

Ecomonitoring of the main river systems  
of National natural park "Podilski Tovtry".

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### Abstract

The investigations were carried out on the territory of National natural park (NNP) "Podilski Tovtry" (Ukraine) during four years. Thus, the aim of our work was to carry out ecological monitoring of the state of rivers of NNP for binding out anthropogenic loading, revealing polluted areas and for comparative analysis of water qualities on basis of hydrophysical, hydrochemical indexes and the data of phytoindicating investigation (taking into account macrophytes). Moreover, not only a qualitative and a quantitative composition of water macrophytes has been established, but also their associations density, projective covering, ecological characteristic. As a result of ecomonitoring it has been established that no one of investigated rivers of NNP corresponded to the standards of (MPC – maximum permissible concentration) according to all indexes; and the phytogroups are impoverished. Investigated rivers according to the system of complex evaluation of surface waters belong to slightly polluted (river Smotrych), polluted (r. Zbruch, r. Zhvanchyk), and very polluted (r. Dnister, r. Muksha) that testifies to considerable anthropogenic pressing on the territory of the park which doesn't correspond to nature protecting aims. Such investigations will give the opportunity to ground the main directions of managing economy in the basins of rivers of NNP and promote the development of ecological standards of anthropogenic loading taking into consideration all peculiarities of given region and the strategy of rational and safe use of nature.

### Introduction

National natural park (NNP) "Podilski Tovtry" was organized and confirmed by the 27<sup>th</sup> of June, 199 № 474/94 on the square of 261.32 thousand hectares. The territory of National park has rather thick system of rivers, ponds and reservoirs. There are 1169 rivers there, their total length is 3.5 thousand kilometers. The Zbruch, the Zhvanchyk and the Smotrych have the length of over 100 km, there are about 60 rivers which have the length from 10 to 100 km, and more than 1000 rivers have the length less than 10 km. The rivers cross the territory of the park from north to south. The valleys of the rivers in Prydnistrovia are not wide, their boundaries fluctuate sharply from some ten metres to 1.5 km and they flow in deep canyonlike valleys, the banks of the rivers are steep and often sharp with limestone outlayering (1). The main hydrographical indexes of river systems of NNP "Podilski Tovtry" are in the table 1.

Table 1. Main Hydrographical Indexes of River Systems (Tributaries of the Dnister)

River system	The length of the main river, km	The square of the basin, km <sup>2</sup>	The density of the net, km/km <sup>2</sup>	Total		Including the quantity with the length	
				quantity	length	10 – 50 km	to 10 km
Zbruch	244	3395	0,53	532	1799	31	504
Zhvanchyk	106	769	0,64	174	489	7	167
Smotrych	169	1800	0,52	263	923	15	247
Muksha	58	322	0,32	41	100	—	40

The saving, improving of the state and renewing of natural and destroyed because of the anthropogenic activity (irrational usage) river systems which cause the formation of water resources of NNP "Podilski Tovtry" and biodifference of water phytocenoses needs the creation of the whole monitoring system of investigations, which could include not only phytoindicative investigations but the evaluation of the influence of hydrochemical and hydrophysical indexes on biota.

### Methods

The object of our investigation were the rivers of National natural park “Podilski Tovtry” – the Dnister and it’s the biggest left tributaries – the Zbruch, the Smotrych, the Zhvanchyk, the Muksha and representative for their species Kuhaiv Ponds. The investigations of the rivers were carried out during 4 years (from 2000 to 2003). The tests of the water were chosen in series, taking into consideration the season differences four times a year on the proving ground in 5 km up and down the current and the florist investigations were carried out too. The scheme of D.Dubyna and U.Sheliag-Sosonco became the basis of ecological classification of macrophytes, taking into consideration morphological and ecobiological peculiarities of the species and the degree of their connection with water environment, ground and air (2). The concentration of nitrite nitrogen was tested with the help of photoelectrokalometer (photoelectro emissive devise) according to aprobated metodics (3). In this work you can see average values of 4 repeatedness according every index, all experimental material is processed using the method of variative statistic (3).

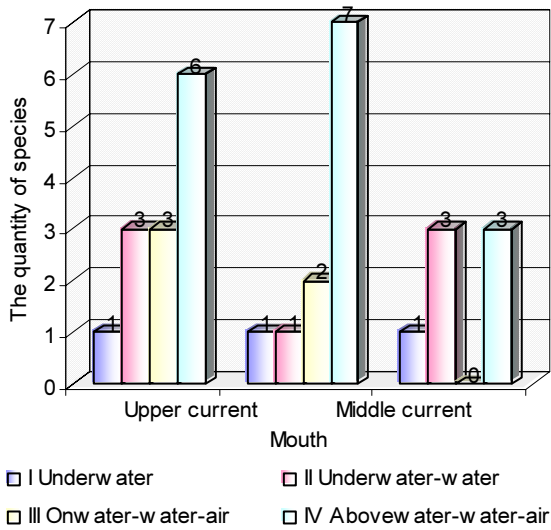
## Results

The flora of the main rivers of NNP includes 35 species of macrophytes-indicators that is 23 per cent of the total quantity of higher water plants of Ukraine (4). In taxonomical consideration these species belong to two departments (Equisetophyta, Magnoliophyta). The class of Liliopsida and Magnoliopsida is characterizes by the biggest species variety. According to the character of placing of macrophytes in different places of growth of the rivers NNP “Podilski Tovtry” some ecological groups were separated (Table 2).

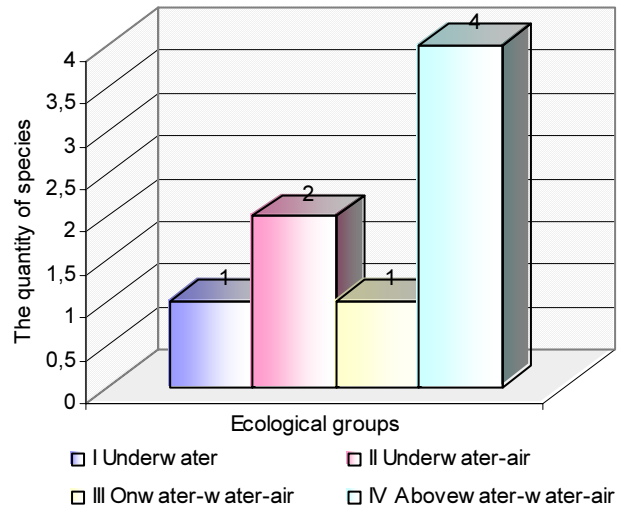
Table 2: Ecological Structure of Macrophytes-Indicators of Water Bodies of NNP “Podilski Tovtry”

Without roots (drifting or freeswimming)	With roots
I. Underwater	
Ceratophyllum demersum L. C. submersum L.	
II. Underwater-air	
Lemna trisulca L.	Elodea canadensis Michx. Myriophyllum spicatum L. M. verticillatum L. Potamogeton crispus L. P. lucens L. P. pectinatus L.
III. Onwater-water-air	
Lemna gibba L. L. minor L. Hydrocharis morsus-ranae L. Spirodela polyrrhiza (L.) Schleid.	Nuphar lutea (L.) Smith Polygonum amphibium L. Potamogeton natans L.
IV. Abovewater-water-air	
	Acorus calamus L. Alisma plantago-aquatica L. Bolboschoenus maritimus (L.) Pslla. Butomus umbellatus L. Caltha palustris L. Carex acuta L. C. acutiformis Ehrh. C. riparia Curt. C. pseudocyperus L. C. vulpina L. C. vesicaria L. Eleocharis palustris (L.) Roem. et Schult. Equisetum fluviatile L. Glyceria fluitans (L.) R. Br. Hippuris vulgaris L. Iris pseudacorus L. Mentha aquatica L. Phragmites australis (Cav.) Trin.ex Steud. Scirpus tabernaemontani C.C. Gmel. Sparganium erectum L. Typha angustifolia L. T. latifolia L.

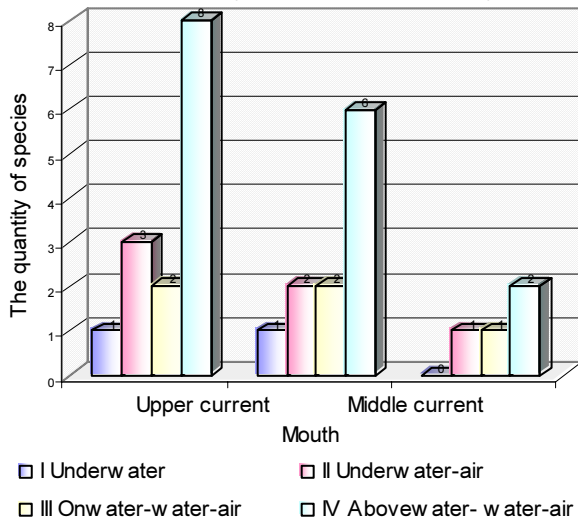
**Illustration 1: Ecological structure of macrophytes of the river Zbruch**



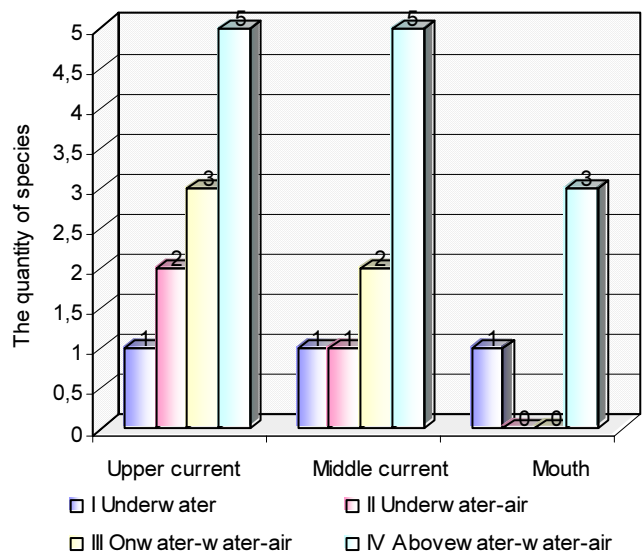
**Illustration 2: Ecological structure of macrophytes of the river Dnister (territory NNP "Podilski Tovtry")**



**Illustration 3: Ecological structure of macrophytes of the river Smotrych**



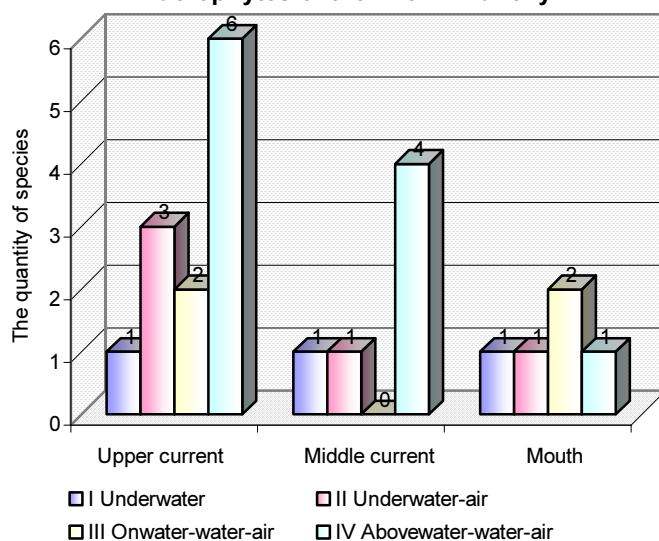
**Illustration 4: Ecological structure of macrophytes of the river Muksha**



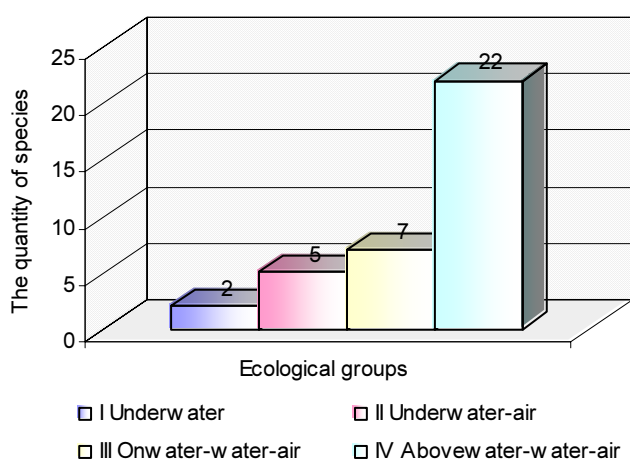
The analysis of correlation of quantity of species in different ecological groups testifies about prevailing of macrophytes with roots – 38 species (81%). The most numerous of them are abovewater-water air – 22 species (55.5%). Other subgroups are represented in this way: underwater-air – 6 species (17%), onwater-water-air – 3 species (8.5%). The group of macrophytes without roots have only 7 species (20%): onwater-water-air – 4 species (11.5%), underwater – 2 species (5.5%), underwater-air – 1 species (3%). As a result of our investigation some peculiarities of spreading of species-indicators on the tributaries of the Dnister were revealed. You can see it on the illustrations 1 – 6. biological monitoring is supplemented by the biochemical one, it allows to make the whole picture of the state of pollution of a water body. Ecomonitoring of the chemical composition of water in the rivers during the last four years shows that the most indicator index is the index of content of nitrites, because their increased content (maximum permissible concentration – MPC – 0.08 mg/l) testifies about

intensification of the process of decomposition of organic substances in the conditions of slower oxidation  $\text{NO}_2^-$  into  $\text{NO}_3^-$ , that shows the pollution of water object (5). The river Dnister arouses great

**Illustration 5: Ecological structure of macrophytes of the river Zhvanchyk**



**Illustration 6: Ecological structure of macrophytes of the Kuchaiv Ponds**



anxiety. During the last four years the level of nitrite-ions in its waters remains stably high and exceeds MPC at the average in 17 times. The same situation is in the rivers Muksha – in 16 times and Zhvanchyk – in 8 times. Moreover the content of nitrite nitrogen in the river Zhvanchyk increased from 0.13 mg/l in 2000 to 0.25 mg/l in 2003; in the rivers Zbruch and Smotrych the level of ions  $\text{NO}_2^-$  was rather lower and fluctuated in the margins 0.05 – 0.10 mg/l and only in 2003 on the river Zbruch we could see the sharp increasing of the content of nitrites. Kuchaiv Ponds appeared to be excellent as for the content of nitrites, where their level did not exceed MPC.

### Discussion

The river Dnister and its left tributaries in the boundaries of NNP “Podilski Tovtry” are anthropogenic factors. During the season there is the change of the chemical composition of water that is connected with the action of temperature, watering, the speed of reaction of conversion of nitrogen containing compounds, the influence of anthropogenic factors and biota. Substantial changes of the bymouth part of the rivers also influence the chemical composition of water. The main part of the ecomonitoring of the water systems is the studying of species variety of flora, that is an indicator of the changes of their chemical and hydrogeological peculiarities. The left tributaries of the river Dnister have the sources on the

swampy, eutrophicated territories. If you approach to the Tovtry range you can see the species variety, which is characterized by the high index of species inheriting in swampy lands and wet meadows. The banks and the river-beds change themselves crossing the Tovtry range, they go through the stone and limestone rocks, canyons and meanders appear. Because of it bybank water flora changes its species and the quantity in the associations. Mouth zone from the river Smotrych to the river Ushitsia goes to the system of the Dnister water reservoir and that caused the rising of the water level, destroying (drowning) of the bybank zone on the distance of 3 – 8 km from the place of flowing the river into the Dnister. The change of species composition of macrophytes depends not only on geographical and geological conditions but to a great extent on mowing, grazing, burning and regulation of the water level on Dnistrovsk Power Electro Station (PES) (1). As a result of our investigations we revealed some peculiarities of species spreading on the rivers-tributaries of the Dnister. In the upper current the species that belong to abovewater-water-air ecological group prevail. They are mainly the following (*Acorus calamus* L., *Alisma plantago-aquatica* L., *Bolboschoenus maritimus* (L.) Palla., *Butomus umbellatus* L., *Carex acuta* L., *Iris pseudacorus* L., *Phragmites australis* (Cav.) Trin.ex Steud., *Scirpus tabernaemontani* C.C. Gmel., *Typha angustifolia* L.) and others. In the middle current of the rivers, where they cross the Tovtry range this group is represented by: (*Caltha palustris* L., *Carex pseudocyperus* L., *C. vulpina* L., *Eleocharis palustris* (L.) Roem. et Schult., *Equisetum fluviatile* L., *Hippuris vulgaris* L., *Mentha aquatica* L.) and others. You can also see there underwater-air representatives of the genus *Lemna* and onwater-water-air (*Spirodela polyrrhiza* (L.) Schleid.,

Hydrocharis morsus-ranae L., Polygonum amphibium L., Nuphar lutea (L.) Smith.) and others. The mouth parts of the rivers have the similar characteristics which liken them to the peculiarities of the mouth of the river Dnister. The constant oscillations of the water level cause the silting and barring of the banks, which during spring-summer are overgrown by one year weeds (*Xanthium strumarium* L., *Sambucus ebulus* L., *Urtica dioica* L., *Ballota nigra* L., *Galium aparine* L.) and others. Very seldom you can meet (*Butomus umbellatus* L., *Acorus calamus* L., *Glyceria fluitans* (L.) R. Br.) and underwater-air (*Ceratophyllum demersum* L., *Potamogeton pectinatus* L., *Myriophyllum verticillatum* L.). the biggest species variety is on Kuhaiv Ponds, where the gutter is well-regulated and the functioning of the sources conducted to the creating of different associations of macrophytes-indicators, which cannot be met in the other rivers (see Table 2). Underwater macrophytes which are closely connected with water environment the most sharply react on the water composition and can reveal its qualities by its indicator (6, 7). Thus water body with slight pollution (Kuhaiv Ponds) have the following characteristic species: (*Potamogeton lucens* L., *Elodea canadensis* Michx., *Lemna trisulca* L. and *Iris pseudacorus* L.). If there is strong pollution, there can be met: (*Myriophyllum spicatum* L., *Ceratophyllum demersum* L., *Potamogeton crispus* L., *P. pectinatus* L., *Spirodela polyrrhiza* (L.) Schleid.) that is confirmed by the results of hydrochemical analysis of nitrites, the content of which in the rivers Dnister, Muksha, Zhvanchyk, Zbruch and Smotrych exceeds MPC. Other indicators of anthropogenic eutrophication of the water bodies are (*Typha latifolia* L., *Butomus umbellatus* L., *Acorus calamus* L., *Sparganium erectum* L.) and others.

### Conclusions

As a result of carried out investigations the ecological structure of macrophytes-indicators of the water bodies of NNP "Podilski Tovtry" was established. It is formed under the influence of natural anthropogenic factors. The intensive development of macrophytes revealing the species characteristic for the polluted waters testifies about strained ecological situation which is in the natural main rivers of NNP showed, that no one of the investigated rivers corresponded the requirements of MPC for the content of nitrite nitrogen. The only exception are Kuhaiv Ponds that can be an etalon because of their ecological state. The comparative analysis of the water quality proves that the investigated rivers are slightly polluted (the river Smotrych), polluted (the rivers Zhvanchyk and Zbruch) and very polluted (the rivers Dnister and Muksha) that testifies about substantial anthropogenic pressing on the territory of the park, that does not correspond the aims of environmental protection. We think that in the nearest future it is necessary to carry out complex monitoring which including of the hydrological indexes and it will help to substantiate the main directory of ecologically safe economy in the basins of the rivers of NNP "Podilski Tovtry", taking into consideration the peculiarities of biovariety of this region.

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