MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY
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ENGINEERING AND TECHNOLOGIES
DEPARTMENT OF ENVIRONMENTAL SCIENCE

APPROVED TO DEFENCE
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«_____» _____ 2022

BACHELOR THESIS

(EXPLANATORY NOTE)

SPECIALTY 101 "ECOLOGY",
EDUCATIONAL AND PROFESSIONAL PROGRAM:
"ECOLOGY AND ENVIRONMENT PROTECTION"

Theme: **«Dynamics of the landscape complexes changes at the border area of the north-east of Ukraine»**

Done by: student of EK-411 group, Tetiana V. Karpenko
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KYIV 2022

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ
ФАКУЛЬТЕТ ЕКОЛОГІЧНОЇ БЕЗПЕКИ, ІНЖЕНЕРІЇ ТА ТЕХНОЛОГІЙ
КАФЕДРА ЕКОЛОГІЇ

ДОПУСТИТИ ДО ЗАХИСТУ
Завідувач випускової кафедри
_____ Т. В. Дудар
«_____» _____ 2022 р.

ДИПЛОМНА РОБОТА

(ПОЯСНЮВАЛЬНА ЗАПИСКА)

ВИПУСКНИКА ОСВІТНЬОГО СТУПЕНЯ БАКАЛАВРА

ЗА СПЕЦІАЛЬНІСТЮ 101 «ЕКОЛОГІЯ»
ОПП «ЕКОЛОГІЯ ТА ОХОРОНА НАВКОЛИШНЬОГО СЕРЕДОВИЩА»

Тема: «Динаміка змінення ландшафтних комплексів прикордонної території північного сходу України»

Виконавець: студентка групи ЕК-411, Карпенко Тетяна Володимирівна
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Department of Environmental Science
Specialty, Educational and Professional Program: specialty 101 "Ecology", Educational and Professional Program: "Ecology and Environment Protection"
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«____» _____ 2022

BACHELOR THESIS ASSIGNMENT
Tetiana V. Karpenko

1. Theme: « Dynamics of the landscape complexes changes at the border area of the north-east of Ukraine » approved by the Rector on April 18, 2022, № 388/ст.

2. Duration of work: from 23.05.2022 to 19.06.2022.

3. Output work (project): data on the landscapes of Novgorod-Siverske Polissya, multispectral images of the Landsat-7 satellites, images of Google Earth.

4. Content of explanatory note: (list of issues): relevance of the study of the dynamics of landscape complexes of the Novgorod-Siverske Polissya in the context of sustainable nature management. Dynamics of landscape complexes in the border area of Novgorod-Severskу Polissya.

5. The list of mandatory graphic (illustrated materials): tables, figures .

6. Schedule of thesis fulfillment

№ з/п	Task	Term	Advisor's signature
1	Receive themes task, search the literature and legislation	08.04.2022	
2	Preparing the main part (Chapter I)	23.05-29.05.2022	
3	Preparing the main part (Chapter II)	30.06-04.06.2022	
4	Formulating conclusions and recommendations of the thesis	05.06.2022	
5	Making an explanatory note to the previous presentation of the department, consultation with the norms controller	05.06 -07.06.2022	
6	Presentation of the work at the department	08.06.2022	
7	Taking into account the comments and recommendations and training to protect	09.06 -13.06.2022	
8	Thesis defense at the department	14/15/16.06.2022	

7. Date of task issue: « 08 » April 20 22 .

Diploma (project) advisor: _____ Dudar T.V.
(advisor's signature) (S.N.P.)

Task is taken to perform: _____ Karpenko T.V.
(graduate's signature) (S.N.P

НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ
Факультет екологічної безпеки, інженерії та технологій
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Спеціальність, освітньо-професійна програма: спеціальність 101 «Екологія», ОПП «Екологія та охорона навколишнього середовища»
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ЗАТВЕРДЖУЮ
Завідувач кафедри
_____Дудар Т. В.
«____» _____ 2022 р.

ЗАВДАННЯ
на виконання дипломної роботи
Карпенко Тетяни Володимирівни

1. Тема роботи «Динаміка змінення ландшафтних комплексів прикордонної території північного сходу України»
затверджена наказом ректора від «18» квітня 2022р. № 388/ ст

2. Термін виконання роботи: з 23.05.2022 по 19.06.2022.

3. Вихідні дані роботи: дані про ландшафти Новгород-Сіверського Полісся, багатоспектральні знімки супутників Landsat-7, знімки Google Earth.

4. Зміст пояснювальної записки: актуальність дослідження динаміки ландшафтних комплексів новгород-сіверського полісся в контексті збалансованого природокористування. Динаміка ландшафтних комплексів прикордонної території новгород-сіверського полісся.

5. Перелік обов’язкового графічного (ілюстративного) матеріалу: таблиці, рисунки

6. Календарний план-графік

№ з/п	Завдання	Термін виконання	Підпис керівника
1	Отримання теми завдання, пошук літературних джерел та законодавчої бази	08.04.2022	
2	Підготовка основної частини (Розділ І)	23.05-29.05.2022	
3	Підготовка основної частини (Розділ ІІ)	30.06-04.06.2022	
4	Формулювання висновків та рекомендацій дипломної роботи	05.06.2022	
5	Оформлення пояснювальної записки до попереднього представлення на кафедрі, консультація з нормоконтролером	05.06 -07.06.2022	
6	Представлення роботи на кафедрі	08.06.2022	
7	Урахування зауважень, рекомендацій та підготовка до захисту	09.06 -13.06.2022	
8	Захист дипломної роботи на кафедрі	14/15/16.06.2022	

7. Дата видачі завдання: «__08__» __квітня__ 20 22 р.

Керівник дипломної роботи (проекту): _____ Дудар Т.В.

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(підпис випускника) (П.І.Б.)

ABSTRACT

Explanatory note to thesis « Dynamics of the landscape complexes changes at the border area of the north-east of Ukraine »: _48_ pages, _17_ figures, _4_ tables, _20_ references.

Object of research – dynamics of landscape complexes on the example of the border area of Novgorod-Siverske Polissya

Aim of work – to reflect the dynamics of landscape complexes for a specific period to improve the management of border areas and understand the further rational use of nature.

Mehods of research: methods of remote sensing of the Earth, analytical, statistical methods of data processing.

The paper developed a classification and analyzed the qualitative and quantitative dynamics of changes in landscape complexes of the border area. The results of the study are implemented for teaching disciplines of educational and scientific program (RPS) "Remote Aerospace Research" in the specialty 103 - Earth Sciences and conducting practical classes with students of the Department of Ecology NAU, and can be used by the administration of Novgorod-Siverskaya OTG.

DYNAMICS OF CHANGE OF LANDSCAPE COMPLEXES, REMOTE METHODS, SANKEY DIAGRAM, BORDER AREAS, WETLANDS. FLOODING, NOVGOROD-SIVERSKE POLISSYA.

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LIST OF SYMBOLIC NOTATIONS, ABBREVIATIONS AND NOTIONS

NNP - National Nature Park;

UTC - United Territorial Community;

MSS - Multispectral Scanner System;

OLI - Operational Land Imager;

TIRS - Thermal Infrared Sensor;

CCD - Charge-coupled device.

INTRODUCTION

Relevance of the work. The main feature of the territory of Novgorod-Siverske Polissya is that the district is located on the border of Ukraine, Russia and Belarus. The total length of the border with Russia in the Chernihiv region is more than 200 km. Territories adjacent to the state border differ in terms of social, economic, ethnicity, and in terms of location and development of various natural groups. This paper considers natural complexes, which with the strengthening of economic impact on nature suffer both from the peculiarities of nature management and intensification of anthropogenic impact, and from changes in natural climatic conditions. Therefore, there is a need for deeper knowledge about the natural potential of landscapes and directions of its use, as well as the patterns of changes in natural complexes in time and space in order to provide information on quality management of modern united territorial communities.

Aim and tasks of the diploma work

Aim of the work – to reflect the dynamics of landscape complexes for a specific period to improve the management of border areas and understand the further rational use of nature.

Tasks of the work:

1. To analyze natural-anthropogenic and anthropogenic landscape complexes, as well as objects of nature reserve fund located on the border territory of Novgorod-Siversky Polissya;

2. With the help of the original multi-spectral space images to perform the classification of landscape coverings of the territory as of 1986 and 2018;

3. To analyze qualitatively and quantitatively and map the dynamics of changes in landscape cover for the period of 32 years (from 1986 to 2018); to build a Sanka diagram and the resulting map of the transformation of the earth's crust, reflecting the basic patterns of dynamics of landscape complexes.

Object of research is dynamics of landscape complexes on the example of the border area of Novgorod-Siverske Polissya.

Subject of research is classification, analysis and mapping of landscape coverings by remote methods using modern means of information processing and presentation.

Methods of research **–** methods of remote sensing of the Earth, analytical, statistical methods of data processing.

Personal contribution of the graduate: analysis of scientific literature on the topic of work, personal inspection of some territories, conducting practical research on the basis of the Center for Aerospace Research IGN NAS of Ukraine, processing and analysis of results, preparation for implementation of research results under the joint agreement on scientific and technical cooperation between NAU and CACD .2018 p.

Approbation of results: Екологічна безпека держави (Київ, 2020, 2021); Екологія, неоекологія, охорона навколишнього середовища та збалансоване природокористування (Харків, 2021); Галузеві проблеми екологічної безпеки – 2021 (Харків, 2021).

Publications*:* "Екологічний стан Мезинського національного природного парку". Екологічна безпека держави. Матеріали XIV Всеукраїнської науково-практичної конференції молодих вчених і студентів. Київ. 2020. С. 75.; "Особливості екологічного моніторингу Новгород-Сіверського району Чернігівської області". Матеріали XV Всеукраїнської науково-практичної конференції молодих вчених і студентів. Київ. 2021. С.49.; "Оцінка змін покриву земної поверхні за допомогою методів дистанційного зондування Землі". Збірка матеріалів: Міжнародна науково-практична конференція за участю молодих науковців «Галузеві проблеми екологічної безпеки – 2021» 27 жовтня 2021, Харків. С. 67-70.; "Current ecological condition of water resources of Ukraine". Матеріали IX міжнародної наукової конференції молодих вчених. 25-26 листопада, Харків. С. 198-199.

CHAPTER 1
URGENCY OF RESEARCH OF DYNAMICS OF LANDSCAPE COMPLEXES OF NOVGOROD-SIVERSKE POLISSY IN THE CONTEXT OF BALANCED NATURE MANAGEMENT

1.1. Novgorod-Siverske Polissya as a border physical and geographical region of Ukrainian Polissya

Novgorod-Siverske Polissya is a natural region of Polissya (mixed-forest) physical-geographical province (Fig. 1.1.) [1]. It is located in the extreme east of the Dnieper lowland and on the low slope of the Middle Russian Uplands, within the Chernihiv and Sumy regions. The main feature of this territory is that it is located on the border of Ukraine, Russia and Belarus. With the strengthening of economic impact on nature, there is a need for deeper knowledge of the natural potential of landscapes and directions of its use, and the patterns of changes in natural complexes as a result of anthropogenic activities [2].

Geographically, Novgorod-Siverske Polissya is connected with the south-western slope of the Voronezh massif.

Fig.1.1. Map of Ukrainian Polissya

Landscape features of Novgorod-Siverske Polissya are due to the peculiarities of geological and geomorphological conditions - the spread of chalk deposits, which in many

places on the day surface, low thickness of anthropogenic sediments, significant depth (up to 100 m) and density of erosive surface dismemberment (the density of the ravine-beam network sometimes exceeds 1 km / km²), insignificant depth of groundwater and more continental climate (compared to other areas of the zone).

Among the landscapes of mixed forests (over 80% of the area) are dominated by moraine-water-glacial, characterized by afforestation (over 30%) and wetlands (up to 20%), the development of passable valleys and karst depressions. The background tracts here are flat and slightly undulating interfluves, composed of low-density sands with layers of gleyed sands with sod-slightly podzolic soils under the cathedrals and weakly cut wide swampy valleys occupied by lowland peatlands [3].

Forest-steppe landscapes (occupying more than 15%) are represented here by highly indented forest plains, located in small areas, mainly on the right bank of the Desna. Typical here are complex tracts of fresh and raw deep beams with steep slopes with hornbeam-oak and maple-linden-oak forests, sometimes with sabors.

Floodplains (about 5%) are well developed in the Desna Valley, as well as its left-bank tributaries; they are mostly used for hayfields and pastures. Widespread high undulating, narrow floodplains with turf low-gley soils under grass-grass meadows and low, flat, extended floodplains, composed of lowland peatlands under wet-grass-sedge groups, with swampy terraced complexes under black alder forests [4].

1.2. Natural conditions and features of Novgorod-Siverske Polissya

As mentioned above, geographically, this area is located on the slope of the Voronezh Shield, the southern and central are connected with the rift zone and the northern side of the Dnieper-Donetsk basin.

The climate of Severske Polissya is temperate-continental, with rather warm summers and relatively mild winters. The northern part of the region is located in a moderately warm humid agroclimatic zone (up to 650 mm of precipitation per year), and the southern part is located in a warm, insufficiently humidified zone (up to 450 mm of

precipitation per year). The boundary between agro-climatic zones almost corresponds to the zonal border "Polissya - Forest-Steppe". The average temperature in January is from -7 C ° to -8 C °, and in July +19 ... + 19.5 C °. The duration of the frost-free period in the region is: in the air - 160 -180 days, on the ground - 140 - 150 days. Most precipitation falls during the warm season. Among the unfavorable natural processes that negatively affect agriculture, the most affected are droughts, which are more common in May and August and last 5-9 days, as well as droughts that occur in the same months, but not annually (after 2-3 years) [2].

On the territory of Severske Polissya there are almost all types of soils that are characteristic of Polissya and the Forest-Steppe of Ukraine. The most common Polissya sod-podzolic soils; gray, dark gray forest and nearby podzolic chernozems; low-humus leached chernozems and low-humus chernozems typical for forest-steppe. Soils of meadows, swamps, as well as peat soils are distributed in some areas.

Novgorod-Siverske Polissya with an area of 5.5 thousand km occupies the northeastern part of the region. It is based on the Pridesnya forest erosion-denudation plateau with numerous deep ravines, which are cut into the native Cretaceous rocks. There are also karst depths. Arable land here occupies about 45% of the area.

The plant world includes more than 900 species of vascular plants, which is about 18.4% of the total number of vascular plants distributed in Ukraine [5].

The fauna is characterized by an even richer species composition, which is about 41% of the all-Ukrainian. Thus, the simplest 600 species are widespread in the territory; arthropods - 1500 species; fish - 50, amphibians - 11 species; reptiles - 7 species; birds - 286 species; mammals - 48 species. Novgorod-Siverske Polissya is characterized by various river-valley (floodplain, terrace, terrace) and inter-river (watershed) natural areas, which are variously preserved. Among them are close to the primary forest landscapes, and greatly altered by reclamation systems meadows and swamps [6-8].

The Desna Basin is characterized by a narrow (from 2 to 10 km, in some places more) strip of forests in the middle and lower reaches; fragmented forests are distributed in the floodplains of the Desna and Snova, on the Left Bank of the Desna above Chernihiv;

on its Right Bank - the whole of Novgorod-Siverskoye Polissya and the north-east of Chernihiv Polissya are marked by considerable afforestation. The floodplain complexes of Desna, Seym, Revna, Snova, Sozh, Dnieper to the top of the Kyiv Reservoir, some small rivers, the basins of which have not been affected or little transformed by land reclamation, are also well preserved.

1.3. Landscape features of the study area

The landscapes of Novgorod-Siverske Polissya (Fig. 1.2.) are in transition from Polissya (79.2%) to the northern forest-steppe (about 15%).

Under natural conditions, Novgorod-Siverske Polissya differs significantly from Chernihiv in its unique geostructural position, has a different geological structure, which affects the relief, hydrological conditions, soil formation processes.

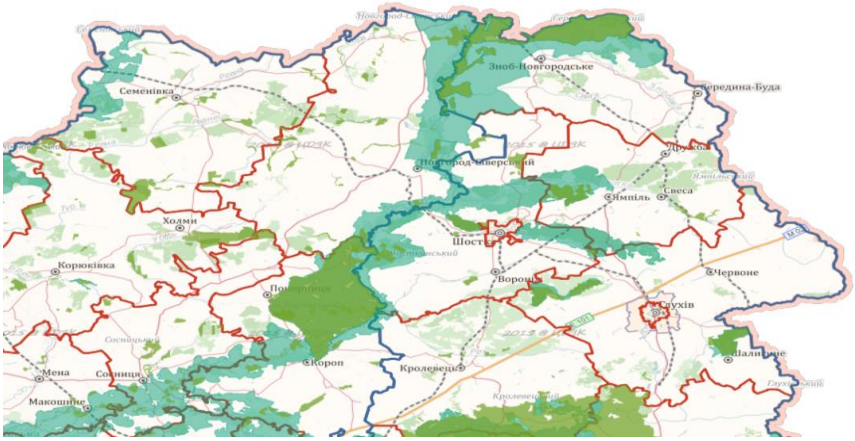


Fig.1.2. Administrative zoning of Novgorod-Siverske Polissya

Novgorod-Siverske Polissya is located on the southwestern slope of the Voronezh crystalline massif. The depth of the foundation varies from 100 (Znobivka river basin) to 400-900 m (Novgorod-Siverske - 384 m, Hills, Carp). The foundation is covered with low-strength sediments of the Upper Paleozoic and Meso-Cenozoic, which occur monoclinically. Particularly characteristic of the Cretaceous rocks, represented by marl and chalk. They are high above the local base of erosion, often exposed in river valleys, and in many places on the Cretaceous preserved Paleogene deposits, which have little

thickness. Most often, Cretaceous sediments are overlain by a small layer of anthropogenic sediments, which are represented by moraine, water-glacial, alluvial sediments and forest-like loams.

Part of Novgorod-Siverske Polissya by the nature of the relief - eroded hill. River valleys here cut deep into the native rocks. On the slopes of the valleys developed ravines and gullies. On the Cretaceous deposits formed karst landforms - funnels and dips. As in other physical-geographical areas, the processes of deep water erosion develop on forest "islands" and partly on the riparian areas of moraine-sander plains. Erosion activity is especially active on the right bank of the Desna and spurs of the Middle Russian Uplands.

Landscape features of Novgorod-Siverske Polissya are due to the peculiarities of geological and geomorphological conditions - the spread of Cretaceous deposits, which in many places on the day surface, low thickness of anthropogenic sediments, significant depth up to 100 m and density of erosional dissection 1km/km², insignificant depth of groundwater and more continental climate compared to other areas of the zone.

Among mixed-forest landscapes, more than 80% of the region's area is dominated by moraine-water-glacial, characterized by more than 30% afforestation and up to 20% wetlands, the development of passable valleys and karst depressions. The background tracts here are flat and slightly undulating interfluves, composed of low-density sands with layers of gleyed sands with sod-slightly podzolic soils under the cathedrals and weakly cut wide swampy valleys occupied by lowland peatlands.

Forest-steppe landscapes occupy more than 15% of the territory, represented here by highly indented forest plains, located in small areas, mainly on the right bank of the Desna. Typical here are complex tracts of fresh and raw deep beams with steep slopes with hornbeam-oak and maple-linden-oak forests, sometimes with sabors.

Floodplains about 5% are well developed in the Desna Valley, as well as its left-bank tributaries; they are mostly used for hayfields and pastures. Widespread high undulating, narrow floodplains with turf low-gley soils under grass-grass meadows and low, flat, extended floodplains, composed of lowland peatlands under wet-grass-sedge groups, with swampy terraced complexes under black alder forests and sedges.

1.4. Nature Reserve Fund of Novgorod-Siverske Polissya

Nature Reserve Fund of Ukraine (NRF) - land and water areas, natural complexes and objects that have special environmental, scientific, aesthetic, recreational and other value and allocated to preserve the natural diversity of landscapes, gene pool of fauna and flora, maintaining the overall ecological balance and ensuring background monitoring of the environment. The nature reserve fund of Novgorod-Siversky Polissya is very large and valuable in terms of its special biodiversity. On the territory of Seversky Polissya there are nature protection objects, which are included in the Emerald Network (Fig. 1.3.) [9].

NAME	DESIG	DESIG_TYPE	IUCN_CAT
Verhnie Podesennia	Emerald Network	Regional	Not Reported
Shostkynskyi	Emerald Network	Regional	Not Reported
Shchorsivskyi	Emerald Network	Regional	Not Reported
Desniansko-Starohutskyi National Nature Park	Emerald Network	Regional	Not Reported
Mezynskyi National Nature Park	Emerald Network	Regional	Not Reported
Seredneseimskyi	Emerald Network	Regional	Not Reported
Shalyhynskyi Zakaznyk	Emerald Network	Regional	Not Reported
Verkhnioesmanskyi Zakaznyk	Emerald Network	Regional	Not Reported
Bohdanivskyi Zakaznyk	Emerald Network	Regional	Not Reported
Nyzhnie Podesennia	Emerald Network	Regional	Not Reported
Bretskyi Zakaznyk	Emerald Network	Regional	Not Reported
Chernihivske Podesennia	Emerald Network	Regional	Not Reported
Smiatsko-Znobivskyi	Emerald Network	Regional	Not Reported
Tern river valley	Emerald Network	Regional	Not Reported
Dolyna Snovu	Emerald Network	Regional	Not Reported
Dolyna Seimu	Emerald Network	Regional	Not Reported
Semenivskyi Snov	Emerald Network	Regional	Not Reported
Verkhn'oesmans'kiy	Regional Zakaznik	National	IV
Vershini	Regional Zakaznik	National	IV
Veshki	Regional Zakaznik	National	IV
Vishens'ka dacha	Regional Zakaznik	National	IV
Vol'nitsya	Regional Zakaznik	National	IV
Volodimirivs'ka dacha	Regional Zakaznik	National	IV
Voroniz'kiy	Regional Zakaznik	National	IV
Yancheve-Kozarivschina	Regional Zakaznik	National	IV
Yur'ivs'kiy	Regional Zakaznik	National	IV
Yurkivschina	Regional Zakaznik	National	IV
Zadesnyans'kiy	Regional Zakaznik	National	IV
Zaplavni ozera	Regional Zakaznik	National	IV
Zaymische	Regional Zakaznik	National	IV
Zaytsevs'ki sosni	Regional Zakaznik	National	IV
Zhayvoronok	Regional Zakaznik	National	IV
Zhornivs'kiy bir	Regional Zakaznik	National	IV
Zhovtiy bir	Regional Zakaznik	National	IV
Zhuklyans'ke	Regional Zakaznik	National	IV
Zorove	Regional Zakaznik	National	IV
Zyati	Regional Zakaznik	National	IV

Fig.1.3. Objects of the Novgorod-Siversky Polissya NPF included in the Emerald Network

The Emerald Network is the newest network of protected areas, which is being implemented in non-EU countries that have ratified the Berne Convention. The Emerald Network is an analogue of the Natura 2000 network, which is present in the EU and is designed to ensure adequate protection of species and habitats listed in Resolutions 4 and 6 of the Berne Convention. The formation of the Emerald Network in Ukraine is far from over. Nevertheless, the Emerald Network is a promising tool for the protection and

sustainable management of forests. The network aims to preserve species and ecosystems that have been recognized as rare throughout Europe. A list of them is available in Resolutions 4 and 6 of the Berne Convention. For example, black storks, lynxes, white-tailed eagles, brown bears and many other species are protected. Examples of protected settlements are the Cretaceous mountains of Slobozhanshchyna, virgin steppes, virgin forests, natural swamps, etc. The Emerald Territories should not be confused with the protected areas of Ukraine, which were created to protect rare animals, plants or ecosystems at the Ukrainian level. The emerald network and the existing protected areas will coexist, harmoniously complementing each other. The adoption of Bill 4461 will not affect the already created protected areas. The Council of Europe and the European Union, through the External Cooperation Office, launched in 2008 a new joint program of the Emerald Network, aimed at establishing the Emerald Network in six countries of the eastern sector of good neighborly cooperation between the EU and the Russian Federation. Its goal is to identify and protect natural habitats that should become part of the Emerald Network in Armenia, Azerbaijan, Belarus, Georgia, Moldova, Russia (the European part, including the North Caucasus) and Ukraine. At the same time, the definition and conservation of the Emerald Network within Ukraine in accordance with the requirements of the Convention on the Conservation of European Wildlife and Natural Habitats (Berne Convention) and taking into account the requirements of Directive № 2009/147 / EC on the Conservation of Wild Birds and Directive № 92/43 / EU on the conservation of natural habitats and species of natural fauna and flora, at this stage is not regulated at the legislative level [10].

The nature reserve fund is characterized by a significant number of objects of small area (more than half of the objects have an area of up to 100 hectares) [11]. Therefore, for better visibility, I have identified the main objects of the NPF and highlighted them on the map (Fig. 1.4.). Among all the objects of the NPF, I singled out two objects that deserve special attention because of their uniqueness - Mezyn National Nature Park and Desnyansko-Starogutsky [12].

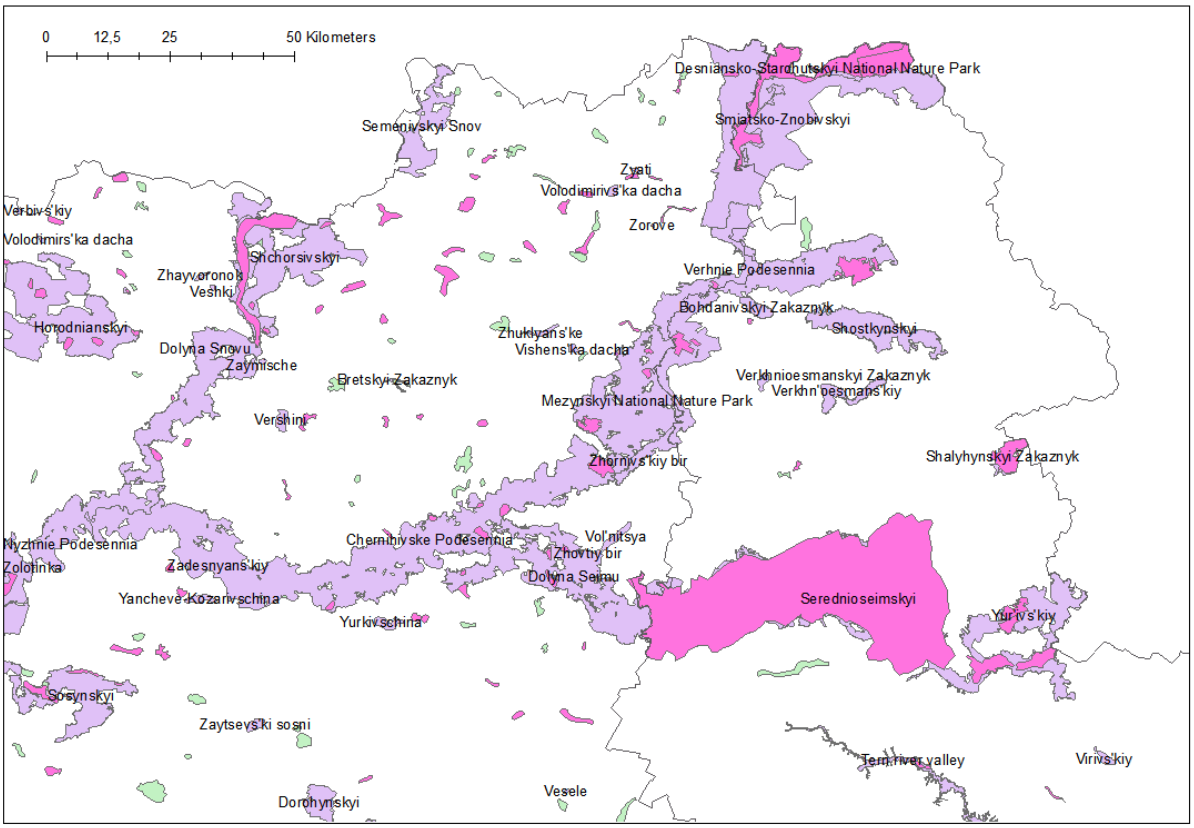


Fig.1.4. Novgorod-Siversky Polissya NRF facilities

Mezyn National Nature Park is a national nature park (NNP) in Ukraine, within the Korop district of the Chernihiv region. The territory of Mezyn National Natural Park belongs to Novgorod-Siversky Polissya, Novgorod-Siverske physical-geographical district and stretches along the right bank of the river Desna. Climatic conditions of the park, as well as the climate of Novgorod-Siverske Polissya, are more continental than in other Polissya regions. The territory of the Mezin National Nature Park includes the following objects of the NPF of Ukraine:

- Landscape reserve of national importance "Rykhlivska Dacha";
- “Zhukiv Yar” Landscape Reserve of Local Importance;
- Landscape Reserve of local significance "Zmiivshchyna";
- “Vyshenska Dacha” Forest Reserve of Local Importance;
- “Dubravka” Botanical Reserve of Local Importance;

- “Krynychne” Landscape Reserve of Local Importance;
- “Sverdlovsk” Landscape Reserve of Local Importance;
- Landscape reserve of local significance "Mezynska Switzerland";
- Botanical natural monument of local significance "Century-old oak";
- Botanical natural monument of local significance "Ancient spruce alley".

The main feature of the Mezyn NNP is that there are about 50 archeological monuments in the park. Among them is the world-famous Mezyn Paleolithic site, which is almost 20,000 years old. The village of Mezyn is located on the banks of the Desna, 47 km from the district center of Korop. In the village in 1908 a settlement of Cro-Magnons of the Late Paleolithic period was discovered - a tribal group of the matriarchy period. His main occupation is hunting wild animals. Remains of dwellings built of mammoth bones were found here. Of extraordinary value are the findings of works of ancient art - ornamented statuettes of mammoth tusks, animal figurines, meandering bracelets, a set of musical instruments made of animal bones, painted red ocher. Currently, an archeological museum operates on the site of the parking lot. Many monuments of different epochs and archeological cultures have been preserved in the villages of Buzhanka, Kurylivka, Sverdlovka, Radychiv, Chereshenky.

"Desnyansko-Starogutsky" NNP (Fig. 1.5) [13] - environmental research institution. Specialists of the park maintain close relations with the Institute of Botany, Institute of Zoology National Academy of Sciences of Ukraine, universities of Sumy, Nizhyn, Chernihiv, Glukhov. The area of the park is 16,215.1 hectares, of which 7,272.6 hectares are provided to the park for permanent use. The National Park was created to preserve, reproduce and rationally use the landscapes of the Left Bank Polissya with typical and unique natural complexes. In the future, it should become part of the bilateral Ukrainian-Russian biosphere reserve "Starogutsky and Bryansk forests”. The Pridesnyan part of the park is a floodplain and pine terrace of the Desna River and its tributaries. The Desna floodplain, 2-4 km wide, is well defined along its entire length and extremely picturesque. It has many lakes, old lakes, wetlands. Desna floodplain within the national park is one of the best preserved natural floodplain complexes of large rivers in Ukraine. The pine

terrace is well developed and stretches along a wide strip along the floodplain. It has a hilly terrain and is covered mainly with pine and oak-pine forests. In the park Desna receives its left tributaries Znobivka and Sviga and the right tributary - Sudost.

The recreational potential of the park is huge due to the preserved floodplain of the Desna River, rich in fish, and the Starogutsky forest, rich in mushrooms and berries such as blueberries, cranberries, cranberries. In 1942, there was a outpost of S.A. Kovpak partisan detachment in the forests of Stara Guta. A historical monument was created on the basis of the remnants of the partisan dugout.

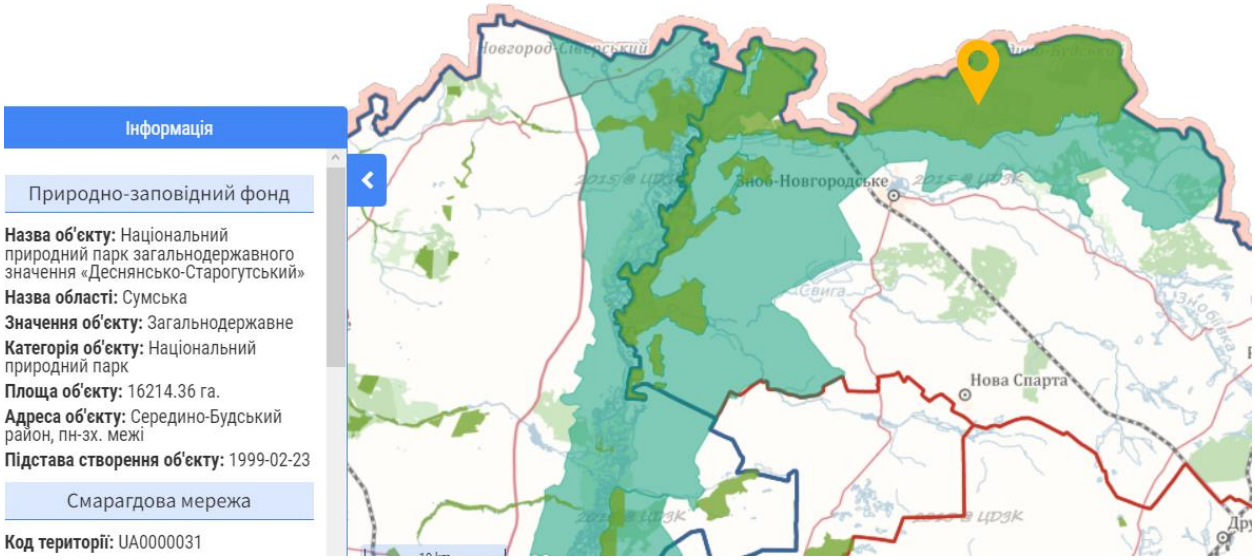


Рис.1.5. Desnyansko-Starogutsky National Nature Park of National Importance

1.5. Conclusion to Chapter

Thus, as a result of the analysis of landscapes of Novgorod-Siversky Polissya their diversity was established, the reasons of landscape features which were caused by features of geological and geomorphological conditions - distribution of the Cretaceous deposits leaving in many places on a day surface, insignificant thickness of anthropogenic deposits, considerable depth density of erosive dismemberment of the surface, insignificant depth of groundwater and more continental climate compared to other areas of the zone. Also, Novgorod-Siverskoye Polissya is famous for a large number of objects of the Nature Reserve Fund.

CHAPTER 2
DYNAMICS OF LANDSCAPE COMPLEXES OF THE BORDER TERRITORY OF NOVGOROD-SIVERSKE POLISSYA

2.1. Methods for assessing the dynamics of landscape complexes

2.1.1 Remote methods of land cover mapping

The study of the dynamics of landscape complexes was conducted using remote sensing methods (remote sensing) [14-16]. Remote sensing is a method of obtaining information about the earth's surface and objects located on it by registering the electromagnetic radiation reflected from them, without direct contact. Quite often, when we talk about remote sensing, we mean the removal of the earth from space. Meanwhile, this method of data collection includes aerial photography and aerial laser scanning.

The bulk of remote sensing data is obtained with the help of electronic devices that record the reflected solar radiation of the so-called charge-coupled devices. These devices allow you to record different ranges of reflected solar radiation in both the visible and ultraviolet and infrared spectral zones. On the basis of such elements, electronic scanning devices are created, which can be installed on various spacecraft designed to capture the atmosphere, ocean and land surface. In the case of radar systems, such satellites can determine the height and length of waves, water level, oil spills on the water surface. The satellites are used to observe the color and density of vegetation, the color and texture of soils, the color of water, and the temperature of the earth's surface. High-precision surveying for topographic mapping, radar surveying of the relief and moisture of the soil surface layer is carried out from space. Shoot continuously according to the route of the satellite, the data is constantly transmitted to ground stations. At the ground stations, the incoming information is processed: geometric correction is carried out (angular distortions of edge zones, linear distortions along the survey line, etc. are eliminated); radiometric

correction (eliminates interference that occurs during the collection, transmission and reception of data, atmospheric interference, equalizes the light); cutting into sections of a certain size, binding to the coordinate system, etc. Such materials can be transferred to the customer within a week after removal.

Data obtained by remote sensing of the earth from space and aerial photography are widely used in various fields of activity, and most importantly, with the help of these images you can create and update maps. There are several methods of remote mapping: photography, scanning, radar, thermal imaging, spectrometric imaging, lidar imaging.

Photography - photographing the surface in the entire visible range of the spectrum or a certain part of it, as well as in the infrared range. Widely used in aerial and space photography to obtain data for creating and updating maps.

Scanning - scanning the surface using optical or multispectral devices - scanners. The difference between such devices and conventional cameras is that the scanner moving along or along and across the shooting route gradually captures the reflection of the beam from the surface and directs it to the lens. When removing the surface with a scanner, an image is formed from individual elements (pixels), each of which corresponds to the brightness of the radiation of the surface.

Radar imaging is an active method of imaging that relies on radiation in the direction of the imaged surface of the signal and the reception of its reflection. Typically, radar imaging is performed in the radio range with the help of locator scanners (LBO). The advantage of this method is the ability to perform surveys in the dark and a slight effect of weather conditions: fog, clouds. Radar survey is used to determine the shape of the surface (relief) and study its geological structure. The use of active radar survey methods is the latest direction in the development of geomorphometry, which correlates with traditional morphometric relief analysis and is promising for remote mapping of the earth's surface.

Thermal imaging - shooting in the infrared range, based on the fixation of thermal radiation of the surface and objects caused by solar radiation or endogenous processes, and the detection of anomalies. Thermal imaging allows to detect elements of hydrography, to

study the geological structure of the surface, ice state, volcanic activity, temperature inhomogeneity of the aquatic environment, to identify the relief of the bottom.

Spectrometric survey - measurement of the reflectivity of the surface or layers of matter. Produced in the microwave, infrared, as well as in the visible and near infrared. It is used to study rocks.

Lidar imaging - active imaging of the surface by non-intrusive fixation of the reflection from the surface, which is irradiated with monochromatic laser radiation with a fixed wavelength. For the most part, lidar removal is performed from media with a very high altitude. The radiation frequency is adjusted to the resonant absorption frequencies of the scanned component and thus in the presence of significant concentrations of this component, the reflection increases significantly. It is used to study the lower atmosphere, to detect the concentration of certain elements and compounds.

In general, remote sensing data in geoecological research allow to address the following issues:

- clarification of the tectonic structure of the territory, in particular the allocation of folded and annular structures;
- clarification of the contours (geological boundaries) of geological bodies, taking into account the natural generalization;
- obtaining additional information on the patterns of mineral placement;
- geomorphological analysis, which includes general geomorphological and structural-geomorphological mapping, creation of three-dimensional terrain models (3D technology);
- assessment of neotectonic activity of the territory;
- geoecological research, including:
- assessment of landscape and ecological conditions;
- identification of geological processes and phenomena potentially dangerous to human life and activity, and forecast their development;

- identification of man-made complexes and objects that affect the geological environment;
- monitoring the state of geosystems;
- introduction of GIS technologies in the geological and cartographic process.

The use of geographic information technologies in the natural sciences allows not only to verify information, but also based on the concept of scientific education, to acquire a new, own system of knowledge and ideas about how our Earth "works" and how we affect it. Given the total computerization that already exists as a fact, and the trend towards deepening is more than obvious, the use of information technology in science education will not lose relevance. In the future, remote sensing methods will only be developed and improved.

2.1.2 Multispectral space images of Landsat satellites

Artificial satellites of the Earth - spacecraft that are launched into Earth orbit and their main purpose is to perform applied and scientific work. Satellites for the study of the Earth's natural resources are extremely promising for use in the economy. The launches of such resource satellites were based on international cooperation and national space programs - the American (LANDSAT, which has been developing since 1972), the French SPOT and the Indian IRS. The author of the photo basis for the creation of the program was a map from LANDSAT, which contains a significant number of images of the earth's surface since 1975. Also, the criterion for selecting image data was the separate activity of images and opportunities (possibility of practical use without involving a significant amount of financial resources): this figure in the LANDSAT series is 30 m.

Landsat is the longest-running project to produce satellite images of the planet Earth. The first satellite in this space program was launched in 1972; the last one at the moment is Landsat on February 8-11, 2013. The equipment installed on the Landsat satellites took billions of pictures. Images from the United States and satellite stations around the world are a unique resource for a wealth of research in agriculture, cartography, geology,

forestry, intelligence, education, and national security. For example, the Landsat 7 satellite delivers images in 8 spectral ranges with a spatial resolution of 15 to 60 meters per point; the frequency of data collection for the entire planet was initially 16-18 days.

The Landsat series satellites had the following shooting systems:

- Return Beam Vidicon multispectral camcorders (RVB; used on Landsat-1, -2; 3 channels, 80 meters)
- Panchromatic RVB camcorders (Landsat-3; 40 meters).
- Scanning multispectral scanner: MSS (Landsat-1, 2, 3, 4, 5)
- Scanning thematic scanner: TM (Landsat-4, 5)
- Improved thematic scanner: (Landsat-6)
- Improved thematic scanner plus: (Landsat-7)

The MSS Multispectral Scanners of the Landsat 1-5 satellites, created by the Santa Barbara Research Center (Hughes), are designed to obtain multispectral images of all the Earth's surface. MSS is an optomechanical system with a scanning mirror (74 ms period) and a reflector telescope with the Ritchey-Chretien system with a mirror diameter of 22.9 cm. Spatial resolution of 80 meters, spectral ranges: 0.5 - 0.6 μm (green).), 0.7 - 0.8 μm, 0.8 - 1.1 μm. Detector calibration comes from every 2 scans.

The quartz mirrors of the telescope are mounted on invar rods. The system is designed so as not to lose focus even in strong vibration created by the 36 cm beryllium oscillating scanning mirror. This engineering solution allowed the United States to launch LANDSAT satellites 5 years earlier than the French remote sensing satellite SPOT (1986 [15]), which used a two-dimensional array of CCD sensors for the first time and did not require a scanning system. Assembly in the focal plane of the MSS tool consists of 24 dielectric waveguides (optical fibers) with extruded ends of 5 μm, organized by a 4x6 array. The fiber bundle brings light to 6 silicon photodiodes and 18 photomultiplier tubes. Each of the 4 spectral ranges used its own set of 6 detectors. Radiometric resolution of each detector is 0-255.

Unlike previous satellites, the LandSat-8 (called Landsat Data Continuity Mission), tested by Orbital Sciences Corporation in Arizona, uses a Push broom scanner with linear sensors instead of a scanning mirror, a development of the ALI system tested on satellite Earth Observing-1. In the focal plane of the main instrument of the Operational Land Imager (OLI) mission, 14 Focal Plane Modules are installed, and 10 linear sensors of different ranges are installed in each module. The OLI telescope consists of 4 fixed mirrors. The Thermal Infrared Sensor (TIRS) uses a similar scheme with 3 modules in the focal plane and a separate telescope with 4 lenses made of germanium and zinc selenide.

2.2. Classification of landscape complexes of Novgorod-Siverske Polissya

Landscape classification is of great organizational importance as a basis for research, mapping and scientific description of landscapes. Great and practical importance of typological classification of landscapes. For practical purposes (for example, when assessing natural conditions for agricultural development or for reclamation or conservation measures), it may be too difficult and even impractical to study and assess each landscape separately. More often it is necessary to develop certain standard norms or measures in relation to typical natural conditions, ie to some, if possible not very large number of landscape groups. Here comes to the aid of a classification in which many landscapes are grouped into a number of species, types, classes, and so on.

One of the main tasks of my research work was to correctly classify the landscapes of Novgorod-Siversky Polissya so that the classification covers all landscape objects. During the processing of space images, the initial landscape objects were identified: water, wetlands, coniferous and mixed forests, fields, agricultural lands, abandoned lands, cultivated lands, artificial surfaces (Table 2.1).

For the best result of the study, agricultural lands, fields, abandoned areas, cultivated fields, artificial surfaces were combined into one class - anthropogenic landscapes (Table 2.2). This was done in order to avoid gross errors in the classification of the territory,

because the above classes of landscapes are very difficult to distinguish during the processing of images, but in any case they are anthropogenic.

Table 2.1

Classification of landscapes of Novgorod-Siverske Polissya

LC Class	1986 (ha)	2018 (ha)
Water	2583,18	2754,99
Wetlands	23676,57	85143,69
Forest conif	93633,12	123833,07
Forest decid	91860,03	100434,96
Artificial	111420,18	164514,42
Field1+Field2	183052,08	129387,6
Baren+Baren2	151635,78	57767,49
Grass	44139,06	38163,78

Table 2.2

Landscape classes are grouped for further analysis of their dynamics

Landscape classes	1986 (га)	2018 (га)
Natural Landscapes		
Water	2583,18	2754,99
Wetlands	23676,57	85143,69
Forest conif	93633,12	123833,07
Forest decid	91860,03	100434,96
Grass	44139,06	38163,78
Human-induced Landscapes	446108,04	351669,51

For the best result of comparison of change of landscape complexes of the territory it is necessary to take the bigger range in time. In my case, I decided to investigate the changes in the territory that occurred from 1986 to 2018 (changes over 32 years). Table 2.2. shows very well which landscapes have changed the most: wetlands, anthropogenic landscapes and coniferous forests.

Wetlands are areas where the soil is an aquifer with constant or seasonal humidity. On the territory of Novgorod-Siverske Polissya the territory of this class of landscape from 1986 to 2018 increased significantly (from 23676 ha to 85143 ha). Wetlands are one of the most productive ecosystems on the planet. They are a source of biodiversity, water and primary productivity on which many species of plants and animals depend, as well as maintain high concentrations of many species of birds, mammals, amphibians, fish and invertebrates and preserve genetic material. In addition, wetlands provide important and sometimes necessary ecosystem services to ensure the health, well-being and safety of people living within, near, and in some places, even globally. The interaction of physical, biological and chemical components, such as soil, water, plants and animals, allows wetlands to provide many vital ecosystem services. The number of wetlands is growing due to the active waterlogging of floodplains and due to the lack of drainage system in the region.

Anthropogenic landscapes (human-induced landscapes). Anthropogenic landscape is a different form of human activity within the class of landscape. According to the results of the study, the territory of such landscapes decreased from 446108 ha to 351669 ha. This trend can be explained by the neglect of previously used territory (for example, afforestation or waterlogging of farmland, etc.).

2.3. Anthropogenic landscapes of the Novgorod-Siverska United Territorial Community

2.3.1 Spot landscapes: urban landscape and landscapes of abandoned chalk quarries

Novgorod-Siverska United Territorial Community is a united territorial community in Ukraine, in the territories of the Novgorod-Siverskyi Council and the Novgorod-Siverskyi District of the Chernihiv Region. The administrative center is the city of Novgorod-Siversky. Novgorod-Siverska United Territorial Community borders the Sumy region and the Russian Federation and is a controlled border area.

The urban landscape is characterized by almost complete transformation of natural relief, change of its hypsometric position and hydrographic network, transformation of soil cover, construction of industrial and residential buildings, significant reduction or increase of groundwater level (Fig. 2.1.). In some cases, due to the decrease in the static level of aquifers, they are not drained by rivers, which leads to shallowing and even disappearance of the latter. In others, within urban agglomerations due to accidents on water supply and sewerage systems, water enters the upper aquifers, which causes an increase in groundwater levels and flooding of residential and industrial facilities.

Fig. 2.1. City landscape of Novgorod-Siverskyi

The creation of urban landscapes leads to irreversible consequences. In particular, natural geological and geomorphological environmental conditions are radically changing and new conditions characteristic of urban agglomerations are being formed.

The territory of the city is heterogeneous in terms of landscape. In different parts of the city, depending on the type of land use - in the historic and business center, residential areas, industrial, transport, water, recreational and suburban areas - the degree of change

of natural elements and saturation of man-made objects is different. A common trend for all cities is the reduction of completely changed and artificial coatings and the degree of development in the direction from the center to the outskirts. But if we evaluate the urban landscape of Novgorod-Siverskyi, we can say with confidence that it is quite rich, natural, green city (Fig.2.2)

Рис.2.2. Landscaping in Novgorod-Siversky

The mining landscape is distinguished by the creation together with production facilities of enrichment, treatment and storage of waste with the appropriate infrastructure of mining and processing plants, quarries, construction of terraced funnels, the emergence of lakes (Fig. 2.3.). The Novgorod-Siverskaya UTC has a well-known abandoned chalk quarry in Putivsk. It is located just east of the village, near the banks of the Desna. In the quarry, the white walls of which are already collapsing and overgrown with weeds, you can find many remnants of the ancient sea, in which the chalk was formed: a pile of belemnites, shells of ancient malacofauna, corals. The Putyv Cretaceous quarry lies within one of the most powerful layers of chalk in Ukraine, with a thickness of 40-45 meters and a volume of chalk rocks of 6 million tons. Not far from the quarry there is a botanical reserve of national importance - "Putivsky". This is a protected floodplain of the Pridesnya meadows, where many rare plants and plant communities grow.

Fig.2.3. Landscapes of abandoned chalk regions Novgorod-Siverska UTC

Man-made negative landforms alternate with positive ones - dumps, heaps, embankments. Vegetation and soil composition are changing. Such landscapes are formed in a relatively short time, occupying large areas. This is especially true of minefields, chalk quarries, deposits of clay, sand, and so on.

2.3.2 Background landscapes: agricultural and forest

The agricultural landscape is formed as a result of intensive agricultural production (agriculture, vegetable growing, horticulture, animal husbandry, poultry farming, etc.) - Fig. 2.4. The creation of such a landscape is accompanied not only by the leveling of the territory with the removal of those objects that interfere with the work, but also the construction of embankments, ponds, irrigation canals.

Рис. 2.4. Agricultural landscape of Novgorod-Siverska UTC

Agricultural landscapes - landscapes that are formed for the purposes and under the influence of agricultural production. Occur in the process of land use, vegetation and soil cover of which undergoes significant changes and which is more or less under human control. According to the nature of the main types of human production activities, the agricultural landscapes of the Novgorod-Siverska UTC can be divided into three subclasses - field, meadow-pasture, garden.

Types of agricultural landscape serve as a link between natural landscapes and types of land use of economic geographers. Cultivated fields, orchards, meadows and pastures, differ sharply from each other in their ecology and the degree of self-regulation, for a long time exposed to the same economic use. Human action, which is repeated many times, on landscape complexes in the form of different types of their economic use causes them to form stable genetic traits that are subject to study by physical geographers.

Old arable soils acquire new features that significantly distinguish them from similar virgin soils. In arable sod-podzolic soils there is a strengthening of sod and weakening, and with high agricultural technology almost complete cessation of the podzolic process. With high agricultural technology, old arable podzolic sod soils have a large capacity of the humus horizon, more saturated with calcium and less podzolic than the original forest soils. The thickness of humus horizons of cultivated sod-podzolic soils is 4–6 cm higher than that of forest soils developed on the same rocks.

At low agrotechnics fertility of all arable soils decreases that is especially noticeable against the background of the natural soils differing in high fertility. In this regard, the process of depletion of fertile southern Russian chernozems in pre-revolutionary Russia is well known, which was expressed in the reduction of their humus, the destruction of the structure, the washing away of the upper layer, etc.

The peculiarity of agrophytocenoses as plant communities is the short duration of their existence, the sharp weakening of endoecogenesis, the continuous renewal of the process of sygenesis. In short: agrophytocenoses - forcibly regulated, syngenetic communities of plants - sown and weeds. The formation of agrophytocenoses is a long process that has been going on for thousands of years throughout the history of agriculture.

Field type. In the creation and operation of this type of anthropogenic landscape, the main types of anthropogenic impact include:

- plowing of the soil layer and destruction of natural vegetation,
- application of fertilizers,
- additional watering, constant irrigation or drainage,
- cultivation of agrophytocenoses, consisting of a limited number of species with annual extraction of most of the biomass.

Garden and mixed garden-field type. Externally, the garden type of landscape is closer to the forest type than to the field, but the low level of self-regulation and the need for high agricultural technology determine its belonging to the agricultural landscapes that are experiencing the greatest changes.

Meadow-pasture type. This is one of the most common types of agricultural landscapes, the condition of which depends entirely on the nature and intensity of use. In general, compared with other agrolandscapes, it is characterized by the lowest geochemical load and transformation.

The main factor of anthropogenic impact in the formation of this landscape is haymaking, which has a beneficial effect, determines the best warming, drying of soils and destruction of shrubs, as well as is an obstacle to weed growth, selects plants capable of vegetative propagation.

Cattle grazing, at its high intensity, leads to soil compaction, its drying, loss of the most valuable species with grass, liquefaction of vegetation. Heavily degraded pastures are foci of pests (ground squirrels, field beetles, weevils, locusts), are centers of wind and water erosion. Significant changes in the state of pastures are called pasture digressions.

Agricultural landscapes with altered lithogenic basis. This category includes landscapes in which people have changed the terrain and underlying rocks. Such changes occur in the formation of terraced field and garden agricultural landscapes on mountain slopes, as well as in the creation of irrigated oases and drainage of swamps.

Coniferous forests are natural and anthropogenic landscapes, due to the fact that Novgorod-Siverske Polissya is divided into forestries (Fig. 2.5). The territory of

coniferous forests increased from 93633 ha to 123833 ha. This trend is explained by the fact that coniferous forests are planted for industrial purposes. But among them there is a part of forests that belong to protected areas, and therefore any activity within the NPF facilities is prohibited. The natural conditions of Novgorod-Siverske Polissya determine not only the main directions of economic activity, but also the specifics of the development of the cultural and domestic sphere.

Fig. 2.5. Forest landscape of Novgorod-Siverska UTC

Self-afforestation also plays an important role in the growth of coniferous forests, as conifers disperse very well in the surrounding areas and fields. Pine forest is a source of quality wood, as well as a source of resin and other valuable raw materials. Even stumps are used: 10-15 years after felling, they are used to harvest spinning resin - raw material for resinous compounds in forest chemical production.

2.3.3. Desna River overflow and flooding of modern territory (March-April 2022)

Desna(Fig.2.6) - This is a river that begins in Russia and flows through Chernihiv and Kyiv regions. The second largest tributary of the Dnieper, which flows into it from the left bank. The length of the river within Ukraine is 591 km. Desna originates on the Smolensk Upland. On the territory of Ukraine the river flows from the village of Muravy

to the mouth. The valley is mostly trapezoidal, wide; in the upper and partly middle part it is asymmetric, with low left and high (up to 35-40 m) right bank, below - the shores are gentle, sandy. The floodplain is swampy, there are many straits, old rivers and lakes.

Fig. 2.6. Desna river

Spring floods for the Desna basin are a characteristic phase of the hydrological regime. But in recent years there has been a shortage of river overflow. The gums are very responsive to climate change. As soon as the meteorological characteristics begin to deviate from the norm, the river immediately shows it all. In the last 5-7 years, spring came 15-20 days earlier than usual, which reduced the period of accumulation of water in the snow cover and the formation of floods. In addition, the period of snow accumulation was reduced. If earlier the clearing of the ice on the river began in late March, now it happens in early March and even in late February. That is, the moon falls. Lack of snow, weak freezing of the soil (also a very important feature for the Desna, which previously reached 1.5 m, and now - 25-30 cm) leads to the absence of floods. There was only a slight rise in water levels within the channel. The water did not flow into the floodplain, that is, the river lived a life uncharacteristic of it.

But the Desna flood in the spring of 2022 was quite surprising. An abnormal inflow of water in the river is recorded in Novgorod-Siverskyi (Table 2.3).

Table 2.3

The water level in the Desna - Novgorod-Siverskyi

Date	water level, cm	increase, cm
07.04.2022	730	4
08.04.2022	734	4
10.04.2022	743	9
11.04.2022	750	7
12.04.2022	756	6
13.04.2022	762	6
14.04.2022	770	8
15.04.2022	775	5
16.04.2022	776	1
17.04.2022	784	8
18.04.2022	793	9
19.04.2022	802	9
20.04.2022	814	12
21.04.2022	825	11
22.04.2022	836	11
21.04.2022	845	9
22.04.2022	854	9
23.04.2022	867	13
24.04.2022	886	19
25.04.2022	913	27
26.04.2022	948	35
27.04.2022	987	39
28.04.2022	1026	39
29.04.2022	1064	38
30.04.2022	1065	1

Such abundant water supply is explained by the fact that in the north of Chernihiv region and in the Bryansk forests there was a lot of snow. The more precipitation there was in winter, the higher the water level in spring. Unless, of course, the temperatures were low and the snow didn't melt earlier than necessary. The table of observations of rising water levels in the Desna very clearly shows that the highest rates of water arrival are recorded from 23 to 29 April 2022. It was during this period that there was a complete melting of snow in the forests.

During the spring floods, water from the Desna flows into floodplains. That is, in the natural lowlands. Right now such a picture can be seen in the Novgorod-Siversky district (Fig.2.7.)

Fig.2.7. Overflow of the river Desna

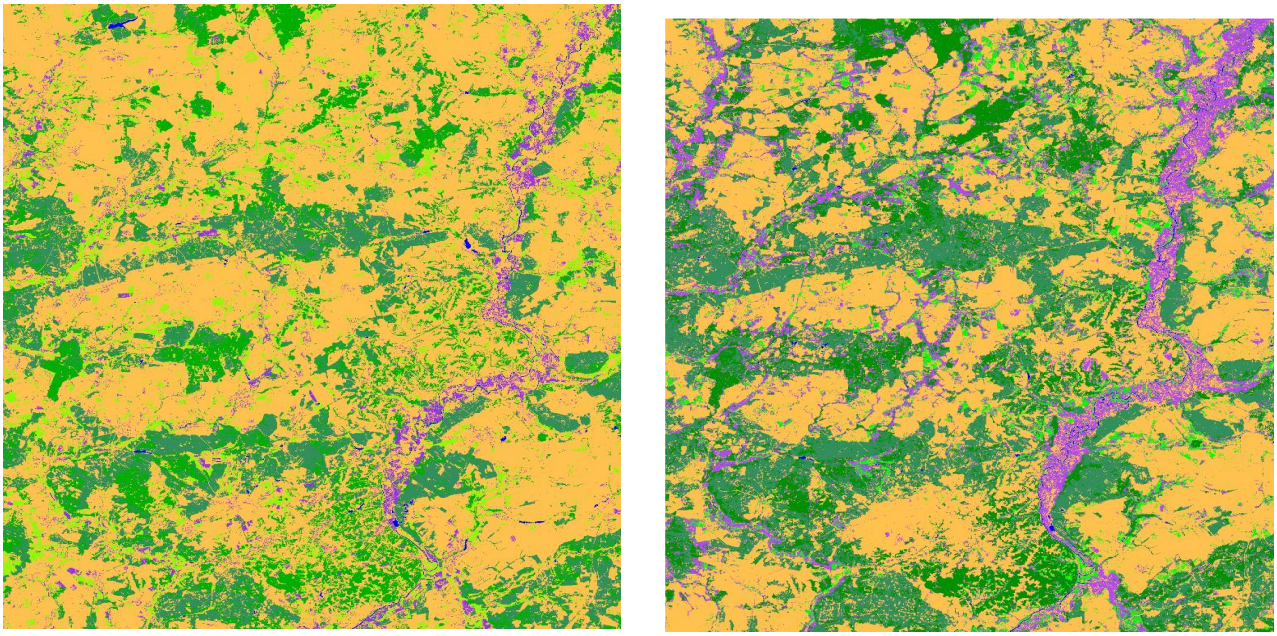
According to hydrological observations, the maximum water level in the Desna River was recorded in 2013, the minimum - in 2020. This year in the Chernihiv region recorded the highest floods in the last nine years. With the further rise of the water level there is a continuation of flooding of floodplains, disruption of transport links, flooding of houses in a number of villages and streets in the lower part of Novgorod-Siversky, Chernihiv region (Fig.2.8).

Fig.2.8. Flooded street in Novgorod-Siverskyi

Large spills for the Desna River are a vital necessity. After all, during the flood the river cleans itself and the floodplain of anthropogenic debris, fertilizes meadows with organic matter, fills floodplain lakes, creates conditions for fish spawning. No, there are no lush pastures, no fish, no clean water. The flood is a life for the river and attractive pictures of the landscapes of the floodplain of the Desnyanskaya floodplain.

2.4. Analysis and mapping of the dynamics of landscape complexes

Landscape analysis of the territory is crucial to begin with any design work on its rational use. Changes in local systems lead to general changes in regional and global, which is entirely due to continuous flows matter and energy [17]. In the study of Novgorod-Siverske Polissya the main goal was to reflect the dynamics of landscape complexes for a particular period in order to understand the further rational use of nature. Figure 2.9. shows the classification of landscape coverings as of 1986 and 2018.



1986 p. 2018 p.

Fig. 2.9. Classification of landscape coverings as of 1986 and 2018

Landscape maps as of 1986 and 2018 (Fig. 2.9), Table 2.4. and Sankey diagram (Fig. 2.4.15) show changes in landscapes and their transformation from one class to another.

Table 2.4. shows the transformation of the territory of different classes of landscape from one to another. The number of hectares remaining within its class of landscapes is highlighted in green.

Table 2.4.

Landscape Transformations from 1986 until 2018 (in hectares)

LC Class		*Initial State (1986) ha*							
		Water	Wetland	ForestC	ForestD	Grass	*Human-induced Landscapes*	Class Total	
Final State (2018) ha	Water	1368,63	13,59	156,6	97,2	43,38	1075.59	2754,99	
	Wetlands	41,49	11015,55	3052,26	6319,71	13081,5	51633.18	85143,69	
	Forest conif	116,46	37,35	73985,4	17757,27	794,61	31141.98	123833,07	
	Forest decid	14,58	2115,81	5554,8	55088,37	6210,54	31450.86	100434,96	
	Grass	9,63	1667,52	368,91	768,42	8325,99	27023.31	38163,78	
	Human-induced Landscapes	1032.39	8826.75	10515.15	11829.06	15683.04	303783,12	351669,51	
	Class Total	2583,18	23676,57	93633,12	91860,03	44139,06	446108.04		
	Class Changes	1214,55	12661,02	19647,72	36771,66	35813,07	142324,92		
	Image Difference	171,81	61467,12	30199,95	8574,93	-5975,28	-94438,53		

The Sankey diagram (Fig. 2.10.) shows the flows and their quantitative values in proportion to each other. The width of the arrows or lines is used to indicate the values, the larger the "arrow", the greater the quantitative value of the flow. Arrows or flow lines can

be combined or separated at different stages of the process. Color gamut is used to divide the chart into different categories or to demonstrate the transition from one process state to another.

The Sankey chart shows that the Wetlands area has increased due to human-induced landscapes, grasslands (Grassland), coniferous forests and mixed forests (Desiduous). The territory of coniferous forests has increased due to the territories of mixed forests and anthropogenic landscapes. Instead, the area of anthropogenic landscapes has decreased due to the transformation into all classes of landscapes, but in different numbers.

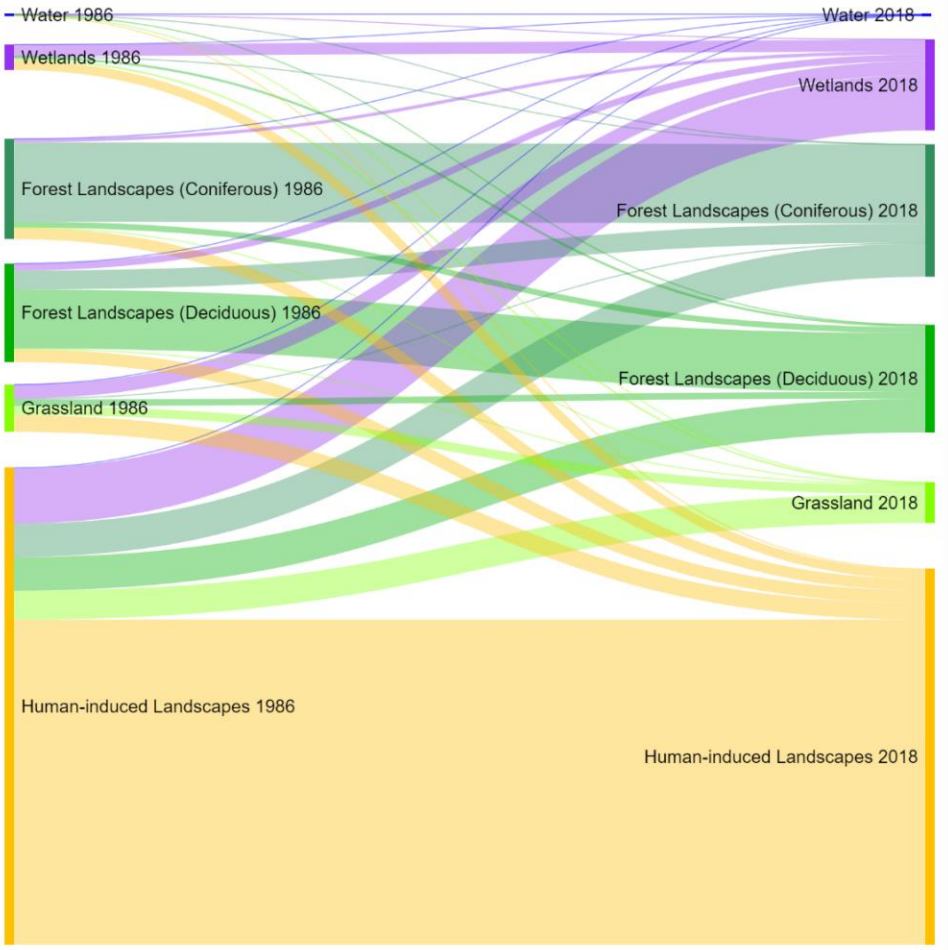


Fig.2.10. Sankey Diagram of landscape class transformation from 1986 to 2018

The diagram in Figure 2.11. shows how all classes of landscapes were transformed into each other and highlighted in colors corresponding to the map in Figure 2.12.

LC Class		*Initial State (1986) ha*						
		Water	Wetland	ForestC	ForestD	Grass	*Hum Landsc*	
Final State (2018) ha	Water	No Change	Wetland loss	Forest loss	Forest loss	Grass loss	Water gain	
	Wetlands	Wetland gain	No Change	Forest loss	Forest loss	Wetland gain	Wetland gain	
	Forest conif	Forest gain	Forest gain	No Change	Decid loss	Forest gain	Forest gain	
	Forest decid	Forest gain	Forest gain	Decid gain	No Change	Forest gain	Forest gain	
	Grass	Grass gain	Wetland loss	Forest loss	Forest loss	No Change	Grass gain	
	Hum Lands	Water loss	Wetland loss	Forest loss	Forest loss	Grass loss	No Change	

Fig.2.11. Semantic scheme of landscape transitions

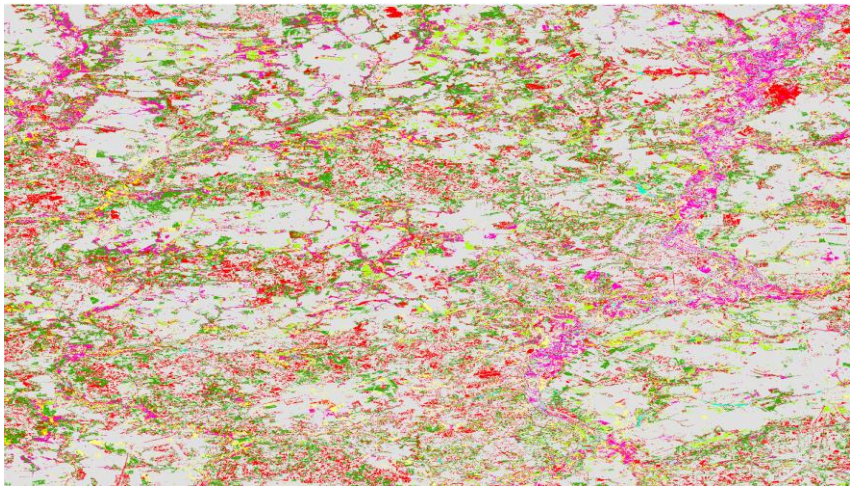


Fig.2.12. The resulting map of changes in landscape coverings, reflecting the basic patterns of dynamics of landscape complexes for the period from 1986 to 2018

The map of land cover flows, which reflects the basic patterns of change of landscape cover within the study area, clearly shows where and how the number of landscape classes

has increased. Thus, the application of the proposed basis provides a quantitative assessment of changes in landscape coverings that occurred within the study area over a period of 32 years (1986-2018), and also reveals the patterns of these changes. Quantitative and qualitative assessment is necessary for further management of the border areas of Novgorod-Siverska UTC and sustainable nature management.

The presented comparative data of all types of landscapes that have changed, allow a better analysis of the situation regarding the transformation of landscape complexes of the study area [18-20]. Analyzing the situation, we can conclude that the area of wetlands is increasing due to the neglect of previously used areas, due to wetlands and due to lack of clear management and control of wetlands in Novgorod-Siverske Polissya. Instead, the area of coniferous forests is increasing in a controlled and uncontrolled way, as forest management is under state control. The territory of anthropogenic landscapes is reduced due to the neglect of part of the territory and the transition to other classes of landscape.

Analyzing the resulting map of changes in landscape cover (Fig. 2.4.17), you can get valuable information for decision-making on land management and sustainable use of nature. Imposing a map of administrative division of the territory, or a map of nature reserves, or any other maps of the study area, you can analyze specific issues - the area of which landscape classes have increased (decreased) and by how much, which artificial coverings predominate, which processes occur within agricultural areas (wetlands, afforestation, etc.) and what measures should be taken to improve the environmental situation, land quality, etc.

2.5 Conclusion to Chapter

Thus, analyzing the results of the study, I can say that remote sensing of the Earth provides a broad overview of landscapes and therefore it is an important source of data for their quantitative analysis. As a result of the analysis of Novgorod-Siverske Polissya, the development of wetlands as the most productive ecosystems was established. The identified changes in the landscape can be divided into the following types: afforestation

and waterlogging, which occurs in agricultural areas and pastures that return to wetlands in accordance with their geomorphological and hydrological conditions. Quantitative and qualitative assessment of the dynamics of landscape complexes should be carried out for further management of the border areas of Novgorod-Siverskaya UTC and sustainable nature management.

CONCLUSIONS

1. As a result of the analysis of natural and anthropogenic and anthropogenic landscapes of Novgorod-Siverske Polissya, their diversity and wide development of wetlands as one of the most productive ecosystems, providing the necessary ecosystem services to ensure the health, well-being and safety of the population. lives near such areas. The number of wetlands is growing due to the active waterlogging of floodplains and due to the lack of drainage system in the region.

2. Remote sensing of the Earth provides a broad overview of landscapes and is therefore considered an important source of data for their quantitative analysis. With the help of many spectral space images, the following classes of landscape coverings were identified: natural and anthropogenic - water bodies, wetlands, coniferous and mixed forests, grasslands - and purely anthropogenic landscapes, which include artificial land, agricultural and abandoned lands.

3. Identified changes in the landscape can be divided into the following types: afforestation; waterlogging that occurs in agricultural areas and pastures that return to wetlands in accordance with their geomorphological and hydrological conditions. The main driving forces of these changes are the reduction of land use, the fall of the drainage system and anthropogenic and natural afforestation.

4. The results of quantitative analysis of landscape changes that have occurred in the territory of Novgorod-Siverske Polissya over the past 32 years have been obtained in the area (ha). They show that the ratio of the most changed landscape complexes of wetlands (from 23676 ha to 85143 ha), coniferous forests (from 93633 ha to 123833 ha) and anthropogenic landscapes (from 446108 ha to 351669 ha). Quantitative and qualitative assessment of the dynamics of landscape complexes is necessary for further management of the border areas of Novgorod-Siverska UTC and sustainable nature management.

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