ECOLOGIA BALKANICA
2018, Vol. 10, Issue 2 December 2018 pp. 149-154

Ecological Status Assessment of Batova River (Bulgaria)

Sonya Damyanova[1*], Emilia Varadinova[2]

1 - University of Forestry, Faculty of Ecology and Landscape Architecture, 10 Kliment Ohridski blvd., 1797 Sofia, BULGARIA
2 - South-West University "Neofit Rilski", Faculty of Mathematics and Natural Sciences, Department of Geography, Ecology and Environmental Protection, 66 Ivan Michailov St. 2700 Blagoevgrad, BULGARIA
*Corresponding author: sonya_damyanova@abv.bg

Abstract. The Batova Valley is protected in the sense of the requirements of the Habitats and Birds Directives and the Biodiversity Act. European environmental agency developed in the 2000 year Directive 2000/60/EC for a mutual strategy of European Council countries, for prevention and protection of waters. Criteria for assessment of surface water bodies based on hydromorphological, phisico-chemical and biological quality elemets for characterization of ecological state had addopted. In this study, two points of water collection sampling of Batova River were chosen: before and after Batovo Village, in order to assess the impact of the village on the quality of waters and the status of aquatic ecosystems. Physico-chemical parameters (pH, conductivity, dissolved oxygen, biochemical oxygen demand, ammonium, nitrate, phosphate ions) were measured and biological/benthological samples were taken. According phisico-chemical quality elements Batova River was classifided as moderate status and "not achieved good" status because of high concentration of ammonium and nitrate ions. The ecological assessment based on the leading of the lotic ecosystem biological quality element macrosoobenthos showed a high status before the Batovo Village and high according Total Number of Taxa and good status on the Biotic Index after the village. The registered less unfavorable values of the studied nutrients during the low waters periods could be attributed at one hand to the natural, active processes of decomposition of riparian vegetation fall and mineralization of the organic matter. Local anthropogenic effects like the interference caused by unauthorized discharges, landfills and diffuse sources of pollution, should not be ignored.

Key words: ecological status assessment, batova river, physoco-chemical parameters, macrozoobenthos.

Introduction

European commission developed in the 2000 year a Directive (WFD) 2000/60/EC (EC, 2000) for a mutual strategy of European Council countries, for prevention and protection of waters. Criteria for an assessment of surface water bodies based on hydromorphological, phisico-chemical and biological quality elements had adopted for characterization of ecological status. The River Basin Management Plan for the period 2016-2021 has a goal to provide a framework for conservation and improvement of water bodies, and also pays particular attention to the sensitive areas requiring special protection. As such is determined Batova Valley which is protected in the sense of

the requirements of the Habitats and Birds Directives and the Biological Diversity Act (2002). A key component of the RBMP is the analysis of significant pressures and impacts on water bodies, which focuses on the identification of specific environmental problems and their origin, leading to the failure to achieve the environmental objectives. The measures have to be taken aim to achieve good status for all water bodies.

The aim of this paper is to assess the current ecological status of the Batova River for the study period (2017-2018), compare it to previous years and determine anthropogenic impact of the Batovo Village.

Materials and Methods

Batovo Village is a small settlement situated at northeastern part of Bulgaria with a population of 653 inhabitants. There were not sewage nor sewage treatment plant, as well as enterprises. To determine a potential influence of Batovo Village on the ecological status of the Batova River, two sampling points were chosen: first was situated 4 km before Batovo Village and second one – 1 km after Batovo Village. The sampling period was November 2017 – September 2018. Physic-chemical parameters: dissolved oxygen concentration (EN 25814, mg L^{-1}), conductivity (EN 27888, μScm^{-1}), acidity (pH, ISO 10523) were measured on site by means of portable Windaus Labortechnik Packageand HANNA multi-parameter instruments. Biochemical oxygen demand (BOD_5), ammonium (NH_4^+), nitrates (NO_3^-) and phosphates (PO_4^{3-}) were determined in the laboratory for environmental analysis at University of Forestry in 24 hours after sampling and storage at 4 °C. Nitrogen containing ions were measured by Kyeldal method using automatic distillation and titration (Keltek Tecatory) and orto-PO_4^{3-} spectrophotometrically (Lambda 5 spectrophotometer). BOD_5 was calculated as a difference between dissolved oxygen concentration at sampling and 5th day after storage of the water samples at 20 °C.

The macrozoobenthos samplings were done with compliance to the multi-habitat sampling approach (Cheshmedjiev *et al.*, 2011) in accordance with the standards BDS EN ISO 5667-1:2007 and BDS EN ISO 5667-3:2012.

The water quality and the ecological status of water bodies at the studied sites were determined by the WFD requirements (EC, 2000) implemented into national legislation – Ordinance №1/2011 and Ordinance № H-4/2012. The ecological status was defined by two metrics - Total Number of Taxa and the leading in the assessment an adapted version (Cheshmedjiev & Varadinova, 2013) of Irish Biotic Index (Clabby & Bowman, 1979; Clabby, 1989).

Results and Discussion

According Bulgarian typology the Batova River is defined in type 11 "Small and medium-size rivers in the Black Sea river basin district". Results obtained for the physic-chemical quantitative parameters at two sampling points of the Batova River for the study period are presented in the Tables 1 and 2.

All measured values of pH and conductivity characterized the status of the study water body before Batovo Village as an high (Ordinance № H-4/2012). Dissolved oxygen concentration values were lower for the mounts: February, May, July and August but still in the range of desirable for Directive 2000/60/EC (EC, 2000) "good" status according the legislation. All BOD_5 and phosphate data corresponded to the high status at that sampling point. The main problem for the surface waters of Batova River appeared N-containing compounds. Ammonium ions demonstrated good status in the late autumn 2017 and spring 2018. For the winter and summer seasons the same quality element showed values classified the study water body as "not achieved good status". With respect to nitrates, the

measured values could be described physic-chemical state before Batovo Village as "Good" in the Spring only. Use of fertilizers, farming, livestock breeding and soil erosion, which through the surface runoff fall into the Batova River is a likely cause for the ammonium and nitrates in the water.

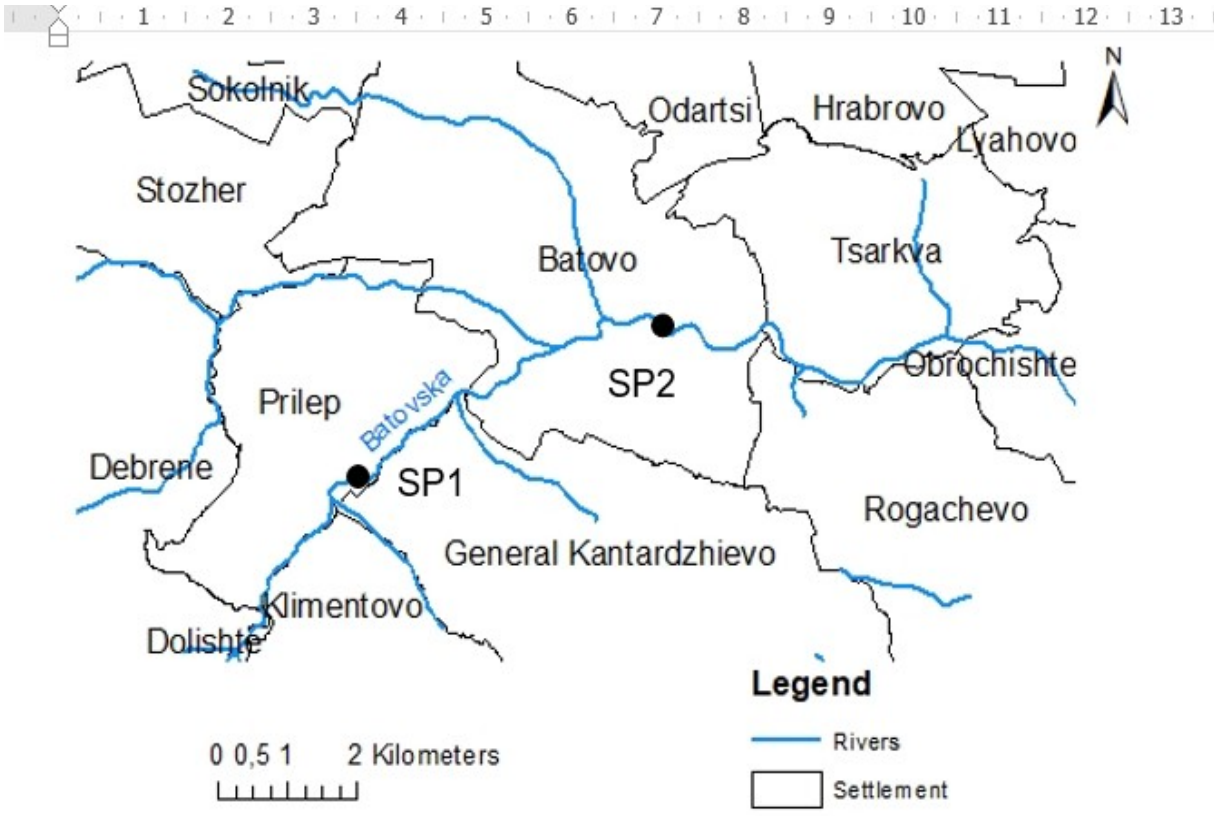

Fig. 1. Indicative map of the location of the two studied sites in Northeastern part of Bulgaria.

Table 1. Values of physic-chemical parameters measured before Batovo Village.

Date	pH	Diss. O_2, $mgdm^{-3}$	Conductivity μScm^{-1}	NH_4^+ $mgdm^{-3}$	NO_3^- $mgdm^{-3}$	PO_4^{3-} $mgdm^{-3}$	BOD_5 $mgdm^{-3}$
November 2017	7.54	7.6	578	0.32	**2.72**	0.0002	1.3
February 2018	7.55	5.5	483	**0.78**	**3.73**	0.0010	1.0
April 2018	7.60	6.4	637	0,06	0.81	0.0004	1.0
May 2018	7.66	5.9	675	0.49	1.04	0.0020	0.8
June 2018	7.76	7.5	670	0.38	1.50	0.0002	2.0
July 2018	7.97	5.5	565	**1.33**	**3.21**	0.0008	1.7
August 2018	7.92	5.2	631	**0.92**	2.28	0.0010	0.3
September 2018	7.86	6.0	602	**1.07**	**3.73**	0.0002	1.5

The data, presented in the Table 2, gave grounds for assessing the water quality status of Batova River after Batovo Village based on the elements: pH, conductivity and phosphates as a high according to the classification of Ordinance № H-4/2012. The oxygen regime in respect of BOD_5 characterized the surface waters as a high with exception of September. That was a good indicator for a lack of organic pollution, nevertheless high turbidity during the almost whole study period caused by frequent rainfall. The dissolved oxygen values corresponded to the good status for the whole study period except for the mounts September ("not achieved good status") and May (high status). The same ions, ammonium and nitrates, caused the worsening status of the study water body. The ammonium ions were higher than regulated standards for physic-chemical quality criteria for Batova River after Batovo Village in November, July and August, while nitrates were in the "Good" status range in June and September only. The data could be explained with a lack of sewage in the Batovo Village and unregulated landfills in the surroundings.

Current (2016-2021) and previous RBMP (2010-2015) pointed out the same physic-chemical quality status ('not achieved good') for the surface waters of Batova River, caused by the ammonium and nitrates, nevertheless the sampling point was mouth of the river.

The ecological status of the studied sites based on macrozoobehtos has been actively studied for the period 2009-2015 in connection with the development of the classification system, establishment of potential reference river sites at the territory of Bulgaria and the development of the Black Sea river basin management plans. According to the RBMP (2010-2015), the two studied sites were defined in good status by biological quality elements and the common ecological status was determined as good. The established ecological situation remains until the Batova River flows into the Black Sea. The same ecological assessment was done in the current RBMP (2016-2021). Our study has shown that, according to the type-specific macrozoobenthos scale, the status of the waters in the river before the village of Batovo based on the two normative indices (Total Number of Taxa and Biotic Index) is characterized as high. This is understandable given the established reference character of the studied river point/stretch. After the village, the evaluation is assessed as a high according index Total Number of Taxa and good pursuant to the leading Biotic Index (Table 3). The reason for the lower score on the Biotic index is the absence of sufficient benthic indicators, which are characterizing clean, unpolluted waters. This is probably a result of the local influence of the village, which is also reflected in the registered less favorable physic-chemical conditions (nutrients) of the aquatic environment.

Conclusions

Evaluation based on biological quality element macrozoobenthos determined Batova River in high-good status. Physic-chemical elements of quality was classified Batova River as "not achieved good" status because of high concentration of ammonium and nitrate ions. The registered less unfavorable values of the studied nutrients during the low waters periods could be attributed at one hand to the natural, active processes of decomposition of riparian vegetation fall and mineralization of the organic matter. Local anthropogenic effects like the interference caused by unauthorized discharges, landfills and diffuse sources of pollution should not be ignored.

Table 2. Values of physic-chemical parameters measured after Batovo Village.

Date	pH	Diss. O_2, $mgdm^{-3}$	Conductivity μScm^{-1}	NH_4^+ $mgdm^{-3}$	NO_3^- $mgdm^{-3}$	PO_4^{3-} $mgdm^{-3}$	BOD_5 $mg.dm^{-3}$
November 2017	7.60	5.8	724	**0.98**	**2.92**	0.0008	0.6
February 2018	7.50	5.4	445	0.06	**3.96**	0.0018	0.4
April 2018	7.69	5.5	674	0.12	**2.83**	0.0004	0.3
May 2018	7.64	6.1	682	0.12	**3.06**	0.0002	0.1
June 2018	7.83	5.9	705	0.30	1.70	0.0004	0.1
July 2018	8.05	5.0	563	**1.79**	**3.41**	0.0008	0.3
August 2018	7.84	4.6	669	**1.13**	**2.75**	0.0015	0.4
September 2018	7.45	5.6	684	0.14	1.94	0.0008	2.2

Table 3. Values of biological indices and ecological status assessment of the study sites in summer 2018.

Study sites	Date	Total Number of Taxa	Biotic index
Before Batovo Village	June 2018	19 - High	4 - High
After Batovo Village	June 2018	15 - High	3 - Good

References

Biological Diversity Act. 2002. Promulgated in the *State Gazette* No. 77/9.08.2002. Available at: [eea.government.bg].

EC. 1992. Council Directive 92/43/EECon the conservation of natural habitats and of wild fauna and flora. Available at: [eur-lex.europa.eu].

EC. 2000. Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy. Available at: [ec.europa.eu].

EC. 2009. Directive 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds. 2009. Available at: [eur-lex.europa.eu].

CHESHMEDJIEV S., R. SOUFI, Y. VIDINOVA, V. TYUFEKCHIEVA, I. YANEVA, Y. UZUNOV, E. VARADINOVA. 2011. Multi-habitat sampling method for benthic macroinvertebrate communities in different river types in Bulgaria. – *Water Research & Management*, 1(3): 55-58.

CHESHMEDJIEV S., E. VARADINOVA. 2013. Bottom Invertebrates. In: BELKINOVA D., G. GECHEVA, S. CHESHMEDJIEV, I. DIMITROVA-DYULGEROVA, R. MLADENOV, M. MARINOV, I. TENEVA, P. STOYANOV, S. MIHOV, L. PEHLIVANOV, E. VARADINOVA, TS. KARAGYOZOVA, M. VASILEV, A. APOSTOLU, B. VELKOV, M. PAVLOVA. *Biological Analysis and Ecological Status Assessment of Bulgarian Surface Water Ecosystems*. University of Plovdiv. Publishing House, Plovdiv, pp. 147-164. (In Bulgarian).

CLABBY K. 1989. The National Survey of Irish Rivers. *A Review of Biological Monitoring*. 1971 - 1979. An Foras Forbartha, Dublin.

CLABBY K.J, J.J. BOWMAN. 1979. Report of Irish Participants. - In: Ghetti, P.F. *3rd Technical Seminar on Biological Water Assessment Methods*. Parma, Vol. 1, Commission of the European Communities.

ISO 5667-1:2007. Water quality - Sampling - Part 1: Guidance on the design of sampling programmes and sampling techniques.

ISO 5667-3:2012. Water quality - Sampling - Part 3: Preservation and handling of water samples.

ISO 5667-6.Water Quality - Sampling Part 6: Guidance on sampling of rivers and streams.

Ordinance H-4/2012 for characterization of the superfcial waters. 2013. Official *State Gazette* № 22, 2013. Available at: [

Ordinance № 1/2011 for water Monitoring. 2011. Offcial *State Gazette* №34, 2011. Available at: [eea.government.bg].

River Basin Management Plans of East/West Aegean Region. 2010-2015. Available at: [moew.government.bg].

River Basin Management Plans of East/West Aegean Region. 2016-2021. Available at: [moew.government.bg].

Received: 23.11.2018
Accepted: 21.12.2018

Union of Scientists in Bulgaria – Plovdiv
University of Plovdiv Publishing House