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Original article

Ecological and coenotic features of the Syrovatka river basin in the Emerald network of the Sumy region, Ukraine

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ABSTRACT

A number of studies were undertaken in the territory of the "Syrovatka river basin of the Emerald Network of Ukraine (UA0000428 Syrovatka river basin). Based on the data gathered from field work surveys of the area, the characteristics of the habitats (C1.222, C1.224, C1.32, C1.33, C2.33+, C2.34, C3.4, C3.51, D5.2, E1.2, E2.2, E3.4, E5.4, F3.247, F9.1+G1.11, G1.21+G1.41, G1.A1, G1.7, G1.8, G1.A4) are presented according to the area covered and their ecological features. Phytosociological characteristics of habitats were given. As a result of the analysis of the distribution of certain species of sozophytes, a brief description of the status of the identified populations was presented. Populations of vascular plant species protected in Europe (*Ostericum palustre, Iris hungarica)*, Ukraine (*Epipactis helleborine, Lilium martagon, Platanthera bifolia*), and at the regional level (*Carpinus betulus*, *Campanula persicifolia*, *Calla palustris*, *Dryopteris cristata*, *Inula helenium*, *Utricularia vulgaris*) have been studied in detail. The main threats to the existence of the natural complex of this area, which may appear in the situation of increasing economic impact are drainage and ploughing of floodplains, terracing, and afforestation of meadow-steppe slopes of the ravine. The typological characteristics of artificial and natural forest plantations of the territory were described based on the generalization of details gathered from information on their local management.

KEY WORDS: natural habitats, forest types, Syrovatka river basin, Emerald Network, rare plant species

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1. Introduction

The Emerald Network is an ecological network of areas of conservation importance. The network has been created to conserve biodiversity in Europe, Ukraine and some African countries. It is a system of interconnected areas that have been managed, monitored, and accounted for. It ensures the preservation of the most valuable and typical regional components of the landscape and biotic diversity. The area includes habitats of rare and endangered species of animals and plants.

The Convention on the Conservation of Europe's Wildlife and Natural Habitats was established and signed in 1979 in Bern, Switzerland, to protect wild flora and fauna and their natural habitats. Articles 1, 2, 3, 4, 6.b, and 9 of the Convention are implemented based on Recommendation № 16 "On Areas of Special Conservation Importance" and Resolution № 3, and these were implemented in the establishment

of the Emerald Network. The Area of Special Conservation of Nature (ASCI) (a protected area in Europe or North Africa) that is part of the Emerald Network contributes to the survival of endangered, endemic, and any other species listed in Annexes I and II of the Bern Convention. It supports a significant number of species in an area of high species diversity and supports key populations of one or more species. It also contributes to a large number of species in an area of high species diversity and contains an important and/or representative sample of endangered habitats (biotopes). It also contains habitats of a special type or different types and is an important area for one or more migratory species.

At the stage of formation and implementation of the Emerald Network that is currently underway in Ukraine, the description of the current state of the natural complex of each specific area is very relevant. The area of the Emerald Network of Ukraine in the Syrovatka river basin (UA0000428) is 35,818.08 hectares. It is important and timely to record the state of preservation of the natural vegetation, to establish the presence of, and to study the status of population viability of sozophytes (rare species of plants) within the territory of this area of conservation. It is also essential to survey and identify, and then to keep records of, habitats that need to be preserved by creating special protected areas. Such surveys are especially relevant since this region is one of the district landscape complexes with large elements of natural origin. Accordingly, such sites are promising examples for the restoration of similar landscapes in other territories.

The study of ecological-coenotic and phyto-sociological features of the Emerald Network within the North-Eastern Forest-Steppe of Ukraine was carried out by BEZRODNOVA ET AL., 2020a, 2020b, 2021 and TYMOCHKO ET AL., 2021a, 2021b. The Syrovatka River Basin of the Emerald Network was selected for further research. The research will assess the importance of vegetation for stabilizing the environmental situation in the region and reveal new ways to use them for improvement of the ecological environment and quality of life.

The aim of this article was to identify and characterize the types of biotopes within the study area, for their appropriate preservation. For this it was necessary to describe the status of the identified populations of species protected at the regional, national and inter-state levels. On this basis, a general assessment of the significance of the Emerald Network of Ukraine in the Syrovatka River Basin is provided.

2. Materials and methods

2.1. Study area

The River Syrovatka is the only left-bank tributary of the upper reaches of the River Psel with a sub latitudinal character. The river valley is located in the depressions between the south-western spurs of the Middle Russian Uplands on the south-western slopes of the Voronezh crystalline massif. The riverbed has a noticeable general inclination to the west. The level of the stream pool in the reservoir near the village of Novodmytrivka is 165 m above sea level. The confluence with the River Psel is 123 m above sea level. The total length of the channel is about 60 km. The width of the floodplain in the middle part of the flow is within 0.3–0.6 km. Height differences in the transverse profile between the upper parts of the plateau and the level of the channel are about 40-70 m. In the upper and middle reaches, the riverbed is blocked by numerous dams, where reservoirs are formed. A feature of the current state of the landscape is the relatively high forest cover of the right-bank of the valley with significant ploughing of the left-bank.

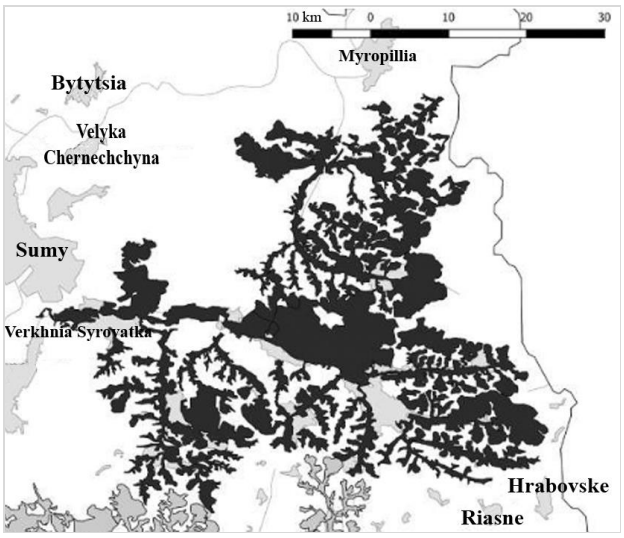


Fig. 1. Map of the location of the Syrovatka River Basin in the Emerald Network of Ukraine UA0000428 (Vasyliuk, 2020)

The Syrovatka river basin (UA0000428) is located in the Sumy region (Fig. 1). It has an area of 35,818.08 hectares. This area is characterized by the diversity of the landscape complexes, which are confined to the spurs of the Central Russian Upland with a significant proportion of well-preserved elements of natural origin. Individual parts of this area can be used as a benchmark for landscaping adjacent territories. According to physical and geographical zoning, the territory of the Syrovatka

river basin mainly belongs to the Sumy-Trostyanets physical-geographical district of the Sumy slope-upland region, in the Eastern Ukrainian region, Forest-steppe zone, Eastern European (Russian) plain (ENCYCLOPEDIA OF ECOLOGY, 2006).

2.2. Data and methods

Reconnaissance studies were performed by a route-floristic method in July 2020 (TOLMACHEV, 1959). The collection of herbarium specimens and their processing were undertaken according to this method (SCVORTSOV, 1977). Taxonomic names were selected according to the checklist (MOSYAKIN & FEDORONCHUK, 1999). Descriptions of vegetation areas with rare species were described according to generally accepted methods (MIRKIN ET AL., 2001). The geobotanical descriptions of study plots were made within the natural boundaries of phytocenoses according to phytosociological study. The study plots were laid out within the natural boundaries of the phytocoenoses. Areas with an area of 30x30 m were selected for forest groups, for meadow-steppe, meadow, and for swamp 5x5 m. Recent literary sources were used to determine the types of biotopes (KUZEMKO ET AL., 2017; KUZEMKO ET AL., 2018). An electronic resource was used to characterize the relief and indicators of altitudes (http://www.vhfdx.ru/altitude_map.html).

Determination of the share of non-forest type biotopes in the transverse profile of the floodplain and extrapolation of measurements for data of forest-free areas of the floodplain were performed using Google Maps. Estimation of forest biotope areas was carried out based on forest management data.

To analyze the types of forest and plant conditions, (forest types, and species composition of the stands of the territory), excerpts from the stand inventory indicators of forest land were used. Their area is 21,940.4 hectares within the Velykyj Bobryk, Verkhnya Syrovatka, Krasnopillya Novodmytrivka, Osoivka Forestry of State Enterprise, "Krasnopil'ske lisove hospodarstvo". The analysis of the typological structure of forests was carried out according to the methods of the Ukrainian school of forest typology (POHREBNIAK, 1955; OSTAPENKO & TKACH, 2002). Data analysis was performed by the means of MS Excel 2016 software.

3. Results and discussion

According to information in the literature on a preliminary list of biotopes in this area it is advisable to create protected areas (VASYLIUK ET AL., 2020). The approximate sizes of the areas were specified (level P) for biotopes such as C1.222; C1,224; C1.32; C1.33; C1.4; C2.33; C2.34; C3.4; C3.51; E2.2; E3.4; E5.4 specified areas (within 100-700 ha). It does not match our estimates of the indicator by KUZEMKO & BORYSENKO, 2019 (Table 1). The total area of aquatic biotopes (group of biotopes C) in the entire territory of this Emerald Network area is not more than 2000 ha. The presence of this type of aquatic habitat as permanent dystrophic reservoirs is improbable from our observations (C1.4).

Habitat of C1.222 are fragmented and distributed on littoral areas in most reservoirs. In particular, these biotopes have been noted in Lake Zhuravlyne (50,832372 north latitude; 35,033844 east longitude) (TYMOCHKO ET AL., 2021) on the surface water along the straightened riverbed of the River Syrovatka between Samotoivka-Krasnopillya villages and in Lake Didove, near the Krasnopillya village.

Habitat of C1.224 occurred rarely. These habitat have been observed only within the reservoir of the above-named lake and in floodplains in the vicinity of the village of Samotoivka (50,801214 north latitude; 35,177496 east longitude).

Habitats of C1.32 were found everywhere along the river. It was also common on the water surface of ponds, formed by artificial barriers. The main dominant is *Lemna minor* L. with colonies of filamentous algae. A group with co-dominance of *Spirodela polyrrhiza* (L.) Schleid. and *Lemna trisulca* L. are also common. Groups dominated by *Wolffia arrhiza* (L.) Lorkel ex Wimmer (Lake Zhuravlyne) have been noted. Usually, synusia of free-floating plants could be developed with different intensities and form groups of different sizes, depending on the weather conditions during the year.

Habitat C1.33 has been noted on the surface of reservoirs. This type of biotope was most often represented by groups dominated by *Ceratophyllum demersum* L. Groups with a predominance of *Potamogeton lucens* L., *P. perfoliatus* L., *P. gramineus* L. grow much less frequently. Along the riverbed and in artificial reservoirs on the floodplain near the village of Samotoivka (50.801214 north latitude; 35.177496 east longitude), fragmented groups (10-20 m^2) dominated by *Ceratophyllum demersum*, *Potamogeton nodosus* Poir. were found.

Habitats C2.33 and C2.34 were most often represented by small fragments of groups with the dominance of *Nuphar lutea* (L.) Smith., *Sagittaria sagittifolia* L., *Sparganium emersum* Rehmann in littoral shallow waters of ponds. Groups were observed in Lake Didove near the village of Krasnopillya, in Lake Zhuravlyne, in and around the village of Zaliznyak (50,830659 north latitude; 35,015160 east longitude), along the riverbed

and in artificial reservoirs on the floodplain near Samotoivka village (50,801214 north latitude; 35,177496 east longitude) in the form of fragments with an area from 10 to 100 m^2. There are groups with small species composition, which form thickets of habitat (C3.4). They were represented by border littoral groups up to 10 m^2 with a predominance of *Eleocharis acicularis* (L.) Roem. & Schult. With co-dominance of *Veronica anagallis-aquatica* L., *Alisma plantago-aquatica* L.

Habitat of C3.51 occupied very small areas up to 10 m^2 on the trails and slopes of pastures, where cattle have grazed intensively. We noted only a few fragments of these with *Bidens frondosa* L. and *Cyperus fuscus* L. co-dominant. It is possible, that the low level of their occurrence was determined by the weather conditions during the year or our fieldwork took place too early to observe them.

Table 1. Habitat types from Resolution 4 of the Bern Convention of the Syrovatka River Basin

Resolution 4 Habitat type			Site assessment			
Code	Cover [ha]	Data quality	A|B|C|D	A|B|C		
			Representativity	Relative surface	Conservation	Global
C1.222	50	M	B	C	A	C
C1.224	30	M	B	C	A	C
C1.32	100	M	A	C	A	C
C1.33	100	M	B	C	A	C
C2.33+C2.34	200	M	B	C	B	C
C3.4	30	M	B	C	B	C
C3.51	10	M	D			
D5.2	500	M	B	C	B	C
E1.2	2000	M	B	C	B	C
E2.2	1000	M	C	C	C	B
E3.4	300	M	B	C	A	C
E5.4	100	M	B	C	C	C
F3.247	100	M	B	C	C	C
F9.1+G1.11	1000	M	B	C	B	C
G1.21+G1.41	600	M	B	C	B	C
G1.A1	10000	M	B	C	B	C
G1.7	3000	M	B	C	C	C
G1.8	300	M	C	C	C	C
G1.A4	5000	M	B	C	C	C

Note. Code: C - Inland surface waters: C1.222 Floating *Hydrocharis morsus-ranae* rafts; C1.224 Floating *Utricularia australis* and *Utricularia vulgaris* colonies; C1.32 Free-floating vegetation of eutrophic waterbodies; C1.33 Rooted submerged vegetation of eutrophic waterbodies; C2.33 Mesotrophic vegetation of slow-flowing rivers; C2.34 Eutrophic vegetation of slow-flowing rivers; C3.4 Species-poor beds of low-growing water-fringing or amphibious vegetation; C3.51 Euro-Siberian dwarf annual amphibious swards; D - Mires, bogs and fens: D5.2 Beds of large sedges normally without free-standing water; E - Grasslands and lands dominated by forbs, mosses or lichens: E1.2 Perennial calcareous grassland and basic steppes; E2.2 Low and medium altitude hay meadows; E3.4 Moist or wet eutrophic and mesotrophic grassland; E5.4 Moist or wet tallherb and fern fringes and meadows; F - Heathland, scrub and tundra: F3.247 Ponto-Sarmatic deciduous thickets; F9.1 Riverine scrub; G - Woodland, forest and other wooded land: G1.11 Riverine *Salix* woodland; G1.21 Riverine *Fraxinus* – *Alnus* woodland, wet at high but not at low water; G1.414 Steppe swamp *Alnus glutinosa* woods; G1.7 Thermophilous deciduous woodland; G1.8 Acidophilous *Quercus*-dominated woodland; G1.A1 *Quercus* – *Fraxinus* – *Carpinus betulus* woodland on eutrophic and mesotrophic soils; G1.A4 Ravine and slope woodland

An assessment of the level of how representative certain types of natural habitats are within this area: A – The highest, B – big, C – significant, D – insignificant (no further evaluation has been performed according to other criteria).

This is the ratio of the area of a particular type of natural habitat within the study area to the sum of the areas of this type of natural habitat in the country. Has gradations: A: 100% >= p > 15%; B: 15% >= p > 2%; C: 2% >= p > 0%.

Conservation – an assessment of the degree of preservation of the structure and function of certain types of natural habitats and opportunities for their restoration. This criterion includes three subcriteria: i) the level of preservation of the structure; ii) the level of preservation of functions; iii) the possibility of recovery. So, the synthesis of estimates according to these three sub-criteria will allow a choice of one of three options: A – excellent, B – good, C – mediocre preservation or preservation with losses.

Global – an assessment of the significance of the object for the preservation of certain types of natural habitats: A – excellent; B – good; C – important. The criterion is used for an integrated assessment of the previous criteria and their significance for the preservation of a particular type of natural habitat throughout the planet (Kuzemko & Borysenko, 2019).

Habitats of D5.2 are quite common in the form of edging along the littoral with water and on the lower floodplain. During spring and summer floods, these areas were occupied by shallow waters. During most of the growing season they are dehydrated. In some places, they have been used for hayfields. Groups dominated by *Phragmites australis* (Cav.) Steud. predominate in terms of area. Groups dominated by *Carex acutiformis* Ehrh., *C. acuta* L., *C. caespitosa* L., *C. disticha* Huds., *Scirpus sylvaticus* L. are also common. *Calystegia sepium* (L.) R.Br., *Lycopus europaeus* L., *Mentha aquatica* L., *Scutelaria galericulata* L., *Symphytum officinale* L., *Urtica pubescens* Ledeb., *Lysimachia vulgaris* L. were also found growing here. Plant populations of species rare for the region and European species, including *Ostericum palustre* were associated with such habitats. The population of *Ostericum palustre* Besser covered a fairly large area (about 5 hectares by approximate estimate) and was found by us in similar habitats. Its exact location is in the plots of wet floodplain meadows, near the village of Samotoivka (50,815701 north latitude; 35,146875 east longitude). As a result of external influences on the soil, plant growth sites are also heterogeneous. *Ostericum palustre* was substituted by tall perennial grasses: *Carex acutiformis*, *Eupatorium cannabinum* L., *Calystegia sepium*, *Sonchus palustris* L., *Elytrigia repens* (L.) Nevski, *Potentilla anserina* L., *Ranunculus repens* L., *Poa palustris* L. And other species: *Lythrum salicaria* L., *Lysimachia vulgaris, Sium latifolium* L., *Scutelaria galericulata, Galium rivale* (Sibth. & Smith) Griseb., *Symphytum oficinale, Cirsium arvense (*L.) Scop., *Filipendula ulmaria* (L.) Maxim., *Angelica sylvestris* L., *Cirsium oleraceum (*L.) Scop. The following species were found: *Carex hirta* L., *Veronica chamaedrys* L., *Rumex hydrolapathum* Huds., *Pastinaca sativa* L., *Phleum pratense* L., *Trifolium pratense* L., *Sonchus oleraceus* L., *Epilobium palustre* L., *Valeriana officinalis* L., *Urtica pubescens, Stachys palustris* L. *Ostericum palustre* forms a projective coverage of 10-20%. Plant height is about 1,50-1,70 m, with a number of umbrellas of 10-17 (30 maximum). There are individuals in the first and second years of development. *Carex disticha*, *C. hirta*, *Trifolium repens* L., *Potentilla anserina* L., *Prunella vulgaris* L., *Ranunculus repens* L. co-dominated in areas of old plowed hay meadow. There are single representatives of the species *Poa palustris* L., *Plantago major* L., *Achilea setacea* Waldst. & Kit, *Taraxacum officinale* Wigg., *Lotus corniculatus* L., *Lysimachianu mmularia* L., *Ranunculus acris* L., *Daucus carota* L., *Rumex confertus, Glechoma hederacea* L., *Sonchys palustris, Pastinaca sativa, Phleum pratense, Angelica sylvestris* L., *Beckmania eruciformis* (L.) Host. *Ostericum palustre* is asectators (coverage less than 1%). The height of individuals was not more than 70 cm, with the number of umbrellas in the range of 2-4.

Among the meso-xerophilous herbaceous vegetation, large areas on slopes were covered by habitat E1.2 and in groups in ancient fallows, which were at different stages of demutation. In particular, to the west of the village of Mykhailivske (50,821160 north latitude; 35,279942 east longitude), the sloping areas of the hills with a slope angle of 5-100° were occupied by overgrown forests. On the tops of the hills are dominated by *Poa angustifolia* L., *Fragaria viridis* Duch., co-dominance *Senecio jacobaea* L., *Picris hieracioides* L., *Agrimonia eupatoria* L., *Galium verum* L., *G. tinctorium* (L.) Scop., *Hieracium robustum* Fr., *Centaurea substituta* Czer., certain species of meadow-steppe forbs *Centaurea scabiosa* L. and a complex of weed species (*Conyza canadensis* (L.) Cronq., *Lactuca serriola* L., *Artemisia absinthium* L.). Near the village of Samotoivka (50,801214 north latitude; 35,177496 east longitude) steep slopes to the floodplain were covered by groups of meadow-steppe vegetation dominated by *Carex praecox* Schreb., *Festuca rupicola* Heuff. The synusia of long-rhizome perennial grasses was quite well expressed in its composition of *Equisetum arvense* L., *Elytrigia repens*, *Bromopsis inermis* (Leys.) Holub with species of typical forbs: *Cichorium inthybus* L., *Salvia nemorosa* L., *Galium verum*, *Fragaria viridis*, *Pimpinella saxifraga* L. There were plots with a dominance of *Elytrigia intermedia* (Host.) Nevski.

Habitat of E2.2 was present on large areas of floodplains (Table 1). The largest number of these were located near the village of Verkhnya Syrovatka, between the villages of Samotoivka and Krasnopillya, and between the villages of Mykhailivka, and Pokrovka. In particular, in the southern outskirts of the village of Krasnopillya (50,788080 north latitude; 35,234488 east longitude) damp and dry meadows were widespread in the valley of the River Syrovatka, with an area of about 200 hectares, which have been intensively grazed. Species of *Poaceae* dominate with the grasses: *Poa angustifolia*, *Elytrigia repens*, *Festuca regeliana* Pavl., and with an increase in the number of species among the forbs: *Trifolium repens*, *T. fragiferum* L., *T. pratense*, *Leotodon autumnalis* L. Also, *Carex hirta*, *Potentilla anserina* L., *Ranunculus repens* L., *Poa palustris*, *Phleum pratense* were co-dominant in slightly lower plots with fresh meadow-turf. And low-peat soils, with projective coverage up to 100% *Trifolium repens, Lotus corniculatus, Ranunculus acris* L., *Daucus carota* L., *Glechoma hederacea, Sonchus palustris, Pastinaca sativa, Angelica sylvestris* were growing with less participation. The localities of

Ostericum palustre were rare, where this species covered up to 1%.

Habitat E3.4 was found in large massifs and was associated with peaty depressions in the floodplain. In particular, in the southern outskirts of the village of Krasnopillya (50,788080 north latitude; 35,234488 east longitude) peat depressions around the alders were occupied by groups of *Filipendulion ulmariae* Segal ex Westhoff et Den Held, 1969 with the main co-dominance of *Filipendula ulmaria, Lysimachia vulgaris, Ranunculus repens, Geum rivale* L., *Vicia dumetorum* L., *Lythrum salicaria* L., *Poa palustris, Symphytum officinale, Iris pseudacorus* L., *Potentilla anserina, Angelica sylvestris, Deschampsia caespitosa* (L.) Beauv. The assectators group consisted of *Carex leporina* L., *Anthoxanthum odoratum* L., *Juncus effusus* L., *Rumex crispus* L.. An *Inula helenium* L. population was found on such meadows in the vicinity of the village of Samotoivka (50,815701 north latitude; 35,146875 east longitude).

In deciduous forests at logging sites and excessively moist depressions were characterized by habitat of E5.4. High-grass complexes of the forest-glade type were present along the River Kryva (a left-bank tributary of the River Syrovatka) (50,784520 north latitude; 35,263468 east longitude) in the alder forest within the village of Krasnopillya.

There were glades of high grass with an area of up to 1 a. These places were dominated by *Angelica sylvestris, Echinocystis lobata* (Michx.) Torr. & Gray, *Lactuca tatarica* (L.) C.A. Mey, *Sonchus palustris.* Near the thalweg depressions and along the thalweg around the village of Krasnopillya (50,801340 north latitude; 35,267703 east longitude), there were glades with high participation of *Dryopteris filix-mas* (L.) Schott (up to 20%), *Cystopteris fragilis* (L.) Bernh. (less then 1%), *Stachis sylvatica* L. (up to 5%), *Campanula trachelium* L. (less then 1%), *Cardamine impatiens* L. (less then 1%). On the island located in Lake Zhuravlyne (50,832372 north latitude; 35,033844 east longitude) there were complexes with co-dominance of *Athyrium filix-femina* (L.) Roth, *Dryopteris carthusiana* (Vill.) H.P. Fuchs, *D. cristata* (L.) A.Gray, *Thelypteris palustris* Schott, *Calla palustris* L., *Calamagrostis canescens* (Weber) Roth. In the complex, within the topographically unified contour, the biotopes of Pontic-Sarmatian deciduous shrubs (F3.247) were also present and were formed of *Pyrus communis* L., *Pinus sylvestris* L., *Malus sylvestris* Mill., *Prunus spinosa* L., *Rosa* sp., and *Crataegus* sp.. The most common was self seeding *Pyrus communis* (up to 100 individuals per 1 ha).

Complexes of habitats F9.1 + G1.11 in the form of large areas (up to several hectares and in fragments) were found everywhere. We inspected the section of the straightened bed of the River Syrovatka between the railway and the village of Krasnopillya. Near the road in the floodplain in front of the bridge, thickets with an area up to 10 ares of the association *Salicetum triandra*, surrounded by willows, were found everywhere on the floodplain. Fragments and sometimes large areas (up to several dozen) were found in riverine willow forests. The main species of the first tier were: *Salix alba* L. (60%), *Acer negundo* L. (10%). *Salix cinerea* (15%), *Swida sanquinea* (L.) Opiz (20%) which most often grew in the shrub layer. Less common were: *Frangula alnus* Mill., *Viburnum opulus* L., *Rhamnus cathartica* L.. In the layer of grasses various species of hygrophytes were growing, including: *Carex riparia* Curt. (20%), *Angelica sylvestris* (5%), *Gallium palustre* L. (3%), and *Sium latifolium* (2%). Different species (less then 1%) of moisture-loving vegetation: *Parthenocissus quinquefolia* (L.) Planch., *Lycopus exaltatus* L. fil., *Equisetum pratense* L., *Urtica pubescens*, *Sonchus palustris*, *Echinocystis lobata*, *Mentha aquatica* L., *Euphatorium cannabinum* L., *Tussilago farfara*, *Lysimachia vulgaris* were found with rather variable participation and less constancy in grassland.

Habitat of G1.21 was found here also in a single contour with habitat G1.41. The right bank near the village of Krasnopillya was covered by a large area of these plants. From the river to the plateau, they were confined to segments of the terraced depression and have the appearance of stripes along the pine terrace. The associations *Urtico dioica-Alnetum* and *Carici acutiformis-Alnetum* predominate. Typical variants of alders also predominate. In the canopy layer *Alnus glutinosa* (L.) Gaertn. (70%) dominated and *Acer negundo* was rare. In the undergrowth layer were: *Padus avium* Mill. (1%), *Sambucus nigra* L. (1%), *Acer negundo* (5%). The grass layer was characterized by: *Urtica dioica* L., *Humulus lupulus* L., *Echinocystis lobata*, *Carex riparia*, *Angelica sylvestris*, *Gallium palustre*, and *Sium latifolium*.

Habitat of G1.7 was confined to high areas of the pine terrace. Some of the patches were observed north of the village of Krasnopillya and here *Quercus robur* L. (30%) predominates in the stand with a density of 70%, and *Betula pendula* Roth and *Pinus sylvestris* also grow. *Acer tataricum* L. (15%) grows in the shrub layer (60%), *Euonymus verucosa* Scop., *Sorbus aucuparia* L., *Acer negundo*, *Prunus padus* L. grow less often. *Stellaria holostea* L., *Elytrigia repens*, *Fragaria vesca* L., *Polygonatum odoratum* (Mill.) Druce, *Poa angustifolia*, *Peucedanum oreoselinum* Moench, *Pteridium aquilinum* (L.) Kuhn. codominate in the grass layer (50%).

Epipactis heleborine (L.) Crantz, *Campanula rotundifolia* L., *C. persicifolia* L., *Rubus saxatilis* L., *Thalictrum simplex* L., *Anthericum ramosum* L., *Trifolium alpestre*, *Veronica officinalis*, *Agrostis gigantea* Roth, *Poa nemoralis* L., *Clinopodium vulgare* L., *Carex michelii* Host, *Chamaecytisus ruthenicus* (Fisch. ex Wol.) Klaskova also grow there. It is in such forests near the forest lake "Didove" where we found one clump of *Iris hungarica* Waldst. & Kit. It had 32 vegetative shoots, and was apparently a clump of subsenile age. According to locals here one of the species *Pulsatila sp*. has been growing in the forest.

Habitat of G1.8 was mostly represented by a parcel of oaks at a demutation stages. They are dominated by stands of pioneer species with oak undergrowth in the lower tiers. Thus, *Betula pendula*, *Pinus sylvestris*, *Populus tremula* L. grow in low-lying areas of the pine terrace in the northern outskirts of the village of Krasnopillya with a crown cover of 60% (the ratio of the sum of the areas of horizontal projections of tree crowns to the total area of the relevant forest area). *Sorbus aucuparia*, *Salix cinerea* L., *Frangula alnus* Mill., *Quercus robur* have formed a crown cover of 20%. In the grass layer (total coverage up to 10%) the following species predominate: *Festuca rubra* L., *Lysimachia vulgaris*, *Pyrola rotundifolia* L., *Veronica officinalis* L. Occasionally with species of: *Clinopodium vulgare*, *Carex hirta*, *Hieracium sp*., *Deschampsia caespitosa* (L.) Beauv., *Carex spicata* Huds., *C. pallescens* L., *Hieracium umbellatum* L., *Geum rivale* L., *Viola canina* L., *Platanthera bifolia* (L.) Rich., *Carex lachenalii* Schkuhr, *Galium rivale* (Sibth. et Smith) Griseb., *Valeriana officinalis* L. Also there are five generative stems of *Platanthera bifolia* (L.) Rich growing here (50,821039 north latitude; 35,143028 east longitude). *Sieglingia decumbens* (L.) Bernh occurs in birch groves.

Habitat of G1.A1 was spread on watershed plateaus, on their gentle slopes and covered a huge areas. Their largest areas were on the left bank of the plateau. The upper canopy (closed 70-90%) was characterized by a predominance of *Quercus robur* (10-40%), *Acer platanoides* (10-20%), *Fraxinus excelsior* (up to 40%), *Tilia cordata* (up to 20%), and occasionally *Carpinus betulus* (sometimes up to 40%). In the undergrowth layer (closed from 10 to 80%) there were most tree species and shrubs: *Sambucus nigra*, *Euonymus europaeus*, *E. verrucosus*, *Rosa sp*., *Corylus avellana*, *Sorbus aucuparia*, *Swida sanguinea* Opiz., and *Viola mirabilis* L., *Carex pilosa* Scop., *Polygonum convolvulus* L., *Lamium maculatum* L., *Asarum europaeum* L., *Stellaria holostea* L., *Glechoma hirsuta* Waldst. & Kit. co-dominate or dominate individual clumps in the grass layer (total coverage from 15 to 50%). A significant list of species were found as assectators: *Polygonatum odoratum* (Mill.) Druce, *Impatiens parviflora* DC., *Galeopsis bifida* Boenn., *Chelidonium majus* L., *Urtica dioica*, *Milium effusum* L., *Aegopodium podagraria* L., *Alliaria petiolata* (Bieb.) Grande, *Pulmonaria obscura* Dumort., *Festuca gigantea* (L.) Vill., *Geranium robertianum* L., *Geum urbanum* L., *Cardamine impatiens* L., and *Scrophularia nodosa* L.

A population of *Lilium martagon* L. was found (Tymocko & Solomakha, 2020) to the north of the village of Krasnopillya (50,801340 north latitude; 35,267703 east longitude) in the middle part of the slope of the western exposure ravine (steepness 150) within the forest area with maple and ash plantations up to 40 years old, after felling. The only shoot of pre-generative age of this species was noted. Single shoots of *Epipactis helleborine* (L.) Crantz also grew here.

Habitat of G1.A4 was spread on canyon and ravine slopes and forest plateau slopes to sand terraces. Its characteristics are more similar to the G1.A1 biotope. Its features are a sparse layer of grasses and the growth of synanthropic species. A special case option is the sloping forests at the transition from the pine terrace to the floodplain. Self-seeding young trees grow on moist soils. The main dominants were: *Pinus sylvestris* (40%), *Populus tremula* (30%), occasionally *Robinia pseudoacacia* L., *Corylus avellana*, *Viburnum opulus*, *Malus sylvestris*, closed stands 90%. It generally has a projective grass cover of up to 25%, dominated by *Equisetum hyemale* L. (20%). *Phragmites australis* (Cav.) Trin. & Steud., *Equisetum pratense*, *Urtica dioica*, *Galium rivale*, and *Solanum dulcamara* L. *Glechoma hederacea* L. has been found occasionally.

We also used information about forest management activities in the analysis of ecological and typological features and of forest ecosystems. Therefore, we investigated the existing artificially created and natural forest groups in the total area of Krasnopil'ske lisove hospodarstvo, which has an area of 21,940.4 hectares. The main forest-forming species were *Quercus robur* (12,593.9 ha, 57.40%) and *Fraxinus excelsior* L. (4,059.8 ha, 18.50%). Much smaller, but significant areas were occupied by *Pinus sylvestris* (1,524.5 ha, 6.95%), *Acer platanoides* (1,378.7 ha, 6.28%), and *Tilia cordata* (984.9 ha, 4.49%). *Quercus rubra* L. (316.3 ha, 1.44%), *Populus tremula* (291.2 ha, 1.33%), *Betula pendula* (226.5 ha, 1.03%), *Alnus glutinosa* (219.8 ha, 1.00%) were much less common. Other tree species have covered small areas, these were: *Ulmus minor* Mill. (54.4 ha, 0.25%) *Fraxinus lanceolata* Borkh. (52.5 ha, 0.24%), *Picea abies* (L.) H. Karst. (42.3 ha, 0.19%), *Acer campestre* (35.5 ha, 0.16%), *Robinia*

pseudoacacia (33.6 ha, 0.15), *Acer negundo* (28.2 ha, 0.13%), *Salix alba* (19.2 ha, 0.09%), *Phellodendron amurense* Rupr. (15.1 ha, 0.07%), *Larix decidua* Mill. (15.0 ha, 0.07%), *Malus sylvestris* (14.1 ha, 0.06%), *Populus nigra* (8.0 ha, 0.04%), *Juglans mandshurica* Maxim. (5.6 ha, 0.03%), *Corylus avellana* L. (4.7 ha, 0.02%), *Populus alba* (4.1 ha, 0.02%), *Pinus pallasiana* (Lamb.) Holmboe (3.3 ha, 0.02%), *Populus deltoides* (2.2 ha, 0.01%), *Pyrus communis* L. (1.9 ha, 0.01%), *Acer saccharinum* L. (1.2 ha, 0.01%), *Populus balsamifera* (1.1 ha, 0.01%). Other tree species had a share of areas less than 0.01%.

The areas covered by forest vegetation are represented by 11 edatopes, covering trophic groups from forrest on transitional, relatively poor soils subirs to forest with oak dominated on rich, fertile soils dibrova and all levels of moisture, except for very dry (Table 2).

Table 2. Distribution of areas of forested plots by edatope (ha)

Hihrotopes	Trophotopes				Total
	A (bir)	B (subir)	C (suhrud)	D (hrud)	
0 (very dry)					0.0
1 (dry)			0.5	289.6	290.1
2 (fresh)		74.9	2,651.1	18,247.5	20,973.5
3 (damp)			67.9	394.9	462.8
4 (moist)			41.9	149.5	191.4
5 (wet)			12.9	9.7	22.6
Total	0.0	74.9	2,774.3	19,091.2	21,940.4

Note. Trophotop (nutrient status) is an ecological factor that characterizes the demanding forest-forming plant species with the richness of the mineral nutrition of the soil and forest-plant conditions: A – forest on very poor soil, with pine or other species (bir); B – forrest on transitional, relatively poor soils (subir); C – oak or pin forest on transitional, relativel fertile soils (suhrud); D – forest with oak dominated on rich, fertile soils (dibrova)
Hygrotopism (soil moisture conditions) is an ecological factor that characterizes the degree of demand of plant species to the conditions of soil moisture in the forest

The presence of such large areas of these habitats, represented by single massifs, favourably distinguishes this area from the similar general area in the Sumy Upland slope region.

Among the trophotopes, oak forests on rich soils (19,091.2 ha, 87.02%) were predominant. There are much fewer oak forest on on transitional, relativel fertile soils (2,774.3 ha, 12.64%). Forests on transitional, relatively poor soils are the least common (74.9 ha, 0.34%). Forests mainly grow on fresh soils (20973.5 ha, 95.60%). Insignificant areas are occupied by forests on wet soils (462.8 ha, 2.11%), on dry soils (290.1 ha, 1.32%), and on wet soils (191.4 ha, 0.87%), and the least common are forests on wet soils (22.6 ha, 0.10%).The least common were wet conditions (22.6 ha, 0.10%). 23 forest types were identified in the plots covered with forest vegetation (Table 3).

Fresh maple-linden dibrova (16,014.7 ha, 73.00%) were prevalent. Fresh linden-ash oak (2,232.8 ha, 10.18%), fresh maple-linden oak (1,512.7 ha, 6.89%), fresh linden-oak-pine suhrud (1,133.3 ha, 5.17%) were less well distributed. Other types of forests covered much smaller areas: dry maple-linden oak (289.6 ha, 1.32%), damp linden-ash dibrova (234.1 ha, 1.07%), damp maple-linden dibrova (160.8 ha, 0.73%), moist black alder hrud (141.3 ha, 0.64%), fresh oak-pine subir (74.9 ha, 0.34%), damp maple-linden sudibrova (41.4 ha, 0.19%), moist black alder suhrud (38.6 ha, 0.18%), damp linden-oak-pine suhrud (24.6 ha, 0.11%), wet black alder suhrud (12.9 ha, 0.06%), wet black alder hrud (9.7 ha, 0.04%), moist maple-linden dibrova (7.4 ha, 0.03%). Other forest types have been quite rare: fresh floodplain sudibrova (3.0 ha, 0.01%), wet floodplain sudibrova (1.9 ha, 0.01%), damp oak-pine suhrud (1.9 ha, 0.01%), fresh eroded maple sudibrova (1.4 ha, 0.01%), moist floodplain willow-poplar suhrud (1.4 ha, 0.01%), moist floodplain willow hrud (0.8 ha, 0.004%), fresh degraded maple sudibrova (0.7 ha, 0.003%), and dry eroded maple sudibrova (0.5 ha, 0.002%).

According to the trophic conditions of the habitat, common oak has been growing mainly in dibrovas (11,482.3 ha, 91.17%), and much less in subdibrovas (1,111.6 ha, 8.83%). According to the humidity of forest areas, common oak has been growing mainly in the fresh conditions of the habitats. (12,200.4 ha, 96.88%), and is quite rare in dry (210.1 ha, 1.67%) and damp conditions (181.8 ha, 1.44%), and very rare in moist conditions (1.6 ha, 0.01%). It was found that common oak grows in 10 forest types, the most common of which is fresh maple-linden oak (dibrova) (9,736.1 ha, 77.32%). A much smaller area was covered by fresh linden-ash oak (dibrova) (1,369.8 ha, 10. 88%),

fresh maple-linden oak (sudibrova) (714.4 ha, 5.67%), fresh linden-oak-pine suhrud (380.1 ha, 3.02%), and dry maple-linden oak (dibrova) (210.1 ha, 1.67%). Other types of forests covered small areas.

Table 3. Distribution of areas covered with forest vegetation

№	Names of forest types	Area [ha]
1	Fresh oak-pine subir	74.9
2	Dry eroded maple sudibrova	0.5
3	Fresh foodplaine sudibrova	3.0
4	Fresh eroded maple sudibrova	1.4
5	Fresh maple-linden sudibrova	1,512.7
6	Fresh degraded maple sudibrova	0.7
7	Fresh linden-oak-pine suhrud	1,133.3
8	Damp floodplain sudibrova	1.9
9	Damp linden - maple sudibrova	41.4
10	Damp linden-oak-pine suhrud	24.6
11	Moist black alder suhrud	38.6
12	Damp oak-pine suhrud	1.9
13	Moist floodplain willow-poplar suhrud	1.4
14	Wet black alder suhrud	12.9
15	Dry maple-linden dibrova	289.6
16	Fresh linden-maple dibrova	16,014.7
17	Fresh linden-ash dibrova	2,232.8
18	Damp linden-maple dibrova	160.8
19	Damp linden-ash dibrova	234.1
20	Moist black alder hrud	141.3
21	Moist floodplain willow hrud	0.8
22	Moist linden-maple dibrova	7.4
23	Wet black alder hrud	9.7
Total		21,940.4

Ash trees were growing mainly in oak wood (dibrova) (4,004.5 ha, 98.64%) and much less in sudibrovas (55.3 ha, 1.36%). According to the humidity of forest plots, this tree species was growing mainly in the fresh conditions of the habitats (3,993.3 ha, 98.36%) and is quite rare in moist (53.8 ha, 1.33%) and dry (10.2 ha, 0, 25%) conditions, and very rare in wet conditions (2.5 ha, 0.06%). *Fraxinus excelsior* L. was growing in 9 forest types, the most common of which are fresh maple-linden oak (dibrova) (3,229.9 ha, 79.56%) and fresh linden-ash oak (dibrova) (709.2 ha, 17.47%). Other types of forests have been colonising small areas.

4. Conclusions

The area of the Emerald Network known as UA0000428 Syrovatka River Basin is a complex of various habitats with natural, historical, and geomorphological conditions. Among these, large areas are represented by biotopes of 22 types. All of these biotopes are recommended for protection and preservation in Europe (KUZEMKO ET AL., 2017). In terms of area, the best habitats represented here are biotopes with a predominance of grass vegetation (D5.2; E1.2; E2.2; E3.4) and forest (G1.11; G1.21; G1.41; G1.A1; G1). 7; G1.8; G1.A4). The presence of such large areas of these habitats, represented by single massifs, favourably distinguishes this area among others in the Sumy slope-upland region. In addition, populations of vascular plant species which are protected in Europe (*Ostericum palustre*, *Iris hungarica*) (CONVENTION ON THE CONSERVATION..., 1979), Ukraine (*Epipactis helleborine*, *Lilium martagon*, *Platanthera bifolia*) (RED DATA BOOK..., 2009), and at the regional level such as *Carpinus betulus*, *Campanula persicifolia*, *Calla palustris, Dryopteris cristata*, *Inula helenium*, *Utricularia vulgaris* are represented here (ANDRIENKO & PEREGRYM, 2012; PANCHENKO & IVANETS, 2019). It is necessary to ensure *Ostericum palustre* development over large areas and for the population's restoration in appropriate habitat conditions to preserve the species in the region.

There may be threats to the natural complex of this area with the case of increasing economic influence. The main ones are drainage and ploughing of floodplain areas, terracing, and afforestation of meadow-steppe slopes of ravines. A separate threat is the active spread, of some invasive species (*Acer negundo*, *Parthenocissus quinquefolia*, *Echinocystis lobata*) especially in well-moistened areas of the floodplain.

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