Scientific Papers. Series E. Land Reclamation, Earth Observation & Surveying, Environmental Engineering. Vol. XIII, 2024
Print ISSN 2285-6064, CD-ROM ISSN 2285-6072, Online ISSN 2393-5138, ISSN-L 2285-6064

BIODIVERSITY AND ECOLOGICAL ASSESSMENT OF THE CHEPELARSKA RIVER, BULGARIA

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Abstract

The results of research on biological diversity in a section of the Chepelarska River and the territories adjacent to it, subjected to anthropogenic pressure, are presented. The studied area (water body code BG3MA500R103, river type R5Semi-mountainous type in Ecoregion 7 Eastern Balkans) falls entirely within protected area BG0000194 "Chaya River". It is located along the lower section of the river before it flows into the Maritsa River (Eastern White Sea Basin). The types of natural habitats and their ecological status are presented. Regarding the registered 45 species of higher plants and 22 animal species, the nature protection status and the species with resource importance have been determined. The results from the ecological monitoring of the freshwater ecosystem based on physicochemical elements (dissolved O_2, pH, electrical conductivity, Ptotal, N-NH_4, N-NO_2, N-NO_3, P-orthoPO_4, Zn, Cu, Pb, Cd) and ecological quality element macrozoobenthos, after applying the established standards are discussed. Measures to improve the ecological condition of the studied area are indicated.

Key words*: chemical state, ecological condition, ecological indices, protected habitats, protected species.*

INTRODUCTION

River Chepelarska (86 km) is a right tributary of the Maritsa River in Central Southern Bulgaria. It springs from 1550 m above sea level, from the mountain resort of Pamporovo, the Rhodope Mountains. It flows into the Maritsa River at 148 m above sea level. The Chepelarska River occupies 1.9% of the watershed of the Maritsa River. Refers to river type R5: Semi-montane type in Ecoregion 7: Eastern Balkans (Belkinova et al., 2013). The waters of the Chepelarska River are used for electricity production, irrigation, and industrial water supply. For a long time, the river has been subjected to pollution from industrial, agriculture and domestic wastewater (withdrawal of water for irrigation; pollution with heavy metals, pesticides; deposition of construction and household waste; removal of ballast substances (Interim overview of the significant water management issues in East Aegean river basin management district. https://earbd.bg/indexdetails.php?menu_id=84). All of them have provoked the performance of a number of studies on the state and management of the river ecosystem (Radeva, Seymenov, 2021; Gartsiyanova et al., 2023; Gecheva et al., 2023; Kolcheva, 2020; Kolcheva et al., 2023; Park et al., 2023; Zaharieva, 2023), as well as for the successful management of agricultural areas and generated waste, according to the Law on Waste Management (Kehajov et al., 2016; Zahariev and Kehajov, 2016; Kehayov et al., 2017; Kehayov et al., 2022; Kehajov et al., 2023). The adjacent coastal and surrounding water ecosystems, the object of the present study, fall entirely within the boundaries of the protected area (SCI) BG0000194 "Chaya River" (650.62 ha), declared under Directive 92/43/EEC for the protection of natural habitats and wild flora and fauna (Decision No. 122/02.03.2007 of the Council of Ministers and Order No RD-688/ 25.08.2020 of the Ministry of Internal Affairs and Communications). The purpose of the research is to present the results

of research on biological diversity in a section of the Chepelarska River and adjacent territories subject to anthropogenic pressure, as well as the results of ecological monitoring research.

MATERIALS AND METHODS

The researched territory is located in the land of Katunitsa village, Popskoto area, Plovdiv region (42005'59.98"N 24051'52.09"E; 42006'00.86"N 25051'46.79"E). The territory has been subject to intense and long-lasting anthropogenic impacts related to removing ballast substances and depositing large amounts of construction waste.

Biodiversity studies were carried out using the method of observation and the method of test plots (Gusev & Bancheva, https://eea.government.bg/bg/bio/nsmbr/praktichesko-rakovodstvo-metodiki-za-monitoring-i-otsenka/Metodika_monitoring_Rastenia.pdf; Coulloudon et al., 1999)

The species identification was carried out according to Delipavlov et al., 2003; Marinov, 2000; Chineri, 1999; Karapetkova, Zhivkov, 2006; Kottelat & Freyhof, 2007.

The basic abiotic characteristics of the water habitat in the region under research were determined (temperature, pH, dissolved oxygen, electrical conductivity, calcium-carbonate hardness, biological oxygen demand (BOD_5), biogenic substances, and heavy metals). The methods of analysis used are as follows: - basic physicochemical indicators: temperature – BSS 17.1.4.01:1977, pH – BSS EN ISO 10523:2012, dissolved oxygen – BSS EN ISO 5814:2012, electrical conductivity – BSS EN 27888:2000, calcium carbonate hardness - BSS ISO 6059:2002, BOD_5 - BSS EN 1899-2:2004 - biogenic substances: Ptotal – BSS EN ISO 6878:2005, P-ortho-PO_4 – BSS EN ISO 6878:2005, N-NH_4 – BSS ISO 7150-1:2002, N-NO_2 – BSS EN 26777:1997, N-NO_3 – BSS EN ISO 10304-1:2009; - priority substances and specific pollutants: Zn – BSS EN ISO 17294-2:2016, Cu – BSS EN ISO 17294-2:2016, Pb – BSS EN ISO 17294-2:2016, Cd – BSS EN ISO 17294-2:2016. The evaluation was carried out according to the accepted European quality standards. The main physicochemical indicators and biogenic substances have been evaluated according to Ordinance № H-4/2012 on the characterization of surface waters and heavy metals - according to the Ordinance on environmental quality standards for priority substances of 11.12.2015. A hydrobiological monitoring and ecologic assessment of the state of the Chepelarska River was carried out on the basis of the macrozoobenthos biological quality element (BSS EN ISO 10870:2012 Water quality - Guidelines for the selection of sampling methods and devices for benthic macroinvertebrates in fresh waters; BSS EN ISO 5667-1:2022 Water quality - Sampling - Part 1: Guidance on the design of sampling programmes and sampling techniques; EN ISO 5667-3:2003/AC:2007 Water quality - Sampling - Part 3: Guidance on the preservation and handling of water samples).

RESULTS AND DISCUSSIONS

Biodiversity and nature habitats

Bulgaria occupies part of the European-West Siberian biogeographic region of the Palearctic kingdom. It is located in the biome of the northern hemisphere's broad-leaved and mixed forests of temperate latitudes. The studied territory is located in the South Bulgarian province, the Central Bulgarian biogeographic region, and the subregion of the Upper Thracian Lowland (Gruev & Kuzmanov, 1994). The types of habitats subject to protection in the protected area are:

1) 92A0 Riverside galleries of *Salix alba* and *Populus alba*/06G1 Willow-poplar galleries in southern Bulgaria. Nature protection status: included in Appendix 1 of the Biodiversity Act, item 3. Natural habitats of the Red Book of the Republic of Bulgaria with the category Vulnerable (VU; IUCN), the Habitats Directive - part of the European ecological network NATURA 2000. The following negative factors are indicated: afforestation with exotic species and cultivars; you cut; waste disposal and water pollution; the invasion of atypical species (*Acer negundo* L., *Amorpha fruticosa* L., etc.); Parasitism (*Viscum album* Linnaeus, 1753 and *Loranthus europaeus* Jacq.); agricultural activities related to converting riparian forests into cultivated areas; grazing; corrections and cleaning of riverbeds, etc. (Red Book of the Republic of Bulgaria, item 3, Natural habitats). The protected habitat occupies 50.21 ha of the

territory of the protected area BG0000194 "Chaya River" (7.72% of the area).
2) 92D0 Southern riverside galleries and shrubs (Nerio-Tamaricetea and Securinegiotinctoriae) are in the Red Book of the Republic of Bulgaria, vol. 3. Natural habitats as natural habitat 31F9 Riparian heather (*Tamarix* spp.) communities. Nature protection status: included in Appendix 1 of the Biodiversity Act, item 3. of the Red Book of the Republic of Bulgaria with the endangered category (EN; IUCN), the Habitats Directive - part of the European ecological network NATURA 2000, the Bern Convention. On the territory of the "Chaya River", both types of natural habitats are in good ecological condition (http://natura2000.moew.government.bg/PublicDownloads/Auto/PS_SCI/BG0000194/BG0000194_PS_16.pdf).
A total of 45 species of higher plants have been established in the aquatic ecosystems of the Chepelarska River (Table 1). They refer to 13 groups of flora elements. The group of European-Asian species (Eur-As; 10 species) is distinguished by the most significant number of species, followed by the groups of European-Mediterranean species and cosmopolitans (Eur-Med and Kos; 5 species each); of adventitious species (Adv; 4 species), etc. Of the established species of resource importance, the largest share is medicinal plants (L; 29 species), followed by weeds (P; 16 species), honey plants (M; 13 species), dye plants (Bg; 11 species), and its. These species are widespread in the terrestrial habitats of the zone and are represented in high numbers. There are no established plant species that are protected by the Biodiversity Act or other national and international legislative documents. Some species of animals were also found, including protected (Table 2).
A total of one species of higher plant, 10 species of invertebrates, and 12 species of vertebrates (8 species of fish, 7 species of amphibians, 7 species of reptiles, and 9 species of mammals) are protected in the protected area (Standard form of Protected area 'Chaya'). None of these species were found in the studied biotopes. The removal of the waste and the improvement of the ecological condition of the studied territory leads to the creation of conditions for the distribution and habitation of species represented in the area, the increase of biological diversity, and the improvement of the ecological potential in the anthropogenic part of the area.

Ecological assessment of the condition of the Chepelarska River

The Chepelarska River belongs to the Eastern White Sea Basin, river type R5: Semi-mountainous rivers in Ecoregion 7: Eastern Balkans. The results of the performed physicochemical and hydrobiological monitoring are presented (Tables 3 and 4).

Physicochemical monitoring

Basic physicochemical parameters were analysed: temperature, pH, electrical conductivity (Multi parameter instrument, WTW Multi 340 i), dissolved oxygen (Microprocessor oximeter, Orion Star A223), $N–NH_4$, $N–NO_2$, $N–NO_3$, P-ortho-PO_4 (Spectrophotometer, DR 3900), total phosphorus (UV-VIS Spectrophotometer, Thermo Scientific UV-Visible), calcium-carbonate hardness (Water Hardness Meter PCE-CP 21), BOD_5 (Manometric method BOD_5 analyzer LH-BOD601SL), zinc, copper, lead and cadmium (ELEMENT HR-ICP-MS system) (Table 3).

Hydrobiological monitoring

As a result of the biomonitoring on the base, 10 taxa of bioindicator macrozoobenthos were established, represented by a total of 231 specimens. *Hydropsyche* sp. (Hydropsichidae; Trichoptera) is represented with the highest number - 79 specimens, followed by *Gammarus* spp. (Gamaridae; Malacostraca) - 38 specimens; *Herpobdella stagnalis* (L.) (Glossiphoniidae; Hirudinea) and *Ephemerella ignita* (Poda) (Ephemerellidae; Ephemeroptera) - 27 specimens each; *Tubifex* sp. (Tubificidae; Oligochaeta) - 25 specimens, etc. The lowest number is *Lymnaea stagnalis* (L.) (Lymnaeidae; Gastropoda) - one specimen. The established taxa are distributed by sensitivity groups. Groups B (fewer sensitive forms), C (relatively tolerant forms) and D (tolerant forms) are represented by 3 taxa each, but the taxa of group B are the most numerous (110 specimens; Table 4).

Table 1. Biological diversity, floral elements and economic importance of plant taxa

№	Taxa Plants	Conservation status	Floral elements	Economic importance
Trees				
1	*Salix alba* L. (Salicaceae)	LC (IUCN)	Eur-As	Fr, Ho, De, Dy, Nt, Fd, He, Ta
2	*Populus alba* L. (Salicaceae)	LC (IUCN)	Eur-As	Fr, V, Ho, He, Ta
3	*Juglans regia* L., 1753 (Juglandaceae)	Not evaluated (IUCN)	Eur-As	Fr, Cu, He, M, Dy, Fr
4	*Fraxinus ornus* L. (Oleaceae)	LC (IUCN)	subMed	Fr, De, Ho, Dy, Fd, He
5	*Ailanthus altissima* Swingle(Simaroubaceae) – China	Not evaluated (IUCN)	Adv	I, De, Ho
6	*Alnus glutinosa* (L.) Gaertner (Betulaceae)	LC (IUCN)	Med-CAs	Fr, He, Ho, Dy
7	*Ulmus minor* Miller (Ulmaceae)	Not evaluated (IUCN)	Eur-Med	Fr, He, Ta, Ho
8	*Robinia pseudoacacia* L. (Robiniaceae) – NorthAmerica	-	Adv	I, Ta, De, Ho, Fr, Ae
Bushes				
9	*Paliurus spina-christi* Millet (Rhamnaceae)	Not evaluated (IUCN)	Eur-As	He, Ho, Dy, De, Ta
10	*Rubus caesius* L., 1753(Rosaceae)	LC (IUCN)	Eur-As	V, Nt, He, Ho
Grasses				
11	*Cynodon dactylon* (L.) Pers. (Poaceae)	Not evaluated (IUCN)	Kos	Fd, He, We
12	*Glyceria fluitans* (L.) Br. (Poaceae)	LC (IUCN)	Kos	Fd
13	*Sorghum halepense* Pers., 1805 (Poaceae)	Not evaluated (IUCN)	subMed-As	We, Fd
14	*Phragmites australis* (Cav.) Trin. Ex Steudel (Poaceae)	LC (IUCN)	Kos	Te
15	*Festuca pratensis* Hudson, 1762 (Poaceae)	Not evaluated (IUCN)	Boreal	Fd
16	*Hordeum murinum* L. (Poaceae)	LC (IUCN)	Boreal	We
17	*Persicaria hydropiper* (L.) Opiz (Polygonaceae)	LC (IUCN)	Eur-As	He, Dy
18	*Xanthium strumarium* L. (Asteraceae)	Not evaluated (IUCN)	Eur	We, He, Po
19	Обикновенасиняжлъчка (*Cichorium intybus* L.; Asteraceae)	LC (IUCN)	Eur-Sib	Nt, He, We
20	*Artemisia vulgaris* L., 1753 (Asteraceae)	LC (IUCN)	subBoreal	He
21	*Lactuca serriola* L. (Asteraceae)	LC (IUCN)	Eur-As	We, He
22	*Xeranthemum annuum* L. (Asteraceae)	Not evaluated (IUCN)	subMed	He
23	*Silybumm arianum* (L.) Gaerner (Asretaceae)	LC (IUCN)	Med	He
24	*Sonchus arvensis* L. (Asteraceae)	Not evaluated (IUCN)	Eur-As	We
25	*Conyza canadensis* (L.) Cronq. (Asteraceae) – North America	Not evaluated (IUCN)	Adv	We
26	*Lapsana communis* L. (Asteraceae)	Not evaluated (IUCN)	Eur-Sib	We
27	*Centaurea solstitialis* L. (Asteraceae)	Not evaluated (IUCN)	Eur-Med	He
28	*Convolvulus arvensis* L., 1753 (Convolvulaceae)	Not evaluated (IUCN)	Kos	We, He
29	*Chenopodium album* L. (Amaranthaceae)	Not evaluated (IUCN)	Kos	We, He
30	*Silene vulgaris* (Moench) Garcke (Caryophyllaceae)	Not evaluated (IUCN)	Eur-As	-
31	*Teucriumpollium* L. (Lamiaceae)	Not evaluated (IUCN)	Pont-Med	He, Dy, Ta, Ho
32	*Urtica dioica* L., 1753 (Lamiaceae)	LC (IUCN)	Boreal	Nt, He, Dy
33	*Lamium purpureum* L. (Lamiaceae)	Not evaluated (IUCN)	Eur-Med	We, Nt, He, Ho
34	*Anthriscus caucalis* Bieb. (Apiaceae)	Not evaluated (IUCN)	Eur-Med	Po
35	*Eryngium campestre* L. (Apiaceae)	Not evaluated (IUCN)	Pont-Med	He, We
36	*Daucus carota* L. (Apiaceae)	LC (IUCN)	Eur-As	We
37	*Foeniculum vulgare* Mill., 1768 (Apiaceae)	Not evaluated (IUCN)	subMed	Eo, Dy, He, Sp
38	*Knautia arvensis* (L.) Colt. (Caprifoliaceae)	Not evaluated (IUCN)	Eur-Sib	Dy, He, Ho
39	*Verbascum sinuatum* L. (Scrophulariaceae)	Not evaluated (IUCN)	Med	-
40	*Verbascum phlomoides* L. (Scrophulariaceae)	LC (IUCN)	Eur	He, D, Dy, Nt
41	*Cynoglossum creticum* Miller (Boraginaceae)	Not evaluated (IUCN)	Med-CAs	-
42	*Euphorbia cyparissias* L. (Euphorbiaceae)	Not evaluated (IUCN)	Eur	We, He
43	*Datura stramonium* L., 1753 (Solanaceae) – America	Not evaluated (IUCN)	Adv	Po, We, He, Ru
44	*Lotus corniculatus* L. (Papilionaceae)	LC (IUCN)	Eur-Med	He
45	*Sinapis arvensis* L. (Brassicaceae)	LC (IUCN)	Med	We

Legend conservation status: LC – non-threatened species; IUCN – International Union for Conservation of Nature; RbBG – Red Book Republic of Bulgaria, vol. 1.

Legend flora elements: Eur-As – European-Asian; Adv – Adventitious; subMed– Sub-Mediterranean; Med – Mediterranean; subMed– Sub-Mediterranean; subMed-As – Sub-Mediterranean-Asian; Pont-Med – Pontic-Mediterranean; Boreal – Boreal; Eur-Med – European-Mediterranean; subBoreal–Subboreal; Med-CAs – Mediterranean-Central Asian; Kos – Cosmopolitan; Eur – European; Eur–Sib – European-Siberian.

Legend resource value: **Fr** – forestry species; **Ho**– honeyed; **De**–dekorative; **Dy**– dyed; **Nt**– nutritionally; **Fd**– fodder; **He** – healing; **Ta** – tanned; **V**–vitaminic; **I** –introduced; **Ae** – anti-erosion; **Fr** – fruity; **Cu** – cultivated; **Po** – poisonous; **Te** – technical; **We** – weed;**Sp** – spice; **Eo** – essential oil; **Ru**– rudely.

Table 2. Biological diversity of established species of animals

№	Species of Animals	Consevation status
1	*Calopterix splendens* (Harris, 1780) (Calopterygidae)	LC (IUCN)
2	*Tettigonia viridissima* Linnaeus, 1758 (Tettigoniidae)	LC (IUCN)
3	*Saturnia pyri* (Denis & Schiffermüller, 1775) (Lepidoptera)	Biodiversity Act-II; Not evaluated (IUCN)
4	*Ciconia ciconia* (Linnaeus, 1758) (Ciconiidae)	LC (IUCN); VU (Vulnerable; RbBg, vol. 2); ЗБР-II
5	*Squalius orphaeus* (Kottelat & Economidis, 2006)	LC (IUCN)
6	*Barbus cyclolepis* (Heckel, 1837)	LC (IUCN)

Legend: Biodiversity Act-II – Biodiversity Act - Appendix II; IUCN - International Union for Conservation of Nature and Natural Resources; LC – non-threatened species; Not evaluated – not evaluated; RbBg, vol. 2 – Red Book of Republic of Bulgaria, volume 2; VU – vulnerable species.

Table 3. Basic abiotic indices of the studied fresh water ecosystems from the Chepelarska River

Abiotic indices	Unit of measure	Mean ± SD	Standard
Temperature	^{0}C	3.5 ± 0.4	-
pH	-	8.02 ± 0.03	6.5 – 8.5
Dissolved oxygen	mg/l	12.7 ± 0.6	6.00
Electrical conductivity	µS/cm	343 ± 9	750
Calcium carbonate hardness	mg $CaCO_3$/l	177 ± 7	-
BOD_5	mg/l	< 1	3
Ptotal	mg/l	0.046 ± 0.005	0.075
P-ortho-PO_4	**mg/l**	**0.040 ± 0.004**	**0.04**
N–NH_4	mg/l	0.19 ± 0.02	0.4
N– NO_2	mg/l	0.0070 ± 0.0006	0.03
N–NO_3	mg/l	0.51 ± 0.03	1.5
Zn	µg/l	56 ± 3	75
Cu	µg/l	2.6 ± 0.1	10
Pb	µg/l	1.7 ± 0.1	14
Cd	**µg/l**	**1.8 ± 0.1**	**0.9**

Table 4. Number of bioindicative taxa, specimens, sensitive and saprobity groups

Sensitive groups, No. taxa (No. specimens)				
B	**C**	**D**	**E**	
3(110)	3(61)	3(35)	1(25)	
Saprobity groups, No. taxa (No. specimens)				
β	**χ-β**	**0-β**	**β-α**	**p**
5(116)	1(38)	1(21)	1(4)	1(25)
Biotic indices				
Total N0. of Taxa (Specimens)	10 (231)			
RETI	0.48			
BI(EQR)	3(0.6)			

Legend: No. taxa – Number of taxa; No. sps. – Number of specimens; B – less sensitive forms; C – relatively tolerant forms; D – tolerant forms; E – most tolerant forms; RETI – Rhithron Feeding Type Index; BI – Adapted Biotic Index.

With one taxon and the smallest number of specimens is group E (most tolerant forms; 25 specimens).

Five saprobic groups are distinguished: β-mesosaprobic organisms; χ-β-mesosaprobic; 0-β-mesosaprobic; β-α-mesosaprobic and p-saprobic organisms.

The group of β-mesosaprobic organisms is represented with the largest number of taxa and number of specimens - 5 taxa with 116 specimens. All other saprobic groups are represented by one specimen each. The Rhithron Feeding Type Index was 0.48, and the determined adapted biotic index (BI) was 3, which corresponds to a moderate (medium) ecological condition (Table 4).

Compared to previous studies (Boyanov et al., 2011; Boyanov et al., 2011a), an increase in the abundance of bioindicators from the sensitive B group was observed, as well as a decrease in the abundance of organisms from the other sensitivity groups, as well as more good environmental condition (BI = 3). The reasons for the state of the taxonomic compositions and

the dominant structure of the macrozoobenthos in the lower section of the Chepelarska River are arable agricultural lands, fishing, poaching, waste disposal (Park et al., 2023).

Leading for determining the ecological condition are the biological elements. The complex assessment, however, is determined according to the lowest indicator. The provisions of the Water Act of 1999, Ordinance № H-4/2012, etc. are implemented. The state of the water body for the period 2012-2021 is presented (Table 5).

Based on the environmental monitoring studies carried out by the Regional Laboratory Complex, Plovdiv, and the reports on the state of water bodies on the territory of the Eastern White Sea region for the period 2012-2021 with the presentation of an integrated ecological assessment, the general state of the river ecosystem for the water body is as bad as in 2021 in terms of biological and physicochemical indicators, as well as in terms of ecological status/potential, an improvement of the status is observed to moderate, in contrast to that for the previous periods (poor). In 2022, our biological and physicochemical indicators (macrozoobenthos) studies confirm the 2021 ecological assessment.

The main groups as shifting indicators exceeding the permissible concentrations can be united into three groups - biological elements (macrozoobenthos), biogenic (nitrites - NO_2^-, phosphates - PO_4^-, total phosphorus, etc.), and heavy metals (cadmium – Cd, lead – Pb, etc.). Based on the ecological monitoring studies carried out with an integrated ecological assessment presentation, the ecological status of the studied section of the river ecosystem is moderate (average).

According to the Plan for the Management of River Basins in the Eastern White Sea Region and the Reports on the Status of Water Bodies in the Eastern White Sea Basin for the period 2012-2021, the Chepelarska River is polluted after the confluence of the Yugovska River with lead, where the source of pollution is the metal enrichment factory ores and the tailings storage facility of "Gorubso", the town of Laki and before flowing into Maritsa river - after "Plant for non-ferrous metals 2000 Group", the town of Plovdiv with lead and cadmium. The discharges of domestic and industrial water from the town of Asenovgrad and other settlements are also indicated as sources: withdrawal of water for irrigation and electricity production; small outflow; pressure from settlements; cosmetic factory Rosa Impex; ISA 2000 Ltd.; "Plant for non-ferrous metals 2000 Group"; "Agria".

Table 5. Condition of surface water body BG3MA500R103 "Chepelarska River" from the town of Asenovgrad to the mouth and "Krumovsky collector"

Year	Biological indicators	Physicochemical indicators	Ecological condition	Chemical condition	Total condition	Shifting metrics
2012	bad	moderate	bad	bad	bad	-
2013	bad	bad	bad	bad	bad	NH_4, NO_2, PO_4, Zn, Cu
2014	bad	moderate	bad	bad	bad	macrozoobenthos, NH_4, NO_2, PO_4, Cd
2015	bad	moderate	bad	bad	bad	PO_4, Zn, Cd
2016	bad	moderate	bad	bad	bad	NO_2, NO_3, PO_4, Ptotal, Ntotal, Mn, Zn, Cd, Pb
2017	bad	moderate	bad	bad	bad	macrozoobenthos, NO_2, PO_4, Ptotal, Ntotal, Mn, Zn, Cd, Pb
2018	bad	moderate	bad	bad	bad	NH_4, NO_2, PO_4, Ptotal, Ntotal, Mn, Cd, Pb
2019	bad	moderate	bad	bad	bad	macrozoobenthos, NH_4, NO_2, PO_4, Ptotal, Ntotal, Mn, Cd, Pb
2020	bad	moderate	bad	bad	bad	macrozoobenthos, electroconductivity, NO_3, NO_2, PO_4, Ntotal, Mn, Cd, Pb
2021	moderate	moderate	moderate	bad	bad	macrozoobenthos, phytobenthos, NO_2, PO_4, Ptotal, Ntotal, Cd, Pb

Optimizing the hydrological regime can restore the river's self-purification ability. For industrial enterprises, a measure for the modernization of an industrial wastewater treatment plant ("Agria") is foreseen collection and removal of industrially polluted waters of "Plant for non-ferrous metals 2000 Group" to the industrial wastewater treatment plant and study of the bioaccumulation of priority and dangerous substances in fish (fish from the Chepelarska River near the collector of "Plant for non-ferrous metals 2000 Groupv). As a result of the measures taken, the implemented plans, and programs from 2021 to the present, improvements have been established in the ecological condition of the Chepelarska River from the town of Asenovgrad to its mouth. The Eastern White Sea Basin River Basin Management Plan for 2022-2027 is also expected to achieve this.

CONCLUSIONS

As a result of the inventory studies on the biological diversity of the anthropogenically influenced section of the Chepelarska River, the restoration of the natural vegetation was established. Still, the protected species characteristic of the protected area BG0000194 "Chaya River" was absent. The performed physicochemical and biological monitoring gives reason to define the ecological condition of the studied section of the river ecosystem as poor.

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