable for their habitation.

2. Species of permanent water reservoirs (*Planorbarius corneus*, *Lymnaea stagnalis, Physa fontinalis, Radix auricularia, Stagnicola corvus, Anisus vortex*) were found in places with a slow flow of the water in front of the dams (Ozersk and Zhuchkovo).

3. Species of litho-rheophilic communities (*A. fluviatilis*, *Th. fluviatilis*, *U. crassus*) were widespread throughout the river bed, but their development is constrained by the presence of suitable substrates.

4. From the village Zhuchkovo area (in the place of the former reservoir) in Angrapa appeared *V. viviparus*, which settled down along the river to the village Veselovka. This is indicated a factor of slowing down current of the river and shows the historicity of the settling of mollusks.

5. In thanatocenoses and settlements of live molluscs in the river, there may be species of standing and slow flowing waters (common for lakes and ponds).

6. Above Ozersk dam, there was a zone of silting (extension up to 5 km) with a complete absence of molluscs, which was explained by the dumping of sewage waters into the dammed section of the river above the Ozersk hydroelectric station.

7. The abundance of *Th. fluviatilis* was increased downstream by the river because of self-purification of the river and the distance from sewage sources in Ozersk, and the number of large bivalves decreased with distance from Ozersk downstream by the river. These bivalves accumulated in the vicinity of Ozersk dam in sandy and silt banks.

The limiting factors for molluscs development in Angrapa are following:

1. Intensive water flow on banks in the low water summertime and everywhere in high water floods that affects the settlements of large bivalves (mechanical redistribution of free-lying examples with the formation of settlements on small stone banks);

2. Minor development of sand bottom sediments suitable for settlements of bivalve mollusks;

3. A periphiton abundant covering and silting of all substrates, affecting the development of gastropods.

4. Anthropogenic pollution of the river by human settlements, especially Ozersk town.

I would like to express my gratitude to Prof. R. Burukovsky (KSTU), Gusev A.A. and Ch.M. Nigmatullin (AtlantNIRO) for assistance in scientific work and Danilov D.Yu. for the technical supply of rafting and my touristic activity (equipment). I very grateful to Maxim V. Vinarski (Saint-Petersburg State University) for corrections of my manuscript.

Literature

1. Gusev, A.A. Preliminary results of the zoobenthos study at the near mouth part of some rivers in the Kaliningrad region / D.O. Guseva, L.V. Rudinskaya // Samara Luka: problems of regional and global ecology. 2014. T. 23. № 2. P. 61-71.

2. Shadin V.I. Mollusks of fresh- and brackish-waters of USSR. M.-L.: USSR Academy of Science, 1952. 376 p.

3. Glöer P., Meier-Brook C. Süsswassermollusken (Ein Bestimmungsschlüssel für die Bundesrepublik Deutschland, 13 neubearbeitete Auflage), Hamburg: DJN, 2003. 135 s.

4. Glöer P. Süßwassergastropoden Nord- und Mitteleuropas. Bestimmungsschlüssel. Lebensweise, Verbreitung. 2. Aufl., Hackenheim: Conchbooks, 2002. 327 s.

5. Macan T.T. A Key to the British Fresh- and Brackish-Water Gastropods, with Notes on their Ecology, 4 Ed. Ambleside: Freshwater Biological Association, Scientific Publication. № 13. 1977. 46 p.

6. Ellis A.E. British Freshwater Bivalve Mollusca. Linnean Society Synopsis of the British Fauna. New Series No. 11. London: Academic Press, 1978. 113 p.

7. Glöer P., Zettler M. Kommentierte Artenliste der Süßwassermollusken Deutschlands. // Malakologische Abhandlungen. 2005. № 23. P. 3-26.

8. Zettler M.L. Bemerkenswerte süßwassermollusken aus Litauen. Aufsammlungen vom September 2004 / M.L. Zettler, A. Zettler, D. Daunys // Malakologishe Abhandlungen. 2005. № 23. P. 27 - 40.