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BIOTOPES OF SAND OF CHERNIHIV POLESIE (FOREST ZONE, NORTHERN UKRAINE)

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Abstract:
Basing on the analysis of 440 vegetation plots (relevés) a classification scheme of sand biotopes of Chernihiv Polesie (Northern Ukraine) of levels IV–VI was compiled. Biotopes, protected by the Resolution 4 of the Bern Convention and Annexes II and IV of the Habitat Directive, were identified. The comparative characteristics of biotopes and syntaxa of vegetation according to floristic classification were given. Characteristics of the represented biotopes were described. The biotopes R1Q, R1P, R1M (EUNIS, 2021) appeared to be the most represented for the sands of Northern Ukraine. Fourteen biotopes of Chernihiv Polesie sands, protected by Council Directive 92/43/EEC of 21 May 1992, were revealed.

Key words: vegetation, habitat, Northern Ukraine, classification of biotopes, Chernihiv Polesie.

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INTRODUCTION

Habitat studies are an important milestone for the development of biodiversity conservation measures. European (EUNIS, NATURA 2000, A classification of Palaearctic habitats) and national (Czech Republic, Slovakia, Hungary, etc.) habitat classifications were developed in the European Union (Dvilliers and Devilliers-Terschuren, 1996; Chytry *et al*., 2001; Stanová and Valachovič, 2002; Davies *et al*., 2004; Bölöni *et al*., 2011; Biró *et al*., 2018). In Ukraine, steppe biotopes classification (Didukh *et al*., 2020) and the National Catalog of Biotopes of Ukraine (Kuzemko, 2018) were developed. Classification units for biotopes of Ukraine were separated up to IV–V level, which corresponds to the level of unions in the ecological and floristic classification of vegetation (Didukh, 2011, 2014).

Much attention was previously paid to rare habitats. Nowadays, the territories, in which changes in environmental factors mostly lead to successional processes, are also taken into consideration as important areas for nature preservation. Successions show changes in the biotic composition and point to patterns of biodiversity changes. Biotopes of successional types are the most vulnerable biotopes, which suffer greatly under the anthropogenic impact and climate change. Any change in the water regime affects strongly those sensitive biotopes due to the influence of various factors (climatic changes, anthropogenic disturbances). Transformed or disturbed biotopes can easily become corridors for invasive species expansion. Thus, such habitats should be protected and require the development of regulatory conservation measures. Pioneer or formed under extreme conditions (for example, in arid conditions on sands or near river banks, where the water level is not stable) biotopes should be given special attention.

The natural conditions of Chernihiv Polesie (Northern Ukraine) have specific features that differ from other territories of Ukraine and Europe. Therefore, there is a question of developing and improving the biotope classification, which could be included in EUNIS in the future, taking into account the regional features of Northern Ukraine.

REGIONAL SETTINGS

Chernihiv Polesie is one of the most important territories of Northern Ukraine. It is distinguished as a separate physical and geographical zone due to its position in the Dnipro-Donetsk depression. Its western border runs along the Dnipro River, at the line of contact with the Ukrainian Shield. The eastern border runs along the foot of the southwestern slope of the Voronezh crystalline massif. Palaeogene sand and clay deposits with thickness of more than 100 m, are found along the river valleys, being a part of the modern relief. Their surface was intensively eroded and therefore remains very uneven (Lanko *et al*., 1969; Marinich *et al*., 1985). Loams and sands of several meters thick, were preserved in Polesie mainly in the relief depressions. Alluvial deposits are widespread in modern and an-

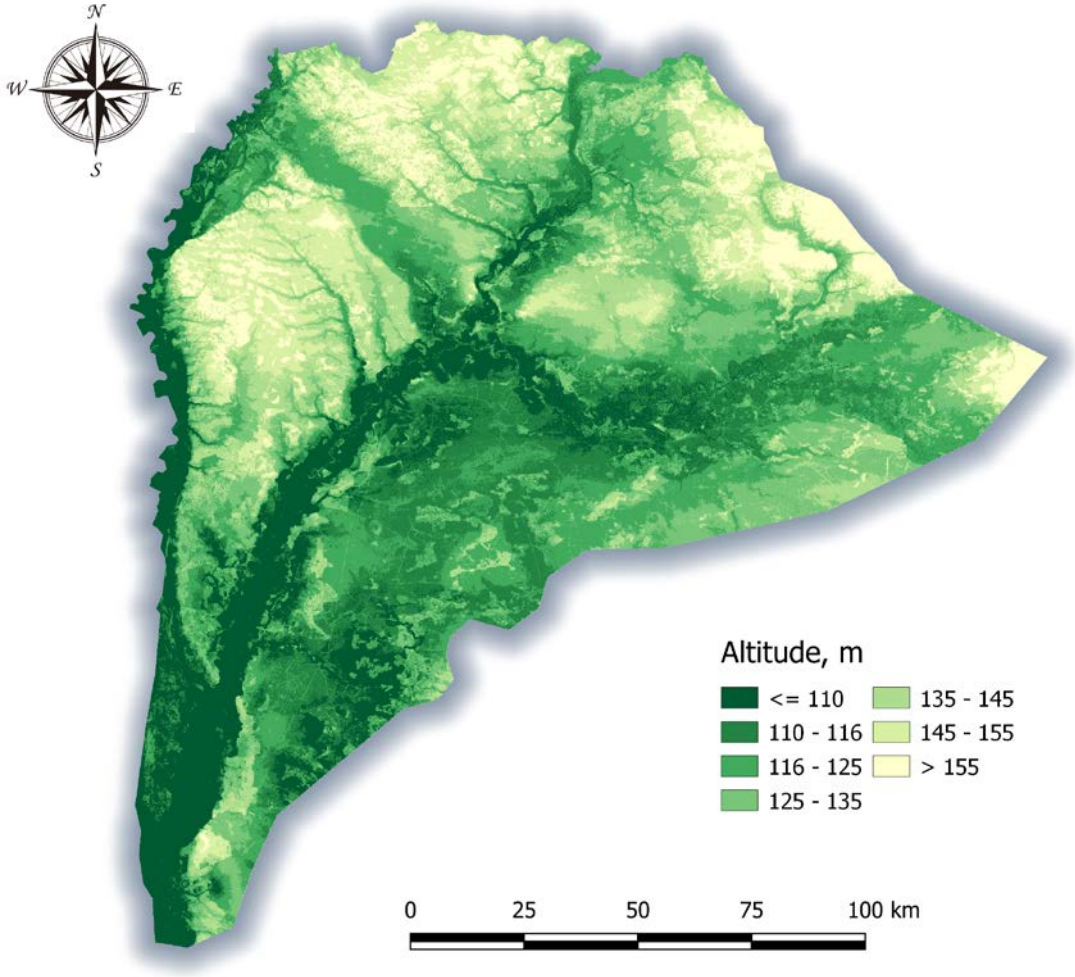

Fig. 1. Relief of Chernihiv Polesie.

cient river valleys, and they are represented by vari-grained sand with pebbles and loams. More than a half of the territory of Chernihiv Polesie is occupied by sod-podzolized, weakly podzolized and medium podzolized soils on boulder loams, water-glacial and alluvial sandy loam and sand deposits (Vernander *et al*., 1986). Due to described soil composition peculiarities, Polesie is different than the other flat parts of the Ukraine.

Chernihiv Polesie is drained by the Desna River and its tributaries – the Bilous, the Snov, the Seim and the Oster. The Dnipro River receives only a few little left-bank tributaries (the Vyr, the Vertech, the Pakulka) within the defined borders. The water regime of the rivers is characterized by spring high water, and summer and winter low water.

Such features of relief as glacial outwash plains, non-drained waterlogged areas, Polesyan plain denudation, alluvial outwash and terrace complexes are represented in Chernihiv Polesie. The Dnipro-Desna alluvial accumulative terraces can reach a height of more than 155 m a.s.l. (Fig. 1). Complexes with features of forest-steppe origin are also widespread (Marinich *et al*., 1985).

Chernihiv Polesie has a warm summer and humid continental climate (Dfb) according to Köppen-Geiger Classification (Kottek *et al*., 2006). Data for the 2016–2021 were retrieved from the regional meteorological stations. The average air temperature (Fig. 2) is +8.8°C. The average temperature of January is -4.1°C, and the mean temperature of July is 20.5°C. Precipitation during a period with temperature above 4°C is 521 mm.

MATERIALS AND METHODS

Vegetation relevés (440), made in 2016–2021 on the territory of the Chernihiv Polesie (Northern Ukraine), were analyzed in the study. Relevés were made on plots of 5–100 m^2. Projective coverage of all plant species is indicated in per cent. GPS navigation of the Oppo Reno 5 Lite smartphone was used to determine geographic coordinates.

All relevés were added to a database in the Turboveg program (Hennekens and Schaminée, 2001). The nomenclature of vascular plant species is given according to The Euro+Med PlantBase – the fundamental European information resource (https://www.europlusmed.org/), mostly used for habitat classification. Data analysis and visualization of the obtained results were carried out in JUICE (Tichý, 2002), Rstudio (https://www.rstudio.com/), and QGIS software (http://qgis.osgeo.org). A modified version of the TWINSPAN algo-

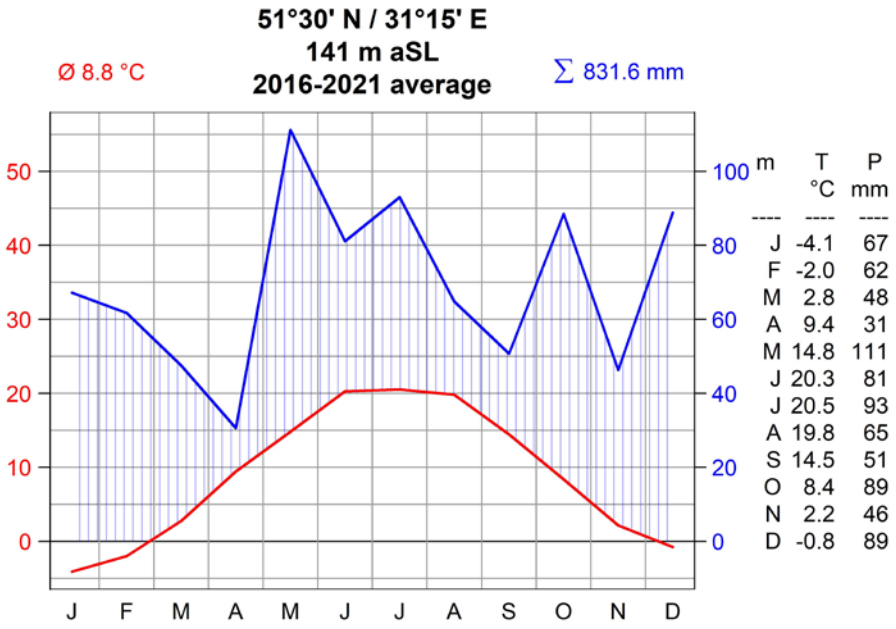

Fig. 2. Average monthly temperature and precipitation (Chernihiv Polesie).

rithm (Roleček *et al*., 2009) was used to classify relevés. The interpretation of the obtained diagnostic species was carried out by using the species fidelity indicator determination. The interpretation of the differentiated syntaxa was carried out, taking into consideration Ukrainian and foreign scientific publications for natural vegetation (Škodová and Janišová, 2008; Mucina *et al*., 2016; Matuszkiewicz, 2019; Lukash and Danko, 2020; Magnes *et al*., 2021; Dengler *et al*., 2022) and synanthropic vegetation (Solomakha *et al*., 1992). Revision of syntaxonomic diversity of psammophyte vegetation of the Polesie was carried out according to "Prodrome of the vegetation of Ukraine" (Dubyna *et al*., 2019). On the basis of the obtained results of the vegetation classification, units of the IV–VII levels of the Chernihiv Polesie biotopes were identified in accordance with the adopted classification (Kuzemko *et al*., 2018; Chytrý *et al*., 2020; Didukh *et al*., 2020).

Biotope mapping was carried out with QGIS (version 3.26.2) in World Geodetic System 1984 (WGS84).

RESULTS AND DISCUSSION

The territory of Chernihiv Polesie, due to its physical and geographical location and human activity influence, is distinguished by the development of dynamic vegetation processes. New areas of sandy substrates appear as a result of a sand mining. Psammophytic vegetation plays a special role in the overgrowth of sand areas. Alluvial (humid) sand in the studied area spread in the nearshore and central parts of the floodplains. Pine-forest terraces sands are also present on river terraces (relief elevations). Sands of anthropogenic origin with anthropogenic vegetation types formed on them are also represented. Basing on the data and taking into account the specific features of the region, a classification scheme of sandy biotopes of IV–VII levels was constructed according to the floristic classification, where the IV and the V levels correspond mainly to unions, and the VI level corresponds to associations, sub-associations and their variants, although a clear correspondence is not observed here (Table 1). Five types of biotopes were distinguished: D – semi-aquatic vegetation, E – herbaceous and shrubby meso- and xerophytic biotopes, F – biotopes formed by shrubs, G – biotopes of the forest type, I – biotopes formed by human economic activity.

D. Waterlogged herbaceous biotopes (semi-aquatic vegetation)

D:1 Semi-aquatic biotopes formed under conditions of sufficient irrigation (Phragmito-Magnocaricetea) on silty and sandy deposits with sharp changes wetting

D:1.1 Dense thickets of plants that form a dense layer of rhizomes or clumps

D:1.11 Communities affecting soil-forming processes

D:1.111 Biotopes of tall herbaceous helophytes, whose standing stems overwinter in a dry state (Phragmition communis: *Phragmites australis*, *Typha angustifolia*, *T. latifolia*)

D:1.1111 Thickets of *Phragmites australis*

D:1.1112 Communities dominated by *Typha angustifolia* and *T. latifolia*

D:1.113 Communities of accumulative zones of overgrown water bodies with silty-sandy and silty bottom deposits

D:1.114 Helophytic communities (Typhion laxmannii) under a lack of water

D:1.1141 Communities with the *Typha laxmannii* participation on sand of anthropogenic origin

D:1.2 Communities of aero-aquatic helophytes, forming on alluvial (mineral) or silty soils

D:1.21 Sparse communities of aero-aquatic perennial

Table 1. Classification scheme of sandy biotopes.

Biotopes according to the EUNIS classification adapted for Ukraine	Biotopes according to Directive 92/43/EEC and the Berne Convention (Resolution 4 of the Berne Convention – EUNIS)		Syntaxonomic units according to floristic classification
	EUNIS 2012	EUNIS 2021	
D:1.113	EUNIS1: D5.2 Beds of large sedges normally without free-standing water. Pal. Hab.2: 53.218 Cyperus sedge tussocks. CD 92/43 EEC3: – NHCU4: B4.1.3. Riparian mesotrophic vegetation on silty substrates.	D5.2	Phragmito-Magnocaricetea; Oenanthetalia aquaticae; Eleocharito palustris-Sagittarion sagittifoliae; Phragmitetalia; Phragmition communis; Phragmitetum australis; Typhetum latifoliae; Typhetum angustifoliae; Magnocaricetalia; Magnocaricion elatae; Carici-Rumicion hydrolapathi; Glycerietum maximae; Sparganietum erecti; Scolochloetum festucaceae; Caricetum elatae; Caricetum acutiformis; Cicuto virosae-Caricetum pseudocyperi; Calletum palustris.
D:1.114	EUNIS: C1.5 Permanent inland saline and brackish lakes, ponds and pools; D6.2 Inland saline or brackish species-poor helophyte beds normally without free-standing water. Pal. Hab.: 53.1 Reed beds; 53.17 Halophile clubrush beds. CD 92/43 EEC: – NHCU: B4.3 Riparian biotopes of saline or brackish water bodies and watercourses.	C1.5, D6.2	Phragmito-Magnocaricetea; Phragmitetalia; Typhion laxmannii; Typhetum laxmannii.
D:1.211	EUNIS: C3.1 Species-rich helophyte beds; C3.2 Water-fring in greed beds and tall helophytes other than canes. Pal. Hab.: 53.14 Medium-tall waterside communities; 53.14A Common spikerush beds. CD 92/43 EEC: – NHCU: B4.1.4. Riparian communities of helophytes on silty substrates.	C3.1, C3.2	Phragmito-Magnocaricetea; Oenanthetalia aquaticae; Eleocharito palustris-Sagittarion sagittifoliae; Sagittario sagittifoliae-Sparganietum emersi; Oenanthetum aquaticae; Oenantho aquaticae-Rorippetum amphibiae; Eleocharitetum palustris; Butometum umbellati; Butomo-Sagittarietum sagittifoliae; Butomo-Alismatetum plantaginis-aquaticae; Oenanthetum aquaticae; Butometum umbellati; Butomo-Sagittarietum sagittifoliae.
D:1.221	EUNIS: C3.5 Periodically inundated shores with pioneer and ephemeral vegetation; E5.4 Moisture wet tall-herb and fern fringes and meadows. Pal. Hab.: 22.33 Bur marigold communities; 24.52 Euro-Siberian annual river mud communities. CD 92/43 EEC: 3270 Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation. NHCU: B4.1.5 Communities of nitrophilic annual vegetation on muddy river banks and shallows.	C3.5, E5.4	Bidentetea; Bidentetalia; Bidention tripartitae; Polygonetum hydropiperis; Leersio-Bidentetum; Myosoto aquatici-Bidentetum frondosae; Chenopodion rubri; Bidenti frondosae-Atriplicetum prostratae.
D:1.312	EUNIS: C3.4 Species-poor beds of low-growing water-fringing or amphibious vegetation; C3.5 Periodically inundated shores with pioneer and ephemeral vegetation. Pal. Hab.: 22.321 Dwarf spike-rush communities; 22.323 Dwarf toad-rush communities. CD 92/43 EEC: 3130 Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea. NHCU: B2.1.1 Alluvial areas and bottoms of dried-up water bodies with annual amphibian vegetation.	C3.4, C3.5	Isoëto-Nanojuncetea; Nanocyperetalia; Eleocharition soloniensis; Cyperetum flavescentis; Cyperetum micheliani; Juncetum bufonii; Stellario uliginosae-Isolepidetum setaceae.
D:1.331	EUNIS: C3.5 Periodically inundated shores with pioneer and ephemeral vegetation. Pal. Hab.: 24.32 River sand communities. CD 92/43 EEC: 6450 Northern boreal alluvial meadows. NHCU: –	C3.5	Molinio-Arrhenatheretea; Filipendulo ulmariae-Lotetalia uliginosi; communities with Petasites spp. participation.
E:1.111	EUNIS: E3.464 Ponto-Sarmatic humid meadows. Pal. Hab.: 37.264 Ponto-Sarmatic humid meadows. CD 92/43 EEC: 6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels. NHCU: T3.1.1. Humid meadows with grasses domination	R355 (=E3.46) Continental humid meadows	Molinio-Arrhenatheretea; Filipendulo ulmariae-Lotetalia uliginosi; Filipendulion ulmariae; Lysimachio vulgaris-Filipenduletum.
E:1.121	EUNIS: E3.44 Flood swards and related communities. Pal. Hab.: 3724 Flood swards and related communities. CD 92/43 EEC: – NHCU: T3.2 Humid meadows of pasture use	R362 (=E3.44) Flood swards and related communities	Molinio-Arrhenatheretea; Potentillo-Polygonetalia avicularis; Potentillion anserinae; Rumici crispi-Agrostietum stoloniferae; Potentilletum anserinae; Potentilletum reptantis; Blysmo-Juncetum compressi; Filipendulo ulmariae-Lotetalia uliginosi; Mentho longifoliae-Juncion inflexi.

Biotopes according to the EUNIS classification adapted for Ukraine	Biotopes according to Directive 92/43/EEC and the Berne Convention (Resolution 4 of the Berne Convention – EUNIS)		Syntaxonomic units according to floristic classification
	EUNIS 2012	EUNIS 2021	
E:1.122	EUNIS: E3.464 Ponto-Sarmatic humid meadows. Pal. Hab.: 37.264 Ponto-Sarmatic humid meadows. CD 92/43 EEC: – NHCU: T3.1.1 Eutrophic and mesotrophic humid hay meadows.	R355 (=E3.46) Continental humid meadows	Molinio-Arrhenatheretea; Molinietalia caeruleae; Deschampsion cespitosae; Poo trivialis-Alopecuretum pratensis; Agropyro-Alopecuretum pratensis; Lathyro palustris-Gratioletum officinalis.
E:1.222	EUNIS: E2.251 Ponto-Pannonic mesophile hay meadows. Pal. Hab.: 38.251 Ponto-Pannonic mesophile hay meadows. CD 92/43 EEC: 6510 Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis). NHCU: T2.3.1 Lowland and low-mountain hay meadows.	R2231 (=E2.251) Ponto-Pannonic mesophile hay meadows	Molinio-Arrhenatheretea; Arrhenatheretalia elatioris; Arrhenatherion elatioris; Agrostio giganteae-Festucetum pratensis; Poëtum pratensis.
E:1.311	EUNIS: E2.251 Ponto-Pannonic mesophile hay meadows. Pal. Hab.: 38.251 Ponto-Pannonic mesophile hay meadows. CD 92/43 EEC: – NHCU: T2.4. Couch grass meadows in the bottoms of hollows	R2231 (=E2.251) Ponto-Pannonic mesophile hay meadows	Artemisietea vulgaris; Agropyretalia intermedio-repentis; Convolvulo arvensis-Agropyrion repentis; Convolvulo arvensis-Agropyretum repentis; Molinio-Arrhenatheretea; Galietalia veri; Agrostion vinealis; Koelerio-Agrostietum vinealis.
E:3.11	EUNIS: E1.9 Open non-Mediterranean dry acid and neutral grassland, including inland dune grassland; E1.93 Corynephorus grassland; E1.94 Inland dune pioneer grassland. CD 92/43 EEC: 2330 Inland dunes with open Corynephorus and Agrostis grasslands. NHCU: E:3.12 Psammophyte communities on outwash and fluvioglacial sandy deposits.	R1Q1 (=E1.93) Corynephorus grassland R1Q2 (=E1.94)	Koelerio-Corynephoretea canescentis; Corynephoretalia canescentis; Corynephorion canescentis; Corniculario aculeatae-Corynephoretum canescentis; Corynephoro-Silenetum tataricae; Sedo-Scleranthetea; Sedo-Scleranthetalia; Sedo-Scleranthion; Ceratodonto purpurei-Polytrichetea piliferi; Polytrichetalia piliferi; Polytrichion piliferi; Brachythecietum albicantis.
E:3.12	EUNIS: E1.9A Pontic inland dunes; E1.12 Euro-Siberian pioneer calcareous sand swards; E1.9 Open non-Mediterranean dry acid and neutral grassland, including inland dune grassland; X35 Inland Sand Dunes. CD 92/43 EEC: 2340 Pannonic inland dunes; 6120 Xeric sand calcareous grasslands; 6260 Pannonic sand steppes. NHCU: E:3.13 Communities of psammophyte forbs and grasses; E:3.21 Psammophyte communities of the azonal type of pine forest terraces with sod grasses; E:3.22 Psammophytic communities of the azonal type, the dominants of which do not have turf.	R1Q8: R1Q82, (=E1.9A) Pontic inland dunes R1P (<E1.9) Oceanic to subcontinental inland sand grassland on dry acid and neutral soils	Koelerio-Corynephoretea canescentis; Corynephoretalia; Koelerion glaucae.
E:3.211	EUNIS: E1.1 Inland sand and rock with open vegetation. Pal. Hab.: 34.91 Pannonic loess steppic grasslans; E 1.2C3 Pannonic semidesert steppes. CD 92/43 EEC: 6250 Pannonic loess steppic grasslands; 6260 Pannonic sand steppes. NHCU: T1.1.2. Psammophyte herbaceous biotopes on neutral substrates	R11 (=E1.1) Pannonian and Pontic sandy steppe; R1B423 (=E1.2823) Substabilised Central European sand grasslands	Koelerio–Corynephoretea canescentis; Corynephoretalia canescentis; Koelerion glaucae; Veronico dillenii-Secaletum sylvestris; Diantho borbasii-Agrostietum syreistschikovii; Festucetalia vaginatae; Festucion beckeri; Artemisio arenariae-Festucion beckeri.
E:3.221	EUNIS: E1.74 Calamagrostis epigejos stands; E1.2F11 Drooping brome pioneer swards. Pal. Hab.: 35.14 Wood small-reed stands; 34.A111 Drooping brome pioneer swards. CD 92/43 EEC: – NHCU: T1.1.2. Psammophyte herbaceous biotopes on neutral substrates.	R1M4 (=E1.74) Calamagrostis epigejos stands; R1BA11 (=E1.2F11) Drooping brome pioneer swards; R1B423 (=E1.2823)	Artemisietea vulgaris; Agropyretalia intermedio-repentis; Calamagrostietum epigei.
E:3.242	EUNIS: E1.9A Pontic inland dunes. Pal. Hab.: 34.A12 Pannonic open sand steppes. CD 92/43 EEC: 6260 Pannonic sand steppes. NHCU: T1.1.2. Psammophyte herbaceous biotopes on neutral substrates.	R1Q8 (=E1.9A) Pontic inland dune R1P (<E1.9A) Oceanic to subcontinental inland sand grassland on dry acid and neutral soils	Koelerio–Corynephoretea canescentis; Corynephoretalia canescentis; Corynephorion canescentis; Corniculario aculeatae-Corynephoretum canescentis; Corynephoro-Silenetum tataricae; Koelerion glaucae; Veronico dillenii-Secaletum sylvestris; Diantho borbasii-Agrostietum syreistschikovii; Sedo-Scleranthetea; Sedo-Scleranthetalia; Hyperico perforati-Scleranthion perennis; Thymo pulegioidis-Sedetum sexangularis.
E:5.211	EUNIS: E5.1. Anthropogenic herb stands; E1.E Trampled xeric grasslands with annuals. E1.3 Mediterranean xeric grassland / Mediterranean xeric grassland; E1.6 Subnitrophilous annual grassland. Pal. Hab.: – CD 92/43 EEC: – NHCU: –	V3 (>E5.1, >E1.E) Artificial grasslands and herb dominated habitats	Sisymbrietea; Sisymbrietalia sophiae; Sisymbrion officinalis; Chenopodietea; Brometalia rubenti-tectorum; Hordeion murine; Brometum tectorum.

Biotopes according to the EUNIS classification adapted for Ukraine	Biotopes according to Directive 92/43/EEC and the Berne Convention (Resolution 4 of the Berne Convention – EUNIS)		Syntaxonomic units according to floristic classification
	EUNIS 2012	EUNIS 2021	
F:1.212	EUNIS: F9.23 Bay willow carrs; F9.212 Central European grey willow carrs (F9.2 Willow carr and fen scrub). Pal. Hab.: 44.921 Grey willow scrub. CD 92/43 EEC: – NHCU: Ч7.3 Wetland shrubs.	S923 (=F9.23) Bay willow carrs S9212 (=F9.212) Central European grey willow carrs S92 (=F9.2) Salix fen scrub	Franguletea; Salicetalia auritae; Salicion cinereae; Salicetum pentandro-cinereae.
F:3.312	EUNIS: F3.1 Temperate and submediterranean thorn scrub. Pal. Hab.: 31.8B71 Ponto-Sarmatic steppe brush. CD 92/43 EEC: 6210 Semi-Natural dry grasslands and scrubland facies on calcareous substrates. NHCU: –	S33 (#F3.1, F3.2) Lowland to montane temperate and submediterranean genistoid scrub	Vaccinio-Piceetea; Pinetalia sylvestris; Dicrano-Pinion sylvestris; Peucedano-Pinetum.
F:5.111	EUNIS: F9.12 Lowland and collinar riverine willow scrub. Pal. Hab.: 44.12 Lowland, collinar and mediterraneo-montane willow brush. CD 92/43 EEC: – NHCU: Ч7.1. Willow thickets of sandy and loamy shores.	S912 (=F9.12) Lowland and collinar riverine Salix scrub	Salicetea purpureae; Salicetalia purpureae; Salicion triandrae; Salicetum triandrae.
F:5.112	EUNIS: F9.35 Riparian stands of invasive shrubs. Pal. Hab.: – CD 92/43 EEC: – NHCU: Ч7.4 Thickets of desert false indigo.	S935 (=F9.35) Riparian stands of invasive shrubs	Salicetea purpureae; Salicetalia purpureae; Rubo caesii-Amorphion fruticosae.
F:5.124	EUNIS: B1.611 Hippophae rhamnoides dune thickets. Pal. Hab.: – CD 92/43 EEC: 2160 Dunes with Hippophae rhamnoides. NHCU: –	N1A11 (=B1.611) Hippophae rhamnoides dune thickets	Salicetea purpureae; Tamaricetalia ramosissimae; Artemisio scopariae-Tamaricion ramosissimae; Calamagrostio epigei-Hippophaetum rhamnoides.
G:1.112	EUNIS: G1.1112 Eastern European poplar-willow forests. Pal. Hab.: 44.1623 Eastern Ponto-Sarmatic steppe willow galleries. CD 92/43 EEC: 92A0 Salix alba and Populus alba galleries. NHCU: Д1.6.1. Floodplain willow- poplar forests.	T11112 (=G1.1112) Eastern European poplar-willow forests	Salicetea purpureae; Salicetalia purpureae; Salicion albae; Salicetum albae.
G:2.214	EUNIS: G3.4 Pinus sylvestris woodland south of the taiga (G3.42111 Subcontinental moss Scots pine forests). Pal. Hab.: 42.5211 Central European Scots pine forests, 42.52111 Subcontinental moss Scots pine forests. CD 92/43 EEC: – NHCU: Д2.2.2 Acidophilic fresh and moist Scots pine forests Acidophilic fresh and moist Scots pine forests.	T35 (<G3.4) Temperate continental Pinus sylvestris forest (T352111 (=G3.42111) Subcontinental moss Pinus sylvestris forests)	Vaccinio-Piceetea; Pinetalia sylvestris; Dicrano-Pinion sylvestris; Dicrano-Pinetum.
G:2.215	EUNIS: G3.4F European Pinus sylvestris reforestation (G3.42112 Subcontinental lichen Scots pine forests). G5.63 Coniferous scrub woodland. Pal. Hab.: 42.52 Middle European [Pinus sylvestris] forests, 42.521 Subcontinental Scots pine forests. CD 92/43 EEC: 91T0 Central European lichen Scots pine forests. NHCU: Д 2.2.1 Lichen Scots pine forests.	T359 (=G3.4F) European Pinus sylvestris reforestation (T352112 (=G3.42112) Subcontinental lichen Pinus sylvestris forests) T413 (=G5.63) Coniferous scrub forest	Vaccinio-Piceetea; Pinetalia sylvestris; Cladonio stellaris-Pinion sylvestris; Cladonio-Pinetum; Dicrano-Pinetum; Peucedano-Pinetum; Veronico incanae-Pinetum.
G:2.221	EUNIS: G3.4232 Sarmatic steppes Pinus sylvestris forests. Pal. Hab.: 42.5232 Sarmatic steppe pine forests. CD 92/43 EEC: 91U0 Sarmatic steppes Pinus sylvestris forests (Cytiso-Pinetalia). NHCU: Д2.2.4 Steppificated Scots pine forests.	T35232 (=G3.4232) Sarmatic steppe Pinus sylvestris forests	Pyrolo-Pinetea sylvestris; Koelerio glaucae-Pinetalia sylvestris; Koelerio glaucae-Pinion sylvestris; Hieracio pilosellae-Pinetum.
I:1.111	EUNIS: G5.8 Recently felled areas; G5.84 Herbaceous clearings. Pal. Hab.: 31.87 Woodland clearings; 31.871 Herbaceous clearings. CD 92/43 EEC: – NHCU: C1.2 Ruderal biotopes of perennial forbs.	T43 (=G5.8) Recently felled areas R57 (=G5.84) Herbaceous forest clearing vegetation	Sisymbrietea; Sisymbrietalia sophiae; Atriplicion; Atriplicetum hastatae; Atriplicetum nitentis; Atriplicetum tataricae; Chenopodietum stricti; Epilobietea angustifolii; Galeopsio-Senecionetalia sylvatici; Epilobion angustifolii; Rubo-Chamaenerietum angustifolii; Senecioni sylvatici-Epilobietum angustifolii; Calamagrostietum epigei.

Biotopes according to the EUNIS classification adapted for Ukraine	Biotopes according to Directive 92/43/EEC and the Berne Convention (Resolution 4 of the Berne Convention – EUNIS)		Syntaxonomic units according to floristic classification
	EUNIS 2012	EUNIS 2021	
I:1.112	EUNIS: G5.85 Shrubby clearings. Pal. Hab.: 31.87 Woodland clearings; 31.872 Shrubby clearings. CD 92/43 EEC: – NHCU: –	T434 (=G5.85) Shrubby clearings	Epilobietea angustifolii; Galeopsio-Senecionetalia sylvatici; Epilobion augustifolii; Rubo-Chamaenerietum angustifolii; Robinietea; Chelidonio-Robinietalia pseudoacaciae; Balloto nigrae-Robinion pseudoacaciae; Chelidonio-Pinetum sylvestris; Sambucetalia racemosae; Sambuco-Salicion capreae; Sambucetum racemosae; Chelidonio-Robinietalia pseudoacaciae; Chelidonio-Acerion negundo; Chelidonio-Aceretum negundi.
I:1.212	EUNIS: I1.5 Bare tilled, fallow or recently abandoned arable land. Pal. Hab.: 87 Fallow land, waste places. CD 92/43 EEC: – NHCU: C1.2 Ruderal biotopes of perennial forbs.	V15 (=I1.5) Bare tilled, fallow or recently abandoned arable land	Sisymbrietea; Sisymbrietalia sophiae; Atriplicion; Atriplicetum nitentis; Atriplicetum tataricae.
I:1.222	EUNIS: I1.5 Bare tilled, fallow or recently abandoned arable land. Pal. Hab.: 87 Fallow land, waste places. CD 92/43 EEC: – NHCU: –	V15 (=I1.5) Bare tilled, fallow or recently abandoned arable land	Robinietea; Chelidonio-Robinietalia pseudoacaciae; Balloto nigrae-Robinion pseudoacaciae; Chelidonio-Acerion negundo.
I:2.111	EUNIS: E1.6 Subnitrophilous annual grassland; E1.D Unmanaged xeric grassland; E1.E Trampled xeric grasslands with annuals; I1.52 Fallow un-inundated fields with annual weed communities. Pal. Hab.: 87.1 Fallow fields. CD 92/43 EEC: – NHCU: C1.1 Biotopes of annual xerophytic grasses on abandoned lands and roadsides.	V3 (>E1.6, E1.D, E1.E) Artificial grasslands and herb dominated habitats V152 (=I1.52) Fallow un-inundated fields with annual weed communities	Digitario sanguinalis-Eragrostietea minoris; Eragrostietalia; Eragrostion; Digitario sanguinalis-Eragrostietum minoris; Sisymbrietalia sophiae; Hordeion murini; Brometum tectorum; Hordeetum murini.
I:2.112	EUNIS: E1.D Unmanaged xeric grassland; E5.1 Anthropogenic herb stands; I1.52 Fallow un-inundated fields with annual weed communities. Pal. Hab.: 87.1 Fallow fields. CD 92/43 EEC: – NHCU: C1.1.2 Biotopes of ruderal annual and biennial forbs on poor soils.	V3 (>E1.D, E5.1) Artificial grasslands and herb dominated habitats V152 (=I1.52) Fallow un-inundated fields with annual weed communities	Digitario sanguinalis-Eragrostietea minoris; Eragrostietalia; Salsolion ruthenicae; Plantagini indicae-Digitarietum sanguinalis; Artemisietea vulgaris; Onopordetalia acanthi; Dauco-Melilotion; Berteroetum incanae; Achilleo millefolii-Grindelietum squarrosae; Ambrosio artemisiifoliae-Xanthietum strumariae; Artemisio-Echinopsetum sphaerocephali; Balloto-Artemisietum absinthii; Onopordetum acanthii; Potentillo argenteae-Artemisietum absinthii; Tanaceto-Artemisietum vulgaris; Xanthietum strumarii; Sisymbrietea; Sisymbrietalia sophiae; Atriplicion; Atriplicetum hastatae; Atriplicetum nitentis; Digitario sanguinalis-Eragrostietea minoris; Eragrostietalia; Eragrostion; Digitario sanguinalis-Eragrostietum minoris; Cynodontetum dactyli; Papaveretea rhoeadis; Aperetalia spicae-venti; Scleranthion annui; Sclerantho annui-Descurainietum sophiae.
I:2.113	EUNIS: E5.1 Anthropogenic herb stands; I1.52 Fallow un-inundated fields with annual weed communities. Pal. Hab.: 87.1 Fallow fields. CD 92/43 EEC: – NHCU: C1.1.3 Biotopes of ruderal annual and biennial forbs on nitrophilic soils.	V3 (>E5.1) Artificial grasslands and herb dominated habitats V152 (=I1.52) Fallow un-inundated fields with annual weed communities	Sisymbrietea; Sisymbrietalia sophiae; Sisymbrion officinalis; Chenopodietea; Brometalia rubenti-tectorum; Hordeion murin; Hordeetum murini; Cannabietum ruderalis; Atriplicion; Chenopodietum stricti.
I:2.121	EUNIS: E1.D Unmanaged xeric grassland; E5.1 Anthropogenic herb stands; I1.53 Fallow un-inundated fields with annual and perennial weed communities. Pal. Hab.: 87.1 Fallow fields. CD 92/43 EEC: – NHCU: C1.2.1 Ruderal biotopes of perennial forbs on pure soils.	V3 (>E1.D, E5.1) Artificial grasslands and herb dominated habitats V153 (=I1.53) Fallow un-inundated fields with annual and perennial weed communities	Artemisietea vulgaris; Onopordetalia acanthii; Dauco-Melilotion; Cirsio setosi-Lathyretum tuberosi; Dauco-Centaureetum diffusae; Melilotetum albo-officinalis.
I:2.122	EUNIS: E5.1 Anthropogenic herb stands; E5.43 Shady woodland edge fringes; I1.53 Fallow un-inundated fields with annual and perennial weed communities. Pal. Hab.: 87.1 Fallow fields; 37.72 Shady woodland edge fringes. CD 92/43 EEC: – NHCU: C1.2.2 Ruderal biotopes of nitrophilic perennial forbs.	V3 (>E5.1) Artificial grasslands and herb dominated habitats R553 (=E5.43) Shady woodland edge fringes V153 (=I1.53) Fallow un-inundated fields with annual and perennial weed communities	Epilobietea angustifolii; Galeopsio-Senecionetalia sylvatici; Epilobion augustifolii; Rubo-Chamaenerietum angustifolii; Circaeo lutetianae-Stachyetalia sylvaticae; Aegopodion podagrariae; Elytrigio repentis-Aegopodietum podagrariae; Arctio lappae-Artemisietalia vulgaris; Arction lappae; Arctietum lappae; Arctio lappae-Artemisietum vulgaris; Balloto-Malvetum sylvestris; Galio-Alliarietalia; Geo urbani-Alliarion officinalis; Polygonetum cuspidati.

Biotopes according to the EUNIS classification adapted for Ukraine	Biotopes according to Directive 92/43/EEC and the Berne Convention (Resolution 4 of the Berne Convention – EUNIS)		Syntaxonomic units according to floristic classification
	EUNIS 2012	EUNIS 2021	
I:2.123	EUNIS: E5.1 Anthropogenic herb stands; I1.53 Fallow un-inundated fields with annual and perennial weed communities. Pal. Hab.: 87.1 Fallow fields; 37.72 Shady woodland edge fringes. CD 92/43 EEC: – NHCU: C1.2.3 Biotopes of thermophilic perennial forbs.	V3 (>E5.1) Artificial grasslands and herb dominated habitats V153 (=I1.53) Fallow un-inundated fields with annual and perennial weed communities	Artemisietea vulgaris; Onopordetalia acanthii; Onopordion acanthii; Ambrosio artemisiifoliae-Xanthietum strumariae; Agropyretalia intermedio-repentis; Convolvulo arvensis-Agropyrion repentis; Agropyretum repentis.
I:2.132	EUNIS: E1.E Trampled xeric grasslands with annuals; E2.6 Agriculturally-improved, re-seeded and heavily fertilized grassland, including sports fields and grass lawns. Pal. Hab.: 81 Improved grasslands. CD 92/43 EEC: – NHCU: C1.2.4 Trampled plots.	V3 (>E1.E, E2.6) Artificial grasslands and herb dominated habitats	Molinio-Arrhenatheretea; Arrhenatheretalia elatioris; Arrhenatherion elatioris; Trifolio-Festucetum rubrae; Sisymbrietea; Sisymbrietalia sophiae; Sisymbrion officinalis; Ivaetum xanthiifoliae; Digitario sanguinalis-Eragrostietea minoris; Eragrostietalia; Eragrostion; Digitario sanguinalis- Cynodontetum dactyli; Eragrostietum minoris; Digitario sanguinalis-Eragrostietum minoris; Portulacetum oleracei; Polygono arenastri-Poetea annuae; Polygono arenastri-Poetalia annuae; Polygono-Coronopodion; Eragrostio minoris-Polygonetum arenastri.
I:3.212	EUNIS: G3.F Highly artificial coniferous plantations: G3.F1 Native conifer plantations; G3.F12 Native pine plantations; G3.F2 Exotic conifer plantations; G4.F Mixed forestry plantations; G5.5. Small mixed broadleaved and coniferous anthropogenic woodlands; G5.74 Early-stage coniferous plantations. Pal. Hab.: 83.31 Conifer plantations, 83.311 Native conifer plantations, 83.3112 Native pine plantations, 83.312 Exotic conifer plantations. CD 92/43 EEC: – NHCU: Д2.6 Coniferous forests of anthropogenic origin.	T3M, T3N (<G3.F) Coniferous plantation of non site-native trees; Coniferous plantation of site-native trees T3N (=G3.F1) Coniferous plantation of site-native trees T3M (=G3.F2) Coniferous plantation of non site-native trees T424 (=G5.74) Early-stage coniferous plantations	Robinietea; Chelidonio-Robinietalia pseudoacaciae; Chelidonio majoris-Robinion pseudoacaciae; Impatienti parviflorae-Robinietum; Balloto nigrae-Robinion pseudoacaciae; Chelidonio-Pinetum sylvestris.

Abbreviations: EUNIS[1] – European Nature Information System (EUNIS, 2012; EUNIS, 2021); Pal. Hab.[2] – Palearctic Habitat (Devilliers & Devilliers-Terschuren, 1996); CD 92/43 EEC[3] – Council Directive 92/43/EEC of 21 May 1992 ("Council Directive 92/43/EEC," 1992); NHCU[3] – National Habitat Catalogue of Ukraine (Kuzemko *et al.*, 2018).

helophytes, with signs of adaptation to the aquatic environment (Oenanthion aquaticae: *Alisma plantago-aquatica*, *Butomus umbellatus*, *Oenanthe aquatica*, *Sagittaria sagittifolia*, *Rumex hydrolapathum*)

D:1.211 Aero-aquatic communities of water plantain, flowering rush, fine-leaved water-dropwort, arrowhead (Alisma sp., *Butomus umbellatus*, *Oenanthe aquatica*, *Sagittaria sagittifolia*) on newly formed alluvial areas

D:1.2111 Communities of Butomo-Sagittarietum sagittifoliae

D:1.2112 Communities of Butomo-Alismatetum plantaginis-aquaticae

D:1.22 Nitrophilic communities of therophytes (Bidentetea tripartitae) on silty and silty-sandy substrates

D:1.221 Nitrophilic communities of beggarticks, knotgrass (Bidentetea: Bidens spp., Polygonum spp.) on alluvial deposits

D:1.2211 Communities of the Bidenti frondosae-Atriplicetum prostratae association

D:1.2212 Communities of the Xanthio riparii-Chenopodietum rubri association

D:1.3 Bare or slightly overgrown shores of water bodies, formed under conditions of changes in substrate moisture

D:1.31 Low-growing communities, formed under conditions of changing substrate moisture along the periphery of water bodies (Isoëto-Nanojuncetea)

D:1.312 Communities of low-growing terophytes on silty soils of temporarily dried-up water bodies

D:1.3121 Communities of the Cyperetum micheliani association

D:1.3122 Communities of the Juncetum bufonii association

D:1.3123 Communities of the Stellario uliginosae-Isolepidetum setaceae association

D:1.33 Riparian communities with Petasites spp. on flat or slightly lowered plots of near-terrace river floodplains

D:1.331 Communities with Petasites spp. (*Petasites spurius*) participation

E. Herbaceous and shrubby meso- and xerophytic biotopes

E:1 Forb and grass biotopes (meadows) Molinio-Arrhenatheretea

E:1.1 Hygromesophytic meadows and other communi-

ties on overmoistened soils with accumulation of organic substances (Molinietalia)

E:1.11 Humid meadows on peaty and silty soils

E:1.111 Humid meadows with dominance of grasses and perennials (Filipendulion ulmariae)

E:1.1111 Near-terraced communities of the Lysimachio vulgaris-Filipenduletum association

E:1.12 Humid meadows with accumulation of peat and silt in soils

E:1.121 Humid alluvial meadows of pasture use

E:1.122 Eutrophic and mesotrophic humid hay meadows (Deschampsion cespitosae) in river floodplains

E:1.1221 Communities of the Agropyro-Alopecuretum pratensis association

E:1.1222 Communities of the Lathyro palustris-Gratioletum officinalis association

E:1.2 Mesophytic true meadows on moderately moistened soils (Arrhenatheretalia elatioris)

E:1.22 Meadows on sod-gleyey meadow sandy-loamy soils (Arrhenatherion elatioris)

E:1.222 Hay meadows (Arrhenatherion elatioris) of the pine terraces slopes

E:1.2221 Communities of the Agrostio giganteae-Festucetum pratensis association on slopes with sandy soils

E:1.2222 Communities of the Poëtum pratensis association on the lower parts of the slopes of the pine forest terraces ridges

E:1.3 Forbs and rhizomatous grass communities on light soils

E:1.31 Forbs and couch grass communities

E:1.311 Tall grass xeromesophytic communities (*Bromopsis inermis*, *Elytrigia repens*, *Agrostis vinealis*)

E:1.3111 Communities of the Convolvulo arvensis-Agropyretum repentis association on sodded sandy soils

E:1.3112 Communities of the Koelerio-Agrostietum vinealis association on elevations with sandy and dusty soils

E:3 Herbaceous xerophytic biotopes (wastelands) of the psammophyte type (Koelerio-Corynephoretea)

E:3.1 Psammophyte herbaceous biotopes

E:3.11 Pioneer Corynephorus grasslands of inland sand

E:3.12 Psammophyte herbaceous biotopes with sod grasses (*Koeleria glauca*)

E:3.2 Psammophytic communities of the azonal type

E:3.21 Psammophytic communities with caespitose plants dominance

E:3.211 Psammophytic bunchgrass communities (*Stipa borysthenica*, *Koeleria glauca* s.l., *Festuca polesica*)

E:3.22 Psammophytic communities of rhizomatous grasses

E:3.221 Psammophyte high grass communities of bushgrass (*Calamagrostis epigejos*)

E:3.2211 Communities of the Calamagrostietum epigei association

E:3.24 Forb and shrub communities

E:3.242 Psammophyte communities of tall stress-tolerant plants (*Artemisia campestris* s.l., Kochia spp.)

E:3.2421 Communities of the Thymo pulegioidis-Sedetum sexangularis association in extreme ecotopes

E:5 Biotopes of ephemeral type with a summer break in development

E:5.2 Ephemeral derivate grass communities

E:5.21 Ephemeral ruderalized derivate grass communities

E:5.211 Ephemeral communities of annual grasses (*Anisantha tectorum*)

E:5.2111 Communities of the Brometum tectorum association

F. Biotopes, formed by shrubs

F:1 Biotopes of marsh shrub cenosis in excessively humid conditions on silty and sandy soils

F:1.2 Marsh shrubs, formed under conditions of excessive moisture

F:1.21 Thickets of Salicetalia auritae on silty and sandy soils

F:1.212 Thickets of marsh willows (Salicion cinereae: *Salix cinerea*, *Salix pentandra*)

F:1.2121 Communities of the Salicetum pentandro-cinereae association on silty and sandy soils

F:3 Biotopes of deciduous shrubs under conditions of sufficient moistening

F:3.3 Mesoxerophilic low-growing thickets of steppe and rock shrubs

F:3.31 Mesoxerophilic low-growing thickets of steppe shrubs (*Prunus fruticosa*, Cytisus spp.)

F:3.312 Mesoxerophilic thickets of Cytisus spp.

F:3.3121 Communities of the Peucedano-Pinetum association on pine forest terraces

F:5 Shrub biotopes on alluvial deposits of river valleys formed under varied moisture conditions

F:5.1 Deciduous shrub biotopes adapted to variable substrate humidification

F:5.11 Riverine shrubs, formed under varied humidification conditions mainly on silty soils

F:5.111 Tall willow shrubs (Salicion triandrae) under conditions of moderately changing humidification

F:5.1111 Communities of the Salicetum triandrae association

F:5.112 Communities, dominated by desert false indigo (Rubo caesii-Amorphion fruticosae)

F:5.1121 Communities of the Rubo caesii-Amorphion fruticosae association

F:5.12 Communities of shrubs on sandy areas

F:5.124 Sea-buckthorn communities (Calamagrostio epigei-Hippophaetum rhamnoidis) on sandy areas of anthropogenic origin

F:5.1241 Communities of the Calamagrostio epigei-Hippophaetum rhamnoidis association

G. Forest type biotopes

G:1 Deciduous forest

G:1.1 Microphyllous forest

G:1.11 Riverine forests, dominated by willows and poplars (Salix spp., Populus spp.) on sandy terraces

G:1.112 Short-term flooded willow forests of white willow (*Salix alba*)

G:1.1121 Communities of the Salicetum albae association

G:2 Coniferous evergreen forests (Vaccinio-Piceetea, Erico-Pinetea, Pulsatillo-Pinetea)

G:2.2 Light coniferous forests

G:2.21 Boreal pine forests (Vaccinio-Piceetea)

G:2.214 Green-moss pine forests (Dicrano-Pinion)

G:2.2141 Communities of the Dicrano-Pinetum association

G:2.215 Dry pine-lichen forest (Cladonio-Pinion)

G:2.2151 Communities of the Peucedano-Pinetum association on elevations of pine forest terraces of moraine-outwash and weakly undulating outwash plains

G:2.22 Forests of continental type with Scots pine *Pinus sylvestris* (Pulsatillo-Pinetea)

G:2.221 Pine forests with a steppe grass stand (Pulsatillo-Pinetea, Chamaecytiso-Pinion)

G:2.2211 Communities of the Hieracio pilosellae-Pinetum association

I. Biotopes formed by human economic activity

I:1 Gap-biotopes

I:1.1 Biotopes, formed at sites of forest felling and forest clearances

I:1.11 Biotopes of grassland communities, formed at sites of forest felling and forest clearances

I:1.111 Ruderal herbaceous communities, formed at sites of fires and forest clearances

I:1.1111 Communities of the Senecioni sylvatici-Epilobietum angustifolii association

I:1.112 Ruderal shrubs, formed at sites of forest felling and forest clearances

I:1.2 Ruderal fallows and abandoned lands (lawns, gardens) biotopes

I:1.21 Herbaceous communities on abandoned lands

I:1.212 Herbaceous communities of fallows on abandoned lands of arid areas

I:1.2121 Communities of the Atriplicetum nitentis association

I:1.2122 Communities of the Atriplicetum tataricae association

I:1.22 Sparse thickets of shrubs and trees on the fallows

I:1.222 Thickets of shrubs and trees on the fallows of arid areas

I:1.2221 Communities of the Chelidonio-Acerion negundo association

I:2 Spontaneous biotopes under constant anthropogenic influence

I:2.1 Ruderal herbaceous biotopes

I:2.11 Ruderal communities of annuals and biennials

I:2.111 Communities of annual xerophytic grass

I:2.1111 Communities of the Brometum tectorum association

I:2.1112 Communities of the Hordeetum murini association

I:2.112 Communities of ruderal annuals and biennials on poor soils

I:2.1121 Communities of the Berteroetum incanae association

I:2.1122 Communities of the Tanaceto-Artemisietum vulgaris association

I:2.1123 Communities of the Xanthietum strumarii association

I:2.1124 Communities of the Atriplicetum nitentis association

I:2.1125 Communities of the Cynodontetum dactyli association

I:2.1126 Communities of the Sclerantho annui-Descurainietum sophiae association

I:2.113 Communities of ruderal annuals and biennials on rich soils

I:2.12 Ruderal communities of herbaceous perennials

I:2.121 Xerophytic ruderal communities of herbaceous perennials on nutrient-poor soils

I:2.1211 Communities of the Melilotetum albo-officinalis association

I:2.122 Mesoxerophyte ruderal herbaceous communities of the nitrophilous type

I:2.1221 Communities of the Chamaenerietum angustifolii association

I:2.123 Xeromesophyte ruderal herbaceous communities of thermophilic type

I:2.1231 Communities of the Ambrosio artemisiifoliae-Xanthietum strumariae association

I:2.13 Biotopes under excessive recreation influence

I:2.132 Trampled plots and communities of mechanically disturbed open, lighted areas on low-humus sandy loamy and sandy soils

I:2.1321 Communities of the Trifolio-Festucetum rubrae association

I:2.1322 Communities of the Ivaetum xanthiifoliae association

I:2.1323 Communities of the Digitario sanguinalis-Eragrostietum minoris association

I:2.1324 Communities of the Eragrostio minoris-Polygonetum arenastri association

I:2.1325 Communities of the Portulacetum oleracei association

I:3 Artificial biotopes, subjected to permanent strong influences

I:3.2 Artificial tree and shrub plantations

I:3.21 Tree stands (gardens, plantations, forest strips, alleys, parks)

I:3.212 Artificial plantations with a dominance of conifers

I:3.2121 Communities of the Impatienti parviflorae-Robinietum association

I:3.2122 Communities of the Chelidonio-Pinetum sylvestris association

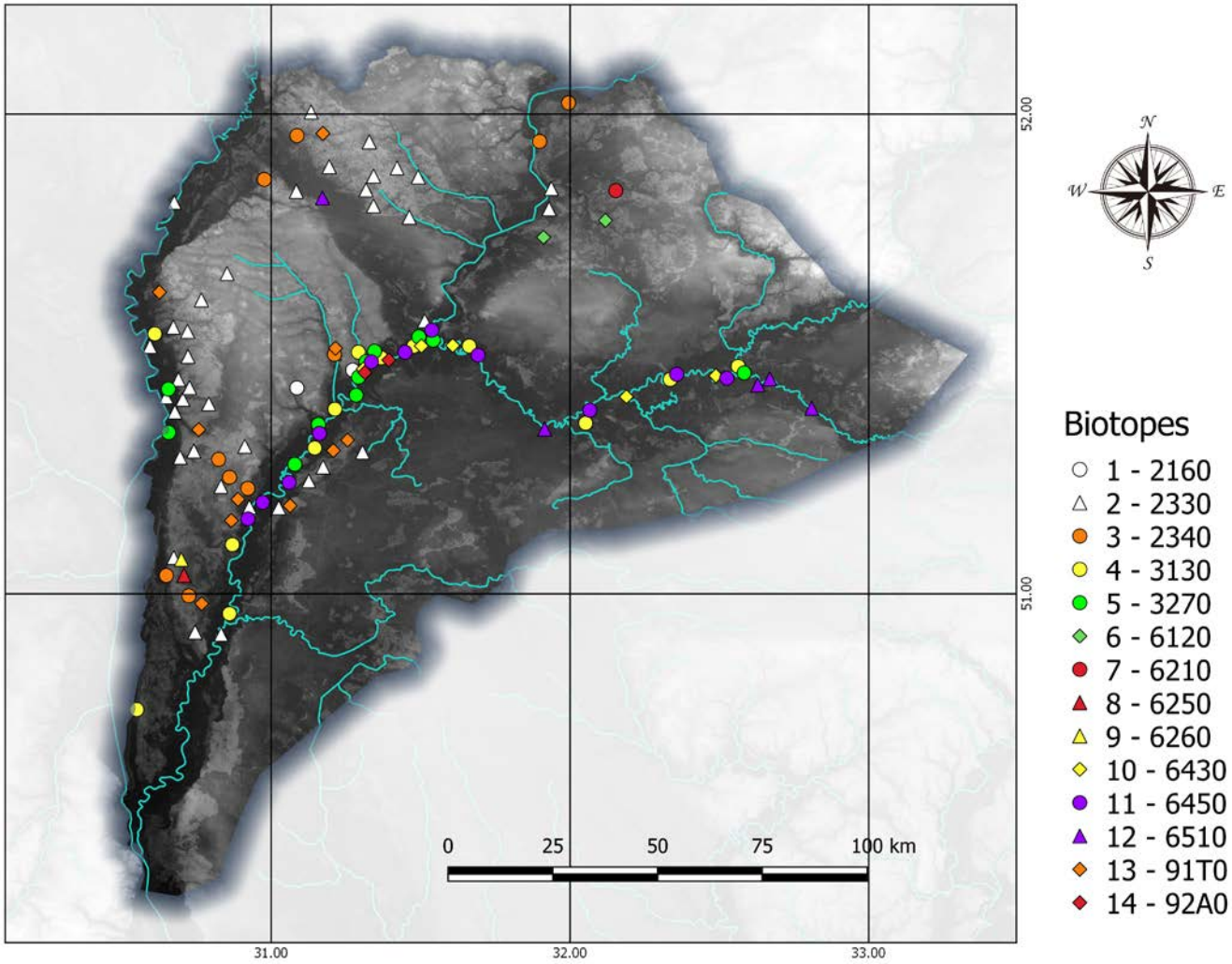

Fig. 3. Distribution of rare biotopes (Directive 92/43/EC) on the territory of Chernihiv Polesie. 1 Dunes with Hippophae rhamnoides, 2 Inland dunes with open Corynephorus and Agrostis grasslands, 3 Pannonic inland dunes, 4 Oligotrophic to mesotrophic standing waters with vegetation of the Isoëto-Nanojuncetea, 5 Rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation, 6 Xeric sand calcareous grasslands, 7 Semi-Natural dry grasslands and scrubland facies on calcareous substrates, 8 Pannonic loess steppic grasslands, 9 Pannonic sand steppes, 10 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels, 11 Northern boreal alluvial meadows, 12 Lowland hay meadows (Alopecurus pratensis, Sanguisorba officinalis), 13 Central European lichen Scots pine forests, 14 Salix alba and Populus alba galleries.

The ecological specificity of the region is reflected by the uneven categories distribution within some biotope types. If a name of a lower-level unit duplicates a name of a higher-level unit in the classification, then differentiation does not occur. The least differentiated biotopes are formed by shrub-type (F), as well as by forest-type biotopes (G). Type E (herbaceous and shrubby meso- and xerophytic biotopes), along with biotopes, formed by anthropogenic activity, are characterized by the highest degree of differentiation. It was determined by the historical and geographical features of the region and by edaphic factors.

The herbaceous xerophytic biotopes (wastelands) of the psammophytic type of the Koelerio-Corynephoretea class (E:3) are the most typical sand habitats for the Chernihiv Polesie. They develop mainly on pine forest terraces of the Dnipro and the Desna rivers. Biotopes of this class are confined to massifs of scattering dune and cumulus sands. Psammophyte communities, forming on continental dunes, have a low species diversity. Projective cover of *Corynephorus canescens* (L.) P. Beauv, which is the dominant species, is up to 40% there. These communities play a significant role in the process of sand overgrowing. At the initial development stages, biotopes E:3.11 are often formed by communities of the Polytrichion piliferi (more often) or Brachythecietum albicantis (less often) associations. Communities of the Corynephoro-Silenetum tataricae association are inherent to the pine forest terraces. *Thymus serpyllum* L., *Scabiosa ochroleuca* L., *Silene tatarica* (L.) Pers., and *Erigeron canadensis* L. form a herb layer. A lichen layer with Cladonia sp. (*Cladonia rangiformis* Hoffm., *C. arbuscula* (Wallr.) Flot.) is also represented. *Tragopogon ucrainicus* Artemczuk, protected on the regional level, occurs in these communities within the study area. The biotopes 2330 (inland dunes with open Corynephorus and Agrostis grasslands) are protected by the Council Directive 92/43/EEC of 21 May 1992 (Fig. 3).

In the EUNIS 2021 system, the communities of the Koelerion glaucae union (E3.12) are considered as Pontic inland dunes and Oceanic to subcontinental inland sand grassland on dry acid and neutral soils. They are quite common in the western regions of Eastern and Central Europe. In Chernihiv Polesie, those communities are richer in species composition than communities with grey hair-grass participation. They are formed by *Koeleria glauca* (Schrad.) DC. with projective cover of up to 35%, *Helichrysum arenarium* (L.) Moench, *Silene borysthenica* (Gruner) Walters, *Hieracium umbellatum* L., *Bassia laniflora* (S. G. Gmel.) A. J. Scott, *Oenothera biennis* L., *Plantago arenaria* Waldst. & Kit., *Sedum rupestre* L. Lichens of the Cladonia genus are also represented.

Landscapes with forest-steppe characteristics are common on the loess plains of Chernihiv Polesie. Indicator plants of forest-steppe and steppe in typical steppe biotopes are available on loess. These are large fragments of the relict steppe in the Polesie. Therefore, this part of the study region is characterized by psammophytic bunchgrass communities of the Artemisio arenariae-Festucion beckeri (E3.211) union, but with the participation of *Festuca polesica* Zapal. They are confined to the loess plains of the Dnipro-Desna interfluve and are quite rare. Those communities include *Stipa borysthenica* Prokudin. This species is a post-glacial relic and is under protection in many European countries such as Ukraine, Poland, Czech Republic and Slovakia (Baláž *et al*., 2001; Didukh, 2009; Grulich, 2012; Kaźmierczakowa *et al*., 2014).

Communities of different projective coverage (up to 85%) with dominating *Calamagrostis epigejos* (L.) Roth (E:3.221) are forming on open sand areas. They are low-species and mostly one-layered. Such communities also represent a successional stage of sand overgrowing. They can occur in pine forest clearings or areas affected by fires.

Low-species communities of the Hyperico perforati-Scleranthion perennis union (E:3.2421) with *Hieracium umbellatum* L., *Hypericum perforatum* L., *Hylotelephium maximum* (L.) Holub, *Sedum acre* L., *Verbascum lychnitis* L. participation are inherent to well-lit areas. Communities of the Thymo pulegioidis-Sedetum sexangularis association (E:3.2421) occur on cliffs and slopes.

Ephemeral ruderalized communities of Brometum tectorum (E:5.2111) are common both along roads and on slopes. They are the pioneer stages of overgrowing of sandy banks, slopes of dams and non-flooded plain areas on sandy, slightly sodded soils. They are dense or sparse xeromesophyte ruderal cenosis in the research territory.

Near-terrace communities of the Lysimachio vulgaris-Filipenduletum association (E 1.1111) are also inherent to Chernihiv Polesie. Those forb and grass communities are distributed along the Desna river. *Filipendula ulmaria* (L.) Maxim., *Lythrum salicaria* L., *L. virgatum* L. can occur in the communities.

Meadow habitats are represented by communities of the Potentillion anserinae (E1.121), the Deschampsion cespitosa, the Arrhenatherion elatioris (E1.122) and the Convolvulo arvensis-Agropyrion repentis (E1.311) associations. E1.121 biotopes take place on trampled riverbanks with sandy and sandy-loamy soils with slight salinity, with the grass layer projective coverage of up to 50%. Biotopes E1.122 are common in the foreshore part of river floodplains on sandy or dusty-sandy soils, as well as in elevations of the near-terrace areas. These biotopes are the least represented meadow habitats in the research area. E1.311 xeromesophytic communities are inherent to elevated elements of the foreshore part of floodplains on sandy loamy soils. *Koeleria delavignei* Domin, *Dianthus borbasii* Vandas, *Potentilla argentea* L., *Agrostis vinealis* Schreb occur in these communities.

Pine forest terraces are characterized by shrub and forest-type biotopes. Communities of the Peucedano-Pinetum association (F:3.3121) are characterized by the presence of *Cytisus ruthenicus* Woł., which forms shrub layer. Projective coverage of such communities is up to 55%. Such species as *Solidago virgaurea* L., *Polygonatum odoratum* (Mill.) Druce, *Festuca ovina* L., *Peucedanum oreoselinum* (L.) Moench, *Anthericum ramosum* L., *Rubus saxatilis* L. are forming the species composition. *Pulsatilla patens* (L.) Mill., a protected species included in the Red Book of Ukraine (Didukh, 2009), is often represented in the communities. This biotope is considered as S33 Lowland to montane temperate and submediterranean genistoid scrub in EUNIS 2021.

Communities of the Rubo caesii-Amorphion fruticosae association (F:5.1121) are distributed mainly on the Desna river terrace, but also occur sporadically, mainly in places of anthropogenic load. Communities of the Calamagrostio epigei-Hippophaetum rhamnoidis association (F:5.1241) are mostly distributed in urbanized areas, in places of active sand mining. Such species as *Calamagrostis epigejos* (L.) Roth, *Cynodon dactylon* (L.) Pers., *Elytrigia repens* (L.) Nevski, *Hippophaë rhamnoides* L., and occasionally *Centaurium pulchellum* (Sw.) Druce are typical for these communities. Such invasive species as *Ambrosia artemisiifolia* L., *Erigeron canadensis* L., *Solidago canadensis* L., *Grindelia squarrosa* (Pursh) Dunal occupy up to 20% of the projective cover on disturbed sandy soils.

Forest biotopes are represented by a pine forest. Fairly large areas are occupied by forests on elevations of pine forest terraces of moraine-outwash and weakly undulating outwash plains (G:2.2151). Communities of the Veronica incanae-Pinetum association are characterized by the participation of *Pinus sylvestris* L., *Campanula persicifolia* L., *Hieracium umbellatum* L., *Orthilia secunda* (L.) House, *Peucedanum oreoselinum* (L.) Moench, *Pilosella officinarum* Vaill. *Epipactis helleborine* (L.) Crantz, which is a Red Book species in Ukraine. This biotope is protected according to EU Directive 92/43 as 91T0 Central European lichen Scots pine forest (Fig. 3). In the Dnipro-Desna interfluve, there are biotopes of a green-moss pine forest of the Dicrano-Pinetum association (G:2.214). The communities are formed by *Calluna vulgaris* (L.) Hull, *Lycopodium clavatum* L., *Pleurozium schreberi* (Willd. ex Brid.) Mitt., *Solidago virgaurea* L., *Dicranum polysetum* Sw., *D. scopa-*

rium Hedw., *Melampyrum pratense* L., *Pilosella officinarum* Vaill., *Poa angustifolia* L., *Polytrichum juniperinum* Hedw., *Pinus sylvestris* L., *Lycopodium complanatum* L., which is included in the Red Book of Ukraine. These communities are considered as the Temperate continental *Pinus sylvestris* forest (T35) and the subcontinental moss *Pinus sylvestris* forests (T352111) in the EUNIS 2021 system. Biotopes of the pine forests with a steppificated grass stand (G:2.221) are also common in Chernihiv Polesie. Communities of the Hieracio pilosellae-Pinetum association (G:2.2211) are distributed in the pine forest terrace of the Dnipro River. Communities include *Jurinea cyanoides* (L.) Rchb., which is a regionally rare species. Biotopes 91U0 Sarmatic steppes *Pinus sylvestris* forests (Cytiso-Pinetalia) are protected by the CD 92/43 EEC (Fig. 3). Forest fringe areas are characterized by the presence of *Pyrus communis* L. The research areas are characterized by communities of artificial young (up to 40 years) pine plantations with poorly formed grass cover on dry, sandy, weakly podzolic soils of pine forest terraces (I:3.212). These communities belong to the Impatienti parviflorae-Robinietum association and are artificially created.

Biotopes of ruderal grass communities (I:1.111) and of shrub communities (I:1.112) formed at the forest fire sites and fillings; biotopes of grass communities (I:1.2121, I:2122), as well as sparse thickets of shrubs and trees on abandoned lands (I:1.2221) are widespread on sandy deposits of the Chernihiv Polesie. Ruderal communities of herbaceous perennials (I:2.12), with projective coverage of invasive species up to 50%, are forming mostly on elevated areas of terrain. Under the anthropogenic load, biotopes with excessive recreation influence (I:2.13) predominate. Biotopes of ruderal annual and biennial herbaceous plants (I:2.11) communities are widespread on sandy substrates. They occur throughout the territory of region, but more often – in the shore zone of the alluvial sandy areas. Invasive species can reach projective coverage up to 85% there. It could be suggested that these habitats are very sensitive to environmental factors (in particular, to moisture). Sandpits are centers of biotopes forming under human economic activity in Chernihiv Polesie.

Alluvial sands of the rivers (the Desna, the Dnipro) are a specific substrate, on which waterlogged biotopes of the grass-type water-fringe vegetation are forming. These biotopes (of D type) are well differentiated and reflect successive overgrowing stages of alluvial sands. Presence of a dense water network determines the development of biotopes of bare or sparsely vegetated shores of water bodies, forming under conditions of permanent changes in substrate moisture. Biotopes of the Isoëto-Nanojuncetea class (D:1.31) are represented along the banks of the Desna and the Dnipro rivers. These communities correspond to biotopes 3130 (Fig. 3), according to the CD 92/43 EEC classification: C3.5 periodically inundated shores with pioneer and ephemeral vegetation. Communities of the Cyperetum micheliani association are alluvial sand pioneers. On the territory of Chernihiv Polesie, these communities are dominated by *Cyperus fuscus* L., *C. michelianus* (L.) Link, *Gnaphalium uliginosum* L., *Juncus bufonius* L., *Rorippa brachycarpa* (C. A. Mey.) Hayek, *Cyperus flavescens* L., *Sagina procumbens* L., *Pulicaria vulgaris* Gaertn. Communities of the Juncetum bufonii association (D:1.3122) are diagnosed by *Juncus bufonius* L., and communities of the Stellario uliginosae-Isolepidetum setaceae association (D:1.3123) are diagnosed by *Centaurium pulchellum* (Sw.) Druce, *Eleocharis uniglumis* (Link) Schult., *Juncus bufonius* L., *Spergularia rubra* (L.) J. Presl & C. Presl, *Gypsophila muralis* L., *Veronica scutellata* L. These habitats are especially sensitive to environmental changes.

The riverside areas of the Desna River are overgrown with communities of Petasites spp. participation (D:1.331). These communities are most often monodominated and have few species. *Petasites spurius* (Retz.) Rchb is dominant. *Xanthium orientale* L. with a cover of up to 35%, *Erigeron canadensis* L. and solitary specimens of *Rumex confertus* Willd. occur in near-terrace depressions. *Xanthium strumarium* L. can also occur, but rarely. *Populus tremula* L. and *P. alba* L. are present in the communities on higher parts of the terraces slopes.

Biotopes of nitrophilous therophytes of the Bidentetea tripartitae class (D:1.22) are forming on the shore sand on silty and silty-sandy substrates. Communities of the Bidenti frondosae-Atriplicetum prostratae (D:1.2211) and Xanthio riparii-Chenopodietum rubri (D:1.2212) associations occur throughout the study area. The biotope is considered as C3.5 periodically inundated shores with pioneer and ephemeral vegetation in the EUNIS system.

On shallow water areas with a weak current, communities of the Oenanthion aquaticae union (D:1.211) are common. These communities are not dense; they have a projective coverage of up to 55% within the research area. The communities are spread in small patches with *Alisma plantago-aquatica* L., *Butomus umbellatus* L., *Oenanthe aquatica* (L.) Poir., *Sagittaria sagittifolia* L., and *Rumex hydrolapathum* Huds participation.

Communities of tall herbaceous helophytes (D:1.111) are forming during the next overgrowing stage of shallow water bodies. They are represented by Typhetum laxmannii, Typhetum latifoliae, Typhetum angustifoliae, Glycerietum maximae, Sparganietum erecti, Scolochloetum festucaceae (rarely), Caricetum elatae, Caricetum acutiformis, Cicuto virosae-Caricetum pseudocyperi and Calletum palustris associations. Various aquatic and meadow-swamp species are present. It is important to note that communities with the *Phragmites australis* (Cav.) Steud., *Typha latifolia* L. or *T. angustifolia* L. dominance are low-species and monodominant, form shore strips and are difficult to pass. Communities with the participation of *Typha laxmannii* Lepech. (D:1.1111) are represented in one locality only (on the artificial alluvium).

Communities of Salicetum pentandro-cinereae (F:1.2121) occur on silty-sandy overmoistened soils. These shrub biotopes of the Salicetum triandrae association (F:5.1111) communities form riparian forests, dominated by willows and poplars (Salix spp., Populus spp.) on sandy terraces.

CONCLUSIONS

The classification scheme of sandy biotopes of the Chernihiv Polesie (Northern Ukraine) of the IV–VI levels, characterizing community diversity and developed according to European Nature Information System (EUNIS 2012, 2021), A classification of Palaearctic habitats, Council Directive 92/43/EEC of 21 May 1992, and National Habitat Catalogue of Ukraine. The biotopes of grass, as well as shrub and forest communities, are represented. Extreme habitats turned out to be the poorest in terms of species composition. Fourteen sandy soils biotopes in the Chernihiv Polesie, protected with the Council Directive 92/43/EEC of 21 May 1992, were identified: 2160 dunes with *Hippophaë rhamnoides*; 2330 Inland dunes with open Corynephorus and Agrostis grasslands; 2340 pannonic inland dunes; 3130 oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea; 3270 rivers with muddy banks with Chenopodion rubri p.p. and Bidention p.p. vegetation; 6120 xeric sand calcareous grasslands; 6210 semi-natural dry grasslands and scrubland facies on calcareous substrates; 6250 pannonic loess steppic grasslands; 6260 pannonic sand steppes; 6430 hydrophilous tall herb fringe communities of plains and of the montane to alpine levels; 6450 northern boreal alluvial meadows; 6510 lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*); 91T0 Central European lichen Scots pine forests; 92A0 *Salix alba* and *Populus alba* galleries. Alluvial sands and pine forest terraces sands have their own overgrowth characteristics due to specific conditions of the region. Therefore, sandy biotopes require special monitoring, protection and development of conservation measures. Such an approach is necessary for ecological network development, creating a cadaster and land assessment, and improving the system of the protected objects. Research continuation, besides the investigation of the current state of biotopes, will allow also to identify threats to the biotope development. Development of the management plan for the use of Chernihiv Polesie natural resources, without biodiversity harming, is an important task for further research.

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