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EDAPHO-CLIMATIC CHARACTERISTICS OF PRECARPATHIAN BIOTOPES IN PARTICIPATION OF CENOPOPULATION OF *POLYGONATUM* MILL. SPECIES

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Abstract. The territory of research on landscape-geographical zoning is confined to the Precarpathians - part of the Western Ukraine, within the Lviv, Ivano-Frankivsk and Chernivtsi regions (Kravchuk, 1999). It stretches a relatively narrow strip between the Dniester valley and the northeastern foothills of the Ukrainian Carpathians (Koinov, 2014). Coenopopulations of four species of the genus Polygonatum Mill (Polygonatum multiflorum (L.) All., Polygonatum odoratum (Mill.) Druce., Polygonatum verticillatum (L.) All., Polygonatum latifolium Desf.) were studied within the seven territorial divisions of the Precarpathian region. We studied these species at 59 research sites dedicated to 14 types of habitats (Didukh, 2011).
The studied biotopes of the Precarpathian region are characterized by a number of edaphic and climatic indices. The humus content is 1.94–2.98 %, reaching the maximum values in the biotopes of the Pokutsk hills, and the minimum – in the Kalush (Limnitsko - Bolokhiv) basin. The average soil solution response rates are very acidic within the Storozhynets strand (pH (saline) – 4.33 units); strongly acidic level – within the Kalush and Stanislav basin and Pokuttia height (pH (salt) – 4.68; 4.82 and 4.76 units, respectively); slightly acidic level - within the Upper Dniester Basin and Voynylivskyi hills (pH (salt) – 5.34) and Chernivtsi hills (pH (salt) – 5.05). The moisture content, the amount of active temperatures and the level of illumination vary greatly depending on the type of biotope. The soils of wetland alder habitats are characterized by maximum moisture content (> 40%) and the minimum - the biotopes along the highways and abandoned pastures (<20 %). The sum of active temperatures at a depth of 20 cm is highest in non-forested areas with a low degree of loosening. The minimum level of illumination (in the range of 760 - 900 lux) was stated in forest biotopes, the maximum (> 2000 lux) was found in biotopes of abandoned pastures and hay meadows. Soils within the studied Precarpathian biotopes are characterized by low and medium supply of N, P and high content of K. The weighted average value of mobile phosphorus varies from 39.49 mg / kg in the biotopes of the Kalush Basin to 81.18 mg / kg in the biotopes of the Chernivtsi Upland; of hydrolyzed Nitrogen - from 68.07 in the biotopes of the Kalush Basin to 83.93 - Storozhynets Strand. The highest weighted average values of mobile potassium content were found within the Pokuttia Upland (150.70 mg/kg), the lowest – the Voynyliv Upland (84.1 mg/kg).

Keywords: metabolic syndrome, visceral fat, inflammation, oxidative stress, insulin resistance.

1. INTRODUCTION

In modern conditions of human development, the influence of urban factors is growing, which leads to destructive changes in plants (Pavlyuchok-Gogerchak, 2011). One of the consequences of anthropogenic transformation of the environment is the growth of aboriginal boreal-nemoral flora, a prominent place among which belongs to the species of the genus Polygonatum Mill.

In the biotopes of the Precarpathian region the coenopopulations of Polygonatum species are characterized by a significant diversity of vitality structure. All three qualitative types of coenopopulations are identified here: depressed, equilibrium and prosperous. According to the level of vitality, the differentiation of Polygonatum individuals has species specificity and is determined by the biotope characteristics of habitats.

The relevance of the study is that the coenopopulations of Polygonatum in the biotopes of the Precarpathian region are still remain unexplored, and the phytoindication value is not find out.

2. MATERIALS AND METHODS

To characterize the population and ecological characteristics of the Polygonatum species in the Precarpathian region the key edapho-climatic factors of the studied habitats were analyzed: humus content in soils; their acidity and moisture content; the sum of active soil temperatures at a depth of 20 cm; easily hydrolyzed nitrogen content; the content of mobile phosphorus compounds; the content of mobile Potassium compounds; the level of illumination of the research area and the degree of loosening of the soil (Aloshkina, 2011). More detailed differentiation of climate is determined by the relief and type of habitat in which it is formed (Didukh and Shelyag-Sosonko, 2003). 59 plots (Table 1) dated to 14 types of biotopes were studied:

E. Pastures and lands covered with weeds:

E. 5.21 ◎ nodal habitats;

E 2.13 ◎ abandoned pasture and hay meadows.

F. Shrubs:

F 3.11 ◎ Central European shrub thickets.

G. Forest-covered lands:

G 1.8 ◎ acidophilic oak forests;

G 1.4115 ◎ Eastern Carpathian wetland alders;

G 1.82 ◎ beech and oak forests;

G 1.22 ◎ mixed oak-elm-ash forests;

G 1.61 ◎ Central European acidophilic beech forests;

G1.A3 ◎ hornbeam forests;

G 1.63 ◎ Central European neutrophilic beech forests;

G 1.A ◎ meso-eutrophic forests with oak, hornbeam, ash and linden

G 5.81 ◎ felling.

J. Anthropogenically modified habitats:

J.1. ◎ residential habitats;

J.4.1. ◎ mainline biotopes (forest plantation belts along the highways).

№ n / a	Territorial allocation within Precarpathian region	Biotopes with studied coenopopulations of *Polygonatum* Mill. species		
		Habitat code according to EUNIS	Cenopopulations of *Polygonatum* Mill. species have been studied	Location of the plot by administrative zoning
1	Upper Dniester basin According to geobotanical zoning, most of the basin belongs to the Medenytsia (Upper Dniester) district of oak forests, swamps and meadows, within the Sambir-Ivano-Frankivsk district of the Eastern Carpathians mountain sub-province of Central Europe provinces	E 5.21	*P.multiflorum* *P.odoratum* *P.latifolium*	1. Stryi district, Dashava neighborhood
				2. Drogobych district, Solonske neighborhood
		F 3.11	*P.multiflorum* *P.odoratum* *P.latifolium*	3. Zhydachiv district, the village of Zhuravno
				4. Sambir district, Luky neighborhood
		G 1.8	*P.multiflorum* *P.latifolium* *P.verticillatum*	5. Drogobych district, Solonske neighborhood
		G 1.4115	*P.multiflorum* *P.latifolium*	6. Zhydachiv district, Zhuravno neighborhood
		J 1	*P.multiflorum* *P.latifolium* *P.odoratum*	7. Stryi district, Dashava neighborhood
				8. Stryi district, Medynychi neighborhood
				9. Zhydachiv district, Zhuravno neighborhood
		J 4.1	*P.multiflorum* *P.latifolium*	10. HighwayH13, Sambir district
				11. Highway T14, Drogobych district
2	Kalush (Limnytsya-Bolokhiv) basin Ivano-Frankivsk-Kolomyia district of the Sambir-Ivano-Frankivsk district of the Eastern Carpathian mountain sub-province of the European deciduous region	E 2.13	*P.multiflorum* *P.latifolium* *P.odoratum*	12. Kalush district, Kadobna neighborhood
		F 3.11	*P.multiflorum* *P.latifolium* *P.verticillatum* *P.odoratum*	13. Rozhnyativ district, Broshniv neighborhood
		E 5.21	*P.multiflorum* *P.latifolium* *P.odoratum*	14. Rozhnyativ district, Broshniv neighborhood
		G 1.8	*P.multiflorum* *P.latifolium* *P.verticillatum* *P.odoratum*	15. Rozhnyativ district, Broshniv neighborhood
		G 1.22	*P.multiflorum* *P.latifolium* *P.verticillatum*	16. Kalush district, Kadobna neighborhood
				17. Surroundings of the Bolekhiv town
		G 1.4115	*P.latifolium*	18. Rozhnyativ district, Broshniv neighborhood
		J 4.1	*P.multiflorum* *P.latifolium*	19 Highway T0910, Kalush district

		J 1	*P.multiflorum* *P.latifolium* *P.verticillatum*	20. Kalush district, Bodnariv village
		G 5.81	*P.multiflorum* *P.latifolium* *P.verticillatum* *P.odoratum*	21. Rozhnyativ district, Broshniv neighborhood
3	Voynylivskyi hills	E 5.21	*P.multiflorum* *P.latifolium* *P.odoratum*	22. Halych district, lands of Halych National Nature Park
		G 1.631	*P.multiflorum* *P.latifolium* *P.verticillatum* *P.odoratum*	23. Kalush district, Voinyliv neighborhood
				24. Halych district, lands of Halych National Nature Park
		G 1.82	*P.multiflorum* *P.latifolium* *P.verticillatum* *P.odoratum*	25. Kalush district, Voinyliv neighborhood
		F 3.11	*P.multiflorum* *P.latifolium* *P.verticillatum* *P.odoratum*	26. Kalush district, Pidmykhailia neighborhood
				27. Kalush district, Staryi Ugryniv neighborhood
		J 4.1	*P.multiflorum* *P.latifolium* *P.odoratum*	28. Kalush district, near the station "Tenetnyky"
4	Stanislavska Basin	G 1.61	*P.multiflorum* *P.latifolium* *P.verticillatum*	29. Tysmenytsia district, Lysets neighborhood
				30. Tysmenytsia district, Rybne neighborhood
		G1.A3	*P.multiflorum* *P.latifolium* *P.verticillatum*	31. Green zone of Ivano-Frankivsk, Yamnytsia neighborhood
		G 1.4115	*P.multiflorum* *P.latifolium*	32. Tysmenytsia district, Tysmenytsia neighborhood, Tysmenytsia forestry
		E 5.21	*P.multiflorum* *P.latifolium* *P.verticillatum*	33. Tysmenytsia district, Lysets neighborhood
				34. Tysmenytsia district, Khomyakivka neighborhood
		E 2.13	*P.multiflorum* *P.latifolium* *P.verticillatum*	35. Tysmenytsia district, Markivtsi neighborhood
				36. Tysmenytsia district, Khomyakivka neighborhood
		F 3.11	*P.multiflorum* *P.latifolium*	37. Kolomyia district, Otyniya neighborhood
		J 4.1	*P.multiflorum* *P.latifolium* *P.odoratum*	38. Tysmenytsia district, Ivano-Frankivsk-Lysets highway

		J 1	*P.multiflorum*	39. Kolomyia district, Vorona village 40. Tysmenytsia district, Pogonya village
5	Pokuttia upland	G 1.63	*P.multiflorum* *P.verticillatum*	41. Horodenka district, Chortovets neighborhood 42. Sniatyn district, Zabolotiv neighborhood
		G 1.A	*P.multiflorum* *P.odoratum*	43. Sniatyn district, Zabolotiv neighborhood
		E 5.21	*P.multiflorum* *P.latifolium*	44. Kosiv district, lands of National Nature Park "Hutsulshchyna"
				45. Horodenka district, Chortovets neighborhood
		G 5.81	*P.multiflorum* *P.latifolium* *P.verticillatum* *P.odoratum*	46. Nadvirna district, Zelena neighborhood
		E 2.13	*P.multiflorum* *P.latifolium* *P.odoratum*	47. Horodenka district, Chortovets neighborhood
		F 3.11	*P.multiflorum* *P.latifolium* *P.verticillatum* *P.odoratum*	48. Kolomyia district, Korshiv neighborhood
		J 4.1	*P.multiflorum* *P.odoratum*	49. Kolomyia district
				50. Nadvirna district
				51. Kosiv district
		J 1	*P.multiflorum* *P.latifolium* *P.odoratum*	52. Nadvirna district, Zelena neighborhood
				53. Kolomyia district, Korshiv neighborhood
6	Chernivtsi upland	G 1.61	*P.multiflorum* *P.latifolium* *P.verticillatum*	54. Lands of Chernivtsi RLP
		G 1.82	*P.multiflorum* *P.latifolium* *P.odoratum*	55. Lands of Chernivtsi RLP
		E 5.21	*P.multiflorum* *P.latifolium* *P.verticillatum*	56. Lands of Chernivtsi RLP
		J 4.1	*P.multiflorum* *P.latifolium*	57. Kitsman district
7	Storozhynets strand	G 1.63	*P.multiflorum* *P.latifolium* *P.verticillatum*	58. Storozhynets district, Dubove neighborhood
		E 5.21	*P.multiflorum* *P.latifolium* *P.odoratum*	59. Storozhynets district, Dubove neighborhood

Tab. 1 Research territory of edapho-climatic conditions

The content of humus in soils was determined by the method of I.V. Tyurin in the modification of V.N. Simakov, based on the oxidation of carbon humic substances to CO_2 0.4 n. with a solution of potassium dichromate ($K_2Cr_2O_7$), prepared on sulfuric acid diluted in water in a ratio of 1: 1 (GOST).

Determination of the pH of the salt extract was carried out by potentiometric method according to GOST 26483, which is based on the displacement of the exchange ions of hydrogen H + and A13 + 1 N. KC1 solution (pH = 5.5 ... 6) followed by measurement of hydrogen ion activity.

Soil moisture was determined gravimetrically; soil temperature - using Savinov's knee thermometers.

Determination of mobile compounds of Phosphorus and Potassium was performed by the modified Chirikov method according to the State Standard of Ukraine DSTU 4115-2002 (44).

The content of alkaline hydrolyzed Nitrogen was determined by Cornfield using alkaline hydrolysis (DSTU).

The light level was set using a digital light meter.

Collection, transportation and storage of the studied soil samples were carried out in accordance with current regulations: GOST 28168-89 "Soils. Sampling "and GOST 17.4.3.01-83 Nature protection. Soils. General requirements for sampling.

Mixed soil samples with a total weight of 1.2 to 1.5 kg were formed by combining elementary samples taken by the "envelope" method. Sampling of soil was performed with a scoop-sampler made of stainless steel from the surface layer. The samples were transported and stored in clean, colorless paper bags.

Water extraction of soil was carried out in accordance with GOST 26423-85 - GOST 26428-85. Soil samples weighing 30 g, weighed with an error of not more than 0.1 g, were stirred for 3 min on a mixer with 150 ml of distilled water. The resulting supernatant was drained and left to settle.

3. RESULTS

The content of humus in the soils of the studied biotopes of the Precarpathian region varies in the range of average values of 1.94–2.98%, which corresponds to a very low and low degree of gradation of the indicator (Fig. 1 A). The maximum values were found in the biotopes of the Pokuttia Upland (2.4–3.9%), and the minimum values were found in the Kalush (Limnytsko-Bolokhivska) Basin (1.3–2.6%).

The average reaction rates of the soil solution (Fig. 1. B) correspond to a very strongly acidic level in the studied habitats within the Storozhynets Strand (average pH (salt) - 4.33 units); strongly acidic level - within the Kalush and Stanislavska basins and Pokuttia upland (average pH (salt) - 4.68; 4.82 and 4.76 units, respectively); weakly acidic level - within the Upper Dniester Basin and Voinyliv Upland (average pH (salt) - 5.34) and Chernivtsi Upland (average pH (salt) - 5.05). It should be noted that in some research areas the pH of the salt is close to neutral values and ranges from 5.6 to 6.0 units. Such areas have been observed in the Upper Dniester, Kalush, Stanislavska Basins and the Pokuttia and Voynyliv Uplands, which are mainly confined to the habitats of Central European shrubs, Eastern Carpathian wetland alders, neutrophilic beech forests and anthropogenic habitats.

Moisture capacity and the sum of active temperatures of the studied soils varies greatly depending on the type of habitat. The general trend in the dynamics of moisture capacity is its growth in the following sequence: mainline biotopes and biotopes of abandoned pastures (<20%) → residential, shrub and forest habitats (20-25%) → forest habitats of various types (26-40%) → wetland alders (> 40%).

The sum of active temperatures at a depth of 20 cm is highest in non-forested areas with a low degree of loosening.

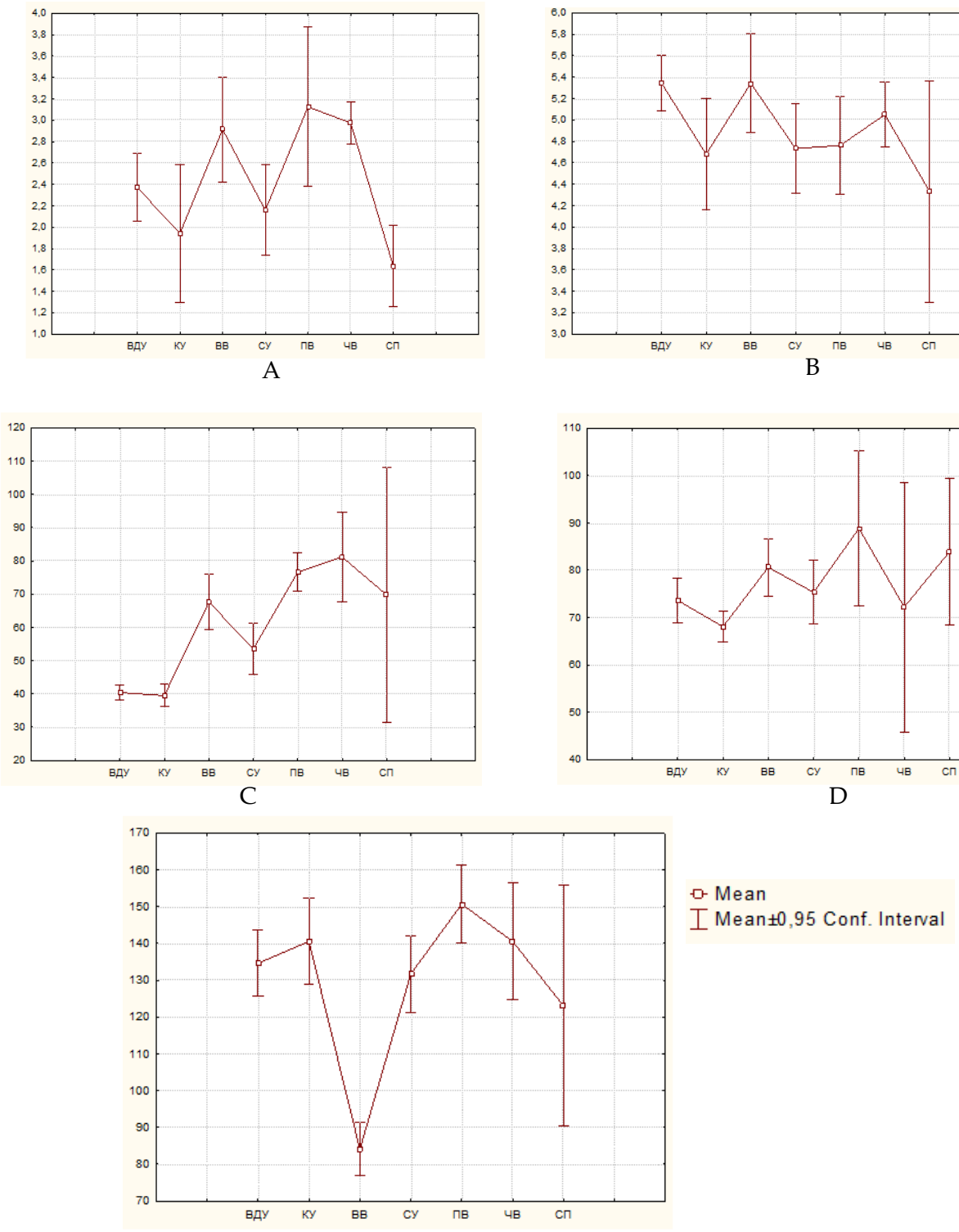

Fig. 1. Edapho-climatic indicators within the landscape-territorial allotments of the Precarpathian region: A - humus content, %; B - pH (salt); C - content of mobile phosphorus, mg / kg; D - content of hydrolyzed Nitrogen, mg / kg; E - content of mobile potassium, mg / kg.*

*Here and below:
UDB - Upper Dniester Basin;
KB - Kalush Basin;
VU - Voynyliv Upland;
SB - Stanislavska Basins;
PU - Pokuttia Upland;
CU - Chernivtsi Upland;
SS - Storozhynets Strand.

The weighted average value of mobile phosphorus according to the Kirsanov method in the surveyed soils of geographical and territorial areas of the Precarpathian region varies in the range of low and medium values - from 39.49 mg / kg in biotopes of Kalush Basin to 81.18 mg / kg in biotopes of Chernivtsi upland. The consistent increase of the weighted average indicator was observed in the following: Upper Dniester Basin (40.41 mg / kg) → Stanislavska Basin (53.55 mg / kg) → Voynyliv Upland (67.63 mg / kg) → Storozhynets Strand (69.77 mg / kg) → Pokuttia Upland (76.62 mg / kg).

The level of illumination in the studied areas varies greatly depending on the type of habitat. Minimum values (within 760–900 lux) were found in forest biotopes, maximum values (> 2000 lux) were found in biotopes of abandoned pastures and hay meadows (Fig. 2).

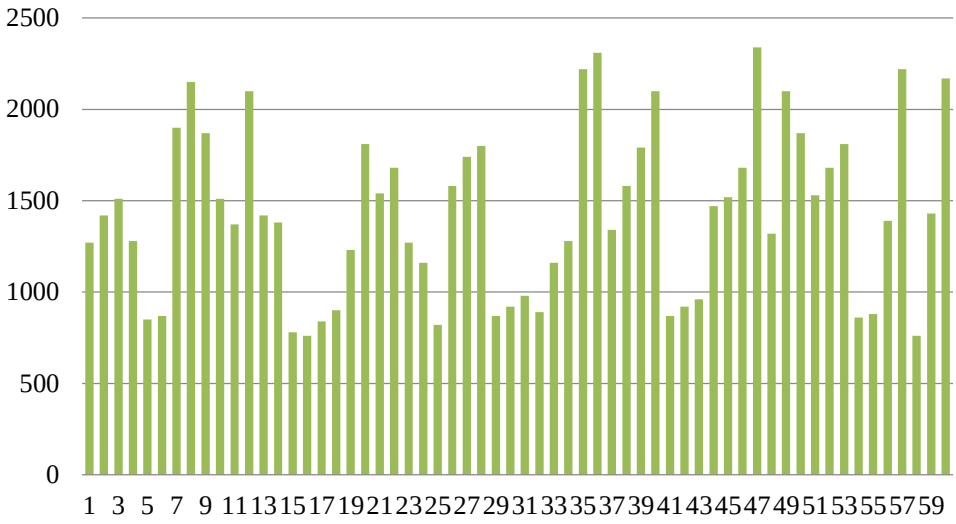

Fig. 2. Level of illumination (LC) at research areas in the Precarpathian region

The results of the conducted researches testify to low supply of the inspected soils with hydrolyzed Nitrogen. The weighted average indicator ranges from 68.07 in the biotopes of the Kalush Basin to 83.93 07 in the biotopes of the Storozhynets Strand. At the same time, an increased content of mobile potassium was noted in all studied biotopes of the Precarpathian region. The highest weighted average values were found within the Pokuttia Upland (150.70 mg / kg), and the lowest - within the Voynyliv Upland (84.1 mg / kg).

Significant changes in the values of soil micronutrient supply were found in the context of different types of studied habitats (Fig. 3).

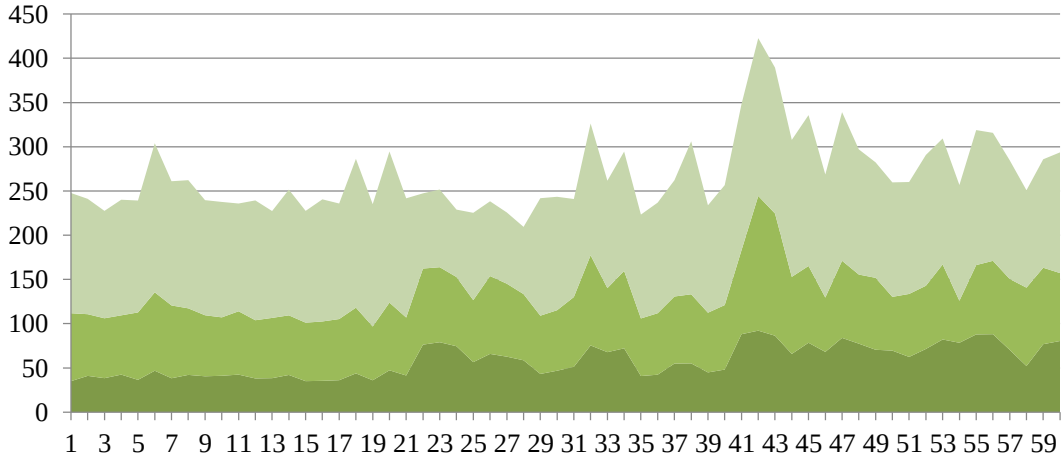

Fig. 3 Provision of soils with microelements mobile potassium content, mg / kg, mobile phosphorus content, mg / kg, hydrolyzed nitrogen content, mg / kg

The grouping of studied areas according to the set of analyzed edapho-climatic parameters by the method of cluster analysis showed that the dominant factor in the formation of abiotic conditions is the type of habitat (Fig. 4). Thus, the main clusters mostly form groups of plots confined to one type of biotope, regardless of their affiliation to the territorial divisions of the Precarpathian region. Therefore, further interpretation of the impact of a set of factors on individuals and coenopopulations of species of the genus *Polygonatum* will be presented in terms of habitats with their participation.

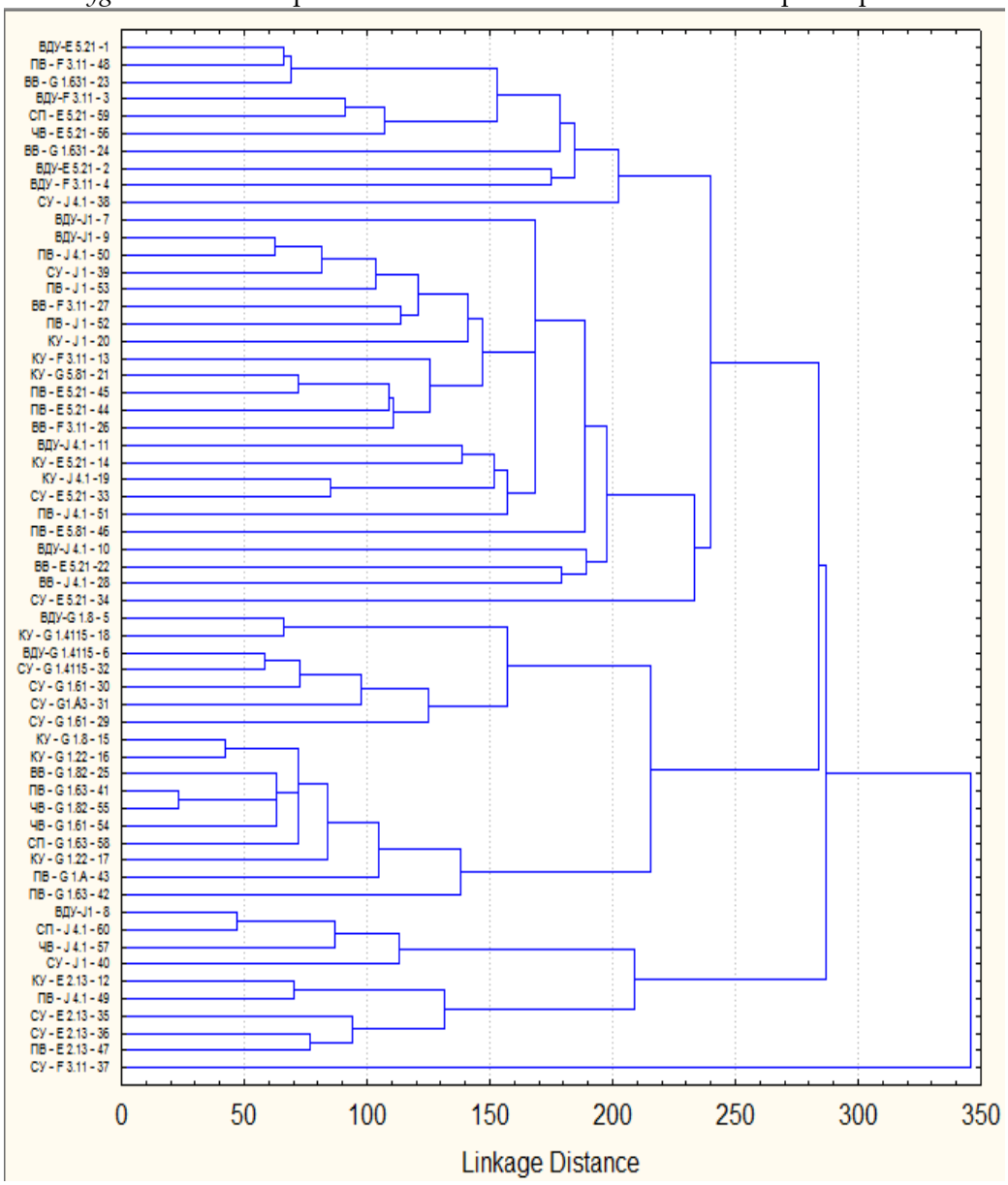

Fig. 4. Cluster diagram of the distribution of studied areas on a set of edapho-climatic factors

4. Discussion

The biotopic (settlement) principle is the basis for the selection of research sites (Kagalo, Prots, 2012). In determining habitats, they were guided by the pan-European classification according to the EUNIS scheme (Davies, 1999).

The database of natural objects of the European Union - EUNIS - was created to implement the Council of Europe Directive 92/43 / EEC (EU Habitats Directive Annex I) and the resolution of the Bern Convention of 1996 (Bern Convention Resolution No. 4), which contains a list of European habitat types (Davies, Moss & Hill, 2004). According to this scheme, the classification of ecosystems can take

into account both their abiotic and biotic components or use different parameters to distinguish classes at different hierarchical levels (Devillers, Devillers-Terschuren & Ledant, 1991). Such a classification is systemic, "modular", or subordinate-serial. At the highest hierarchical level, the division into classes is based on physiognomic features (Bodnaruk, Tselishchev, 2015). Smaller levels are distinguished by climatic and edaphic factors and the nature of vegetation. This principle is used in the European classification EUNIS (Didukh, 2005; Didukh, 2016; Didukh, 2017; Didukh, 2018).

The unit of classification of EUNIS is "habitat" as a habitat of a population or group, which is primarily characterized by abiotic features (climate, relief, soil), and secondly - species of plants and animals.

Along with the term "habitat" in Europe use the term "biotope" (Germany, Sweden, Hungary) (EEA, 2004). M. Udvardy proposes to allocate "biotope" to denote the place of growth, or "habitat" to denote a biotic group. D. Davis emphasized that "habitat" is precisely the space, the territory occupied by an organism, a population, a group or even an ecosystem or ecosystems (Davies, Moss, 2002; Kuzemko, 2017; Yemelyanova, Kuzemko, 2017). A. Tensley uses the concept of "habitat factors", a set of abiotic components, and the biotic component ("biome") to define the term "ecosystem" as "any natural space with living organisms and inanimate components involved in matter-energy metabolism". Because the term "habitat" does not always have an exact equivalent when translated into another language, many countries use the term "biotope" to refer to both "habitat" and "biotope". Lviv Scientific School, headed by O.O. Kagalo uses the term “settlement” as the equivalent of the term “habitat” (Kagalo, Tsaryk, Skibitska et al., 2012). The concept of “habitat” is a key object in the program of development of the European ecological network NATURA 2000 (Kagalo, Kolodiy, 2013; Onishchenko, 2016). The habitat concept is one of the key documents of the European Union in environmental protection, and is known as the Habitat Directive, adopted in May 1992 by European Union governments and aimed at protecting the most vulnerable habitats and species across Europe (Didukh, Kagalo, Prot, 2012; Vasilyuk, 2015; Kiyak, 2015; Burda et al., 2018; Baraboha, 2017).

We accept the term "biotope" - to denote the habitat of a particular biotic group and as a counterpart to the term "habitat".

5. CONCLUSIONS

1. According to the agro-soil zoning of Ukraine, the territory of Precarpathia belongs to the forest-meadow brown zone - accumulative plain with sod-podzolic and turf ashed mostly surface-gleyed soils. The Naddnistrian (within the Upper Dniester and Kalush Basins and Voynyliv Upland) and Nadprutsky (Pokuttia and Chernivtsi Uplands, Storozhynets Strand and Stanislavka Basin) soil areas are clearly distinguished within its boundaries. The peculiarities of the Naddnistrian region are the wide floodplains of the Dniester River and its tributaries and large wetlands. Here are mostly sod-podzolic and dark gray podzolic soils. The following main types of soils are widespread in the Nadprutsky soil region of Precarpathia: within the Chernivtsi Upland and the Storozhynets Strand, sod-podzolic surface-gleyed loamy soils predominate; within the Pokuttia Upland - chernozems podzolic gleyed; Stanislavska Basin - dark gray podzolic gleyed soils.

2. There are three climatic regions in the Precarpathians: North-western climatic region, up to the town of Stryi, with a moderately warm climate (sum of active temperatures - 2500 °; precipitation - 700 mm per year); Central climatic region, to the city of Kolomyia, warm (sum of active temperatures - 2600 °; precipitation - 700 mm per year); eastern climatic region, to Chernivtsi, with a very warm but less humid climate (sum of active temperatures - 2800 °; precipitation - 600 mm per year).

3. The studied biotopes of the Precarpathian region differ in a number of edapho-climatic indicators. The humus content is 1.94–2.98%, reaching a maximum in the biotopes of the Pokut Upland, and a minimum in the Kalush (Limnytsko-Bolokhivska) Basin. The average reaction rates of the soil solution correspond to a very strongly acidic level within the Storozhynets Strand (pH (salt) - 4.33 units); strongly acidic level - within the Kalush and Stanislavska Basins and Pokuttia Upland (pH

(salt) - 4.68; 4.82 and 4.76 units, respectively); weakly acidic level - within the Upper Dniester Basin and Voynyliv Upland (pH (salt) - 5.34) and Chernivtsi Upland (pH (salt) - 5.05).

4. Moisture capacity, the sum of active temperatures and the level of illumination vary greatly depending on the type of biotope. The maximum moisture content is the soils of wetland alder habitats (> 40%), the minimum - the mainline biotopes and abandoned pastures (<20%). The sum of active temperatures at a depth of 20 cm is highest in non-forested areas with a low degree of loosening. The minimum level of illumination (within 760–900 lux) was found in forest biotopes, the maximum (> 2000 lux) was found in biotopes of abandoned pastures and hay meadows.

5. Soils within the studied biotopes of the Precarpathian region are characterized by low and medium supply of N, P and high content of K. The weighted average value of mobile phosphorus varies from 39.49 mg / kg in the biotopes of the Kalush Basin to 81.18 mg / kg in the biotopes of the Chernivtsi Upland; hydrolyzed Nitrogen - from 68.07 in the biotopes of the Kalush Basin to 83.93 - Storozhynets Strand. The highest weighted average values of mobile potassium content were found within the Pokuttia Upland (150.70 mg / kg) and the lowest - within the Voynyliv Upland (84.1 mg / kg).

6. The grouping of studied areas according to the set of analyzed edapho-climatic parameters by the method of cluster analysis showed that the dominant factor in the formation of abiotic conditions is the type of habitat. Therefore, further interpretation of the impact of a set of factors on individuals and coenopopulations of species of the genus *Polygonatum* Mill. will be presented in terms of habitats.

REFERENCES

[1] Aloshkina U.M. Distribution and characteristics of rare habitats in Kyiv. *Ukrayinskyj botanichnyj zhurnal*, **68** (1) (2011), 76 – 90 (in Ukrainian).

[2] Baraboxa N.M. VBU "Milk estuary": biodiversity and conservation problems. Ecology - the philosophy of human existence. Materialy` IV mizhnarodnoyi naukovo-prakty`chnoyi konferenciyi (Melitopol, 17 travnya 2017 r.). S. 22-26 (in Ukrainian).

[3] Bodnaruk M.A., Celishhev O.G. Phytoindication of climatic regimes of ecotopes of forest ecosystems of the Middle Russian forest-steppe district of Ukraine. *Forestry and agroforestry*. **127** (2015), 144-153 (in Ukrainian).

[4] Borovykov V. Statistica: the art of data analysis on a computer. *For professionals.* **2** (90), 259-266, (2001). doi:10.32839/2304-5809/2021-2-90-52 (in Russian).

[5] Burda R.I., Pashkevych N.A., Blinkova O.I., Shupova T.V., Stukalyuk S.V., Ivanenko O.M., Bilushenko A.A. *Adaptive strategy of populations of adventive species*. Naukova dumka, Kyiv, 2018. (in Ukrainian).

[6] Spinoni J., Szalai S., Szentimrey T. Climate of the Carpathian Region in the period 1961–2010: climatologies and trends of 10 variables. *International Journal of climatology.* **35** (7) (2014). doi:10.1002/joc.4059 (in Ukrainian).

[7] Davies C.E., Moss D. EUNIS Habitat Classification. Final Report to the European Topic Centre on Nature Conservation. European Environment Agency, (1999). (in English).

[8] Davies, C.E., & Moss, D. EUNIS Habitat Classification, February 2002. European Topic Centre on Nature Protection and Biodiversity, Paris, 2002. (in English).

[9] Davies C.E., Moss D., Hill M.O. EUNIS Habitat Classification Revised 2004. Report to European Environmental Agency, European Topic Centre on Nature Protection and Biodiversity, (2004). (in English).

[10] Devillers P., Devillers-Terschuren J., Ledant J.-P. CORINE biotopes manual. Habitats of the European Community. Commission of the European. Luxembourg, 1991. (in English).

[11] Didukh YA.P. The ecological scales for the species of Ukrainian flora and their use in synphytoindication. Fitosotsiotsentr, Kyiv, 2011 (in Ukrainian).

[12] Didukh Ya.P. Scheme of classification of shrub habitats of Ukraine. *Ukrainian Botanical Journal*. **74** (4) (2017). 347–354 (in Ukrainian).

[13] Didukh Ya.P.. Modern approaches to the classification of biotic objects. *Visnyk of the National Academy of Sciences of Ukraine,* (1) (2005) (in Ukrainian).
[14] Didukh Ya.P., Chornej I.I., Budzhak V.V. Rare tuffogenic biotope in the Dniester basin. Ukrayinskyj botanichnyj zhurnal. **75** (2) (2018). 149-159 (in Ukrainian).
[15] Didukh Ya.P., Ficzajlo T.V., Korotchenko I.A. [ta in.] Habitats of forest and forest-steppe zones of Ukraine. MAKROS, Kyiv, 2011. (in Ukrainian).
[16] Didux Ya.P., Kagalo O.O., Procz B.G. (red.). Biotopes (settlements) of Ukraine: scientific bases of their research and practical results of inventory: (materials of the working seminar. Kyiv, March 21-22, 2012.). Kyiv-Lviv, 2012 (in Ukrainian).
[17] Didux Ya.P., Palyuta P.G. Phytoindication of ecological factors. Naukova dumka, Kyiv, 1994 (in Ukrainian).
[18] Didux Ya.P., Shelyag-Sosonko Yu.R. Geobotanichne rajonuvannya Ukrayiny ta sumizhnyh terytorij. [Geobotanical zoning of Ukraine and adjacent territories. *Ukrainian Botanical Journal*, **60** (1) (2003), 6 – 17 (in Ukrainian).
[19] Didukh YA.P. Syntaxonomic diversity of Ukraine and its ecological assessment. Problemy eksperymental'noyi botaniky. XI Kuprevichskie chytannya. Tekhnalohiya, Mins'k, 2017, 5-76 (in Ukrainian).
[20] DSTU ISO 10390-2001 Soil quality. Determination of pH. Available at: http://online.budstandart.com/ua/catalog/doc-page.html?id_doc=59261(in Ukrainian).
[21] Ellenberg H. et al. Zeigerwerte von Pflanzen in Mitteleuropa. Göttingen: Verlag Erich Göltze KG, 1991. **18**. 248 s (in English).
[22] Gileczkyj J.R. Geography of Ivano-Frankivsk region. Lviv: VNTL – Klasyka. (2003), 6 – 33 (in Ukrainian).
[23] GOST 28168 – 89 "Selection of soils". Available at: http://vsegost.com/Catalog/29/29278.shtml (in Ukrainian).
[24] Homyak I.V. Dynamics of flora of fallow lands of Ukrainian Polissya. *Science Rise: Biological Science*, **1** (10) (2018), 8–13 (in Ukrainian).
[25] Kagalo O.O., Czaryk J.V., Skibiczka N.V., Danylyk I.M., Sychak N.M., Bednarska I.O., Doroshenko K.V. Proposals for methods of monitoring populations of plant species included in the Red Book of Ukraine. *Visnyk Prykarpatskogo nacionalnogo universytetu imeni Vasylya Stefanyka. Seriya Biologiya*. **17** (2012), 3 – 8 (in Ukrainian).
[26] Kagalo O.O., Kolodij V.A. Features and prospects of realization of settlement approaches to preservation of natural populations of rare species (on an example of Schivereckia podolica (Bess.) Andrz. Ex DC. *Naukovyj visnyk Cherniveczkogo universytetu. Biologiya (Biologichni systemy)* (2013). (in Ukrainian).
[27] Kagalo O.O., Procz B.G. (red.). Habitat concept of biodiversity conservation: basic documents of the European Union. ZUKCz, Lviv, 2012 (in Ukrainian).
[28] Kojnov M.M. On the physical and geographical division of Precarpathians in Physical geography and geomorphology within the Ivano-Frankivsk region. *Visnyk of the Lviv university. Series geography*, **7** (1972) (in Ukrainian).
[29] Kravchuk Ya.S. (1999). Geomorphology of Precarpathia. Merkator, Lviv(in Ukrainian).
[30] Kravchuk YA.S. Relief-forming processes and their dynamics in the Ukrainian Carpathians and adjacent territories. *Visnyk of the Lviv university. Series geography*, **14** (1984), 20 – 26 (in Ukrainian).
[31] Krichfalushij V.V., Mygal A.V. Chorological and ecological-phytocenotic features of ephemeroid geophytes of the Ukrainian Carpathians. *Ukrainian Botanical Journal*, **50** (6) (1993), 13 – 22 (in Ukrainian).
[32] Krykunov V.G. (1993). Soils and their fertility: a textbook. Vyshha shkola, Kyiv (in Ukrainian).
[33] Kuzemko A.A. «Species and biotopes from the annexes of the Habitats Directive in Ukraine». NATURA 2000 network as an innovative system of protection of rare species and habitats in Ukraine. Materialy naukovo-praktychnogo seminaru, Kyiv, 15 February 2017.
[34] Kyak V. Age and ontogenetic structure in plants - the need for differentiation. *Visnyk of the Lviv university. Series biological*, **70** (2015), 162 – 172 (in Ukrainian).
[35] Lipins`kyj V.M., Dyachuk V.A., Babichenko V.M. Climate of Ukraine. Rayevskogo, Kyiv, 2003 (in Ukrainian).

[36] Masikevych Yu.G. (2015). System theory in ecology. Sumy State University, Sumy. 330 s (in Ukrainian).
[37] Melnyk V.I., Shynder O.I., Nesyn Yu.D. Habitat conditions and condition of Cypripedium calceolus (Orchidaceae) populations in Ukraine. *Ukrainian Botanical Journal*, **75**(2) (2018), 160–168 (in Ukrainian).
[38] My`ller G.P. Landscape research of mountain and foothill areas. Vyshcha shkola, Lviv, 1974 (in Ukrainian).
[39] Onyshhenko V.A. Settlements of Ukraine according to EUNIS classification. Fitosociocentr, Kyiv, 2016, 56s (in Ukrainian).
[40] Palyanychko N.I. The current state of production of medicinal plant raw materials in Ukraine. *Zbalansovane pryrodokorystuvannya*. (2) (2019), 81-87 (in Ukrainian).
[41] Pasternak P.S., Pryhodko M.M. Forest soils. Natural resources of Transcarpathia. Karpaty, Uzhgorod, 1987, 123 – 134 (in Ukrainian).
[42] Rudenko S.S., Kostyshyn S.S. Workshop on general ecology: textbook. manual. EUNIS web application. Available at: http://eunis.eea.eu.int/index.jsp (in Ukrainian).
[43] Seriya: «Conservation Biology in Ukraine». **1**, 64–70 (in Ukrainian).
[44] Vasylyuk O.V. «To the history of species protection in Ukraine (1912–1932)». Aktualni problemy doslidzhennya dovkillya: mat. VI Mizhnar. nauk. konf., prysvyach. 150-richchyu z dnya narodzhennya akademika G.M. Vysoczkogo (Sumy 20–23 travnya 2015 r.). – Sumy: SumDPU imeni A.S. Makarenka, 2015. T. 1. S. 22–27 (in Ukrainian).
[45] Yemelyanova S.M., Kuzemko A.A. (2017). National phytosociological database of vegetation of Ukraine (UkrVeg): relevance of creation and problems of development. Classification of vegetation and biotopes of Ukraine as a scientific basis for biodiversity conservation. mat. drugoyi nauk.-teor. konf. (m. Kyiv, 14–15 March 2016 r.). Kyiv. S. 24–37 (in Ukrainian).

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Різничук Надія, Гнєзділова Вікторія. Едафо-кліматична характеристика біотопів Передкарпаття за участі ценопопуляцій видів роду Polygonatum Mill. *Журнал Прикарпатського університету імені Василя Стефаника*, **8** (4) (2021), 20–33.

Територія досліджень за ландшафтно-географічним районуванням приурочена до Передкарпаття – частини Західної України, в межах Львівської, Івано-Франківської і Чернівецької областей (Кравчук, 1999). Простягається вона порівняно вузькою смугою між долиною Дністра та північно-східним підніжжям Українських Карпат (Койнов, 2014). Всього у межах семи територіальних виділів Передкарпаття досліджено ценопопуляції чотирьох видів роду Polygonatum Mill. (Polygonatum multiflorum (L.) All., Polygonatum odoratum (Mill.) Druce., Polygonatum verticillatum (L.) All., Polygonatum latifolium Desf.) на 59 дослідних ділянках, приурочених до 14 типів біотопів (Дідух, 2011). З'ясовано, що досліджені біотопи Передкарпаття відрізняються низкою едафо-кліматичних показників. Вміст гумусу становить 1,94 - 2,98%, сягаючи максимуму у біотопах Покутської височини, мінімуму – Калуської (Лімницько - Болохівської) улоговини. Усереднені показники реакції ґрунтового розчину відповідають дуже сильно кислому рівню у межах Сторожинецького пасма (pH(сольове) – 4,33 од.); сильно-кислому рівню – у межах Калуської і Станіславської улоговини та Покутської височини (pH(сольове) – 4,68; 4,82 та 4,76 од., відповідно); слабо-кислому рівню – у межах Верхньодністровської улоговини і Войнилівської височини (pH(сольове) – 5,34) та Чернівецької височини (pH(сольове) – 5,05). Вологоємність, сума активних температур і рівень освітлення сильно

варіюють у залежності від типу біотопу. Максимальною вологоємністю відзначаються ґрунти біотопів заболочених вільшаників (>40 %), мінімальною – примагістральних біотопів і занедбаних пасовищ (<20 %). Сума активних температур на глибині 20 см є найвищою на нелісовкритих ділянках з низьким ступенем розпушення. Мінімальний рівень освітлення (в межах 760 – 900 лк) констатовано у лісових біотопах, максимальний (>2000 лк) – в біотопах занедбаних пасовищ і сіножатних лук. Ґрунти у межах досліджених біотопів Передкарпаття відзначаються низькою і середньою забезпеченістю N, P та підвищеним вмістом K. Середньозважений показник рухомого Фосфору змінюється від 39,49 мг/кг в біотопах Калуської улоговини до 81,18 мг/кг в біотопах Чернівецької височини; гідролізованого Нітрогену – від 68,07 в біотопах Калуської улоговини до 83,93 – Сторожинецького пасма. Найвищі середньозважені значення вмісту рухомого Калію констатовано у межах Покутської височини (150,70 мг/кг), найнижчі – Войнилівської височини (84,1 мг/кг).

Ключові слова: оселище, класифікація EUNIS, Фосфор, Калій, Нітроген.