УДК 630*1 DOI 10.36910/775.24153966.2025.81.17

В.О. Волянський, О.П. Герасимчук, Т.В. Волянський

Луцький національний технічний університет

ЛІСОРОСЛИННІ УМОВИ В ЗАПЛАВАХ РІЧОК ПСЕЛ І ВОРСКЛА

Проведено аналіз лісорослинних умов заплав річок Псел і Ворскла. Він показав, що основними факторами, що визначають лісорослинні умови в заплавах річок Псел і Ворскла є повторюваність і тривалість затоплення заплав. У зв'язку із зниженням впливу факторів заплавностілісорослинні умови змінюються в сторону висушення, на ріст лісових насаджень все більший вплив мають зональні кліматичні фактори. Різноманітність лісорослинних умов і формування великої кількості типів лісу в заплавах річок вимагають розробки методів господарювання в них.

Ключові слова: *заплава річки, затоплення, лісорослинні умови, заплавні ліси.*

V.O. Volianskyi, O.P. Herasymchuk, T.V. Volianskyi

FOREST GROWING CONDITIONS IN FLOODPLAINS OF PSEL AND VORSKLA RIVERS

This study analyses the forest growing conditions within the floodplains of the Psel and Vorskla rivers. The findings indicate that the primary factors influencing these conditions are the frequency and duration of floodplain inundation. Due to a reduction in the impact of floodplain-specific factors, the forest growing conditions are shifting towards increased dryness, with zonal climatic factors exerting a growing influence on forest stand development. The diversity of forest growing conditions and the formation of numerous forest types within these floodplains necessitate the development of tailored management strategies.

Keywords: *river floodplain, inundation, forest growing conditions, floodplain forests.*

Problem Statement. Due to the regulation of surface runoff, the construction of a cascade of reservoirs, and the commissioning of water intake and other hydraulic structures, the forest growing conditions in the floodplains of rivers have significantly changed towards either drying or excessive waterlogging. Currently, there is an increasing risk of damage and death of floodplain forests due to anthropogenic overload. The insufficient study and lack of a management system in the floodplain forests of the Vorskla and Psel rivers highlight the urgency of addressing these issues.

Analysis of Recent Research and Publications.A number of researchers have studied the ecological factors in river floodplains across various regions, focusing on their impact on the growth, productivity, and water-protective functions of forests. Among the scientific publications dedicated to this topic, the works of Yu.P. Byallovych, M.V. Romashov, M.A. Lokhmatov, O.S. Mihunova, I.D. Avramenko, V.H. Shatalov, I.V. Trieshchevskyi, I.V. Yakimov, O.S. Mihunova, I.B. Shynkarenko, V.P. Tkach, O.B. Bondar, V.V. Nazarenko and others [1–5] have been analyzed. The study of the specific forest growing conditions in the floodplains of the Psel and Vorskla rivers is particularly important.

Task formulation. The aim of this study is to examine the forest growing conditions that influence the growth, productivity, and water-protective functions of forest stands in the floodplains of the Vorskla and Psel rivers. To achieve this, the research investigates the hydrological regime of the floodplains, soil cover, and the spatial distribution of floodplain forests.

The research focuses on floodplain forests along the Psel and Vorskla rivers. To analyze the structure of these floodplain areas, topographic maps at a 1:25000 scale were utilized. The study is based on the comparative ecology method. The duration and frequency of floodplain inundation were determined by correlating river water levels during flood events with a vertical profile laid across the floodplain perpendicular to the river channel.

Presentation of the Main Material. The forest growing conditions in the floodplain are determined by the characteristics of the river's hydrological regime. The Psel and Vorskla rivers are classified as medium-sized rivers. Flowing in a meridional direction, they pass through regions with varying forest growing conditions, which also results in changes to the rivers' own parameters that define the floodplain hydrology.

The main ecological factors influencing the water supply regime of the floodplain are the frequency, timing, and duration of inundation by floodwaters. These indicators vary from the river's source to its mouth. In the lower reaches, due to earlier spring warming, flooding begins sooner and lasts longer—up to one month or more. In contrast, the middle and upper reaches experience shorter flood periods, usually not exceeding 10 days. In recent decades, the regulation of water flow and increased water withdrawal have significantly altered the flood regime, which has had a profound impact on floodplain processes.

Analysis of research materials shows that until the mid-1950s, the floodplain of the Vorskla River was flooded almost every year. Today, this figure has decreased to an average of 5 times per decade. The floodplain may remain unflooded for 2–3 consecutive years, which leads to changes in the previously established forest growing conditions. Additionally, both the duration of flooding and the average maximum spring water level have decreased. In the middle section of the Vorskla River, these parameters have dropped from 11 to 4 days and from 264 cm to 221 cm, respectively.

The reduction in the average duration of floodplain inundation is primarily caused by river flow regulation and increased water extraction. The decreased frequency and duration of inundation events lead to a decline in the groundwater table. The floodplain moisture regime also changes throughout the growing season. Following significant spring moisture accumulation, a drier summer period ensues, during which zonal climatic factors play a more dominant role. As a result, there is a shift in hygrotopic conditions toward drier site types.

Based on the study of the floodplain inundation regimes of the Psel and Vorskla rivers, and considering the changes observed in recent decades, the following types of inundation regimes have been identified:

- Short-term through-flow inundation – inundation of the highest floodplain areas (natural levees, elevated ridges) for up to 10 days;
- Medium-term through-flow inundation – flooding of elevated terrain elements for 10 to 40 days;
- Long-term through-flow inundation – flooding of slightly elevated or level areas for 40 to 60 days;
- Short-term stagnant inundation – flooding of slightly depressed areas for up to 40 days;
- Long-term stagnant inundation – flooding of significantly depressed areas for more than 40 days.

Prior to the regulation of river flow, short-term through-flow inundation occurred primarily in the upper reaches of rivers and partially in their middle reaches. Today, this inundation type is typical for much of the Vorskla and Psel rivers. Medium-term through-flow inundation occurs in the middle and lower reaches, but only in years with increased flood intensity. Both short- and medium-term through-flow inundation are characteristic of the near-channel and central parts of the floodplain. Approximately 80% of the floodplain forest stands of the Vorskla and Psel rivers were formed under these inundation regimes.

Long-term through-flow inundation is observed only in small areas, such as sandy shallows, small islands, and depressed terrain features. Stagnant inundation primarily occurs in the terrace-adjacent portion of the floodplain and is present along the entire length of the rivers. The duration of stagnant flooding depends on the magnitude of the flood, the degree of terrain depression and enclosure, and the emergence of groundwater to the surface.

Due to changes in floodplain-related factors, many forest stands that originally developed under conditions of medium-duration through-flow inundation are now growing in floodplains characterized by short-term through-flow inundation regimes. To assess the influence of hydrological factors on the growth of floodplain forests, the dynamics of radial increment were analyzed in relation to flood duration and the average river water level during flood events.

A strong correlation was established between the growth index, the duration of flooding, and the average floodwater level in the river. This indicates that the hydrological variables studied significantly affect the formation of the annual increment in forest stands.

Further degradation of the hydrological regime—caused by declining river discharge and reduced frequency and duration of floodplain inundation—will lead to a decrease in the productivity of floodplain forests.

The percentage distribution of site condition types in the floodplains of the Psel and Vorskla rivers is presented in Table 1.

Table 1.

Distribution of Site Condition Types in the Floodplains of the Psel and Vorskla Rivers, %

Hygrotop	Trophotop				Total
	A	B	C	D	
0	-	-	-	-	-
1	-	-	-	-	-
2	-	1,4	20,4	23,8	45,6
3	-	4,2	13,8	14,9	32,9
4	-	-	3,4	10,1	13,5
5	-	-	0,1	7,9	8,0
Total	-	5,6	37,7	56,7	100,0

Alluvial and floodplain processes have a significant influence on the formation of soil cover within river valleys. The periodic inundation of floodplains modifies the soil-forming environment by altering the aeration and salinity regimes of the soils and by raising the groundwater level.

The Psel and Vorskla rivers are freely meandering watercourses. The sinuosity of their channels results in a complex floodplain morphology, characterized by ridged elevations, near-channel natural levees, and scour depressions formed by floodwaters. As a result, there is considerable soil variability throughout the floodplain.

In the near-channel part of the floodplain, coarse alluvium is deposited due to active fluvial processes. In the central part, finer sediments accumulate, while silty particles are deposited in the terrace-adjacent (outer) zone. Near-channel forest stands reduce the velocity of floodwaters and promote the deposition of coarse sand particles, which facilitates the formation of levees and ridges. The annual transport and deposition of sand create stratified soils, where buried soil horizons are often encountered. The upper soil layers are typically light loam or sandy loam in texture.

Due to the meandering nature of the Psel and Vorskla, their channels often intrude into the central floodplain zone. This results in the central floodplain soils occurring directly adjacent to the river channel. The terrain in the central floodplain is relatively flat, with minor micro-elevations. During flooding, fine nutrient-rich particles are deposited in this area, where meadow-type soil formation processes dominate.

The terrace-adjacent floodplain is characterized by meadow-bog and bog soils, which have formed under the influence of alluvial and deluvial processes in conditions of prolonged through-flow and stagnant flooding. The soil types found in the floodplains of the Psel and Vorskla rivers exhibit varying degrees of forest suitability. With an appropriate forest typological assessment, it is possible to cultivate forest stands across all areas of these floodplains. It is essential to determine the correspondence between the forest growing conditions of different floodplain zones and the tree species growing on them.

In the terrace-adjacent floodplain, black alder stands can grow successfully without the need for any additional interventions, as optimal conditions exist for their development, and they effectively perform meliorative functions. The near-channel floodplain is also suitable for afforestation. Woody and shrubby willows and poplars find favorable growth conditions in this zone and are indispensable for riverbank protection. In the fertile soils of the central floodplain, it is advisable to cultivate the most valuable and highly productive oak stands. Around old riverbeds located in the central floodplain, it is appropriate to establish poplar plantations, as they exhibit high productivity in such environments.

The diversity and dynamism of soil and hydrological conditions in river floodplains lead to the formation of a wide variety of forest types. The spatial distribution of floodplain forest stands follows specific patterns and is generally associated with particular segments of the floodplain.

In the near-channel floodplain, the most common forest types are fresh and moist black poplar forests (subory), fresh and moist poplar stands (suhroudky), and fresh elm-spindle and maple-linden oak forests (sudibrovy). Medium-duration through-flow inundation, which was typical for this part of the floodplain until the mid-1950s, has now been replaced by short-term through-flow flooding. Only on sandy shoals is long-term through-flow inundation still observed. Willows do not form large stands; instead, they typically grow as narrow strips on sandy shoals and along riverbanks, where they perform an important anti-erosion function. Poplar stands are found on ridged near-channel elevations. The formation of oak forest types in the near-channel zone is driven by the meandering of the river, which causes the riverbed to shift across the floodplain and intrude into its central zone. The successful development of oak stands under such conditions is explained by the presence of deep, buried humus-rich soil horizons located up to 1 meter deep. In such cases, the near-channel zone acquires characteristics typical of the central floodplain.

It is important to note that erosion-accumulative processes in this zone lead to a deterioration in site trophic conditions. A forest typological survey and analysis of the herbaceous vegetation cover indicate that a significant portion of the floodplain is “over-dried.” Most areas within the near-channel floodplain are classified as moist site types.

The central floodplain is characterized by richer growing conditions. It is dominated by fresh and moist elm-spindle and maple-linden oak forests.

In the central floodplain, short-term through-flow inundation is predominant, while medium-duration through-flow flooding is observed less frequently. Intense spring moisture from flooding is typically followed by a low-water summer period characterized by limited moisture availability. As a result, during the growing season, the hygrotopic conditions shift progressively from D3 → D2-3 → D2 → D1-2. Under such conditions, the forest stands must exhibit high ecological resilience.

The terrace-adjacent floodplain is primarily composed of moist and wet black alder stands, both as pure coppice and, less commonly, seed-regenerated or mixed-origin stands. Due to regulated river flow, long-term stagnant flooding has become less typical for this part of the floodplain. The dominant inundation regimes in the terrace-adjacent zone are short-term stagnant and long-term through-flow flooding.

It is important to note that river flow regulation has resulted not only in a reduction in the duration and frequency of floodplain inundation but also in the emergence of areas that are no longer flooded or experience flooding only rarely. These areas are mostly associated with sandy ridges. Silvicultural experience shows that Scots pine (Pinus sylvestris), which is tolerant of poor soils and can withstand short-term flooding, grows successfully in such locations [1, 2].

Conclusions.A distinctive feature of the floodplain forests along the Psel and Vorskla rivers is their irregular inundation regime. Compared to larger river systems, these floodplains are characterized by a simpler vegetation pattern. However, this spatial organization is modified by the meandering of the rivers, which leads to the formation of numerous old riverbeds and channels, often accompanied by alluvial deposits. In the central floodplain, willows and poplars commonly grow along the banks of these former channels.

The near-channel floodplain frequently exhibits forest growing conditions similar to those found in the central floodplain, which facilitates the development of oak stands in these areas. The dynamic nature of soil and hydrological conditions, along with the intense impact of anthropogenic factors on the vegetation, contributes to the formation of derivative stands that are less valuable and less resilient.

Analysis of systematic research results shows that the primary ecological factors determining forest growing conditions in the floodplains of the Psel and Vorskla rivers are the frequency and duration of inundation. With the decreasing influence of floodplain-related factors, the conditions are trending toward increased dryness, and zonal climatic factors are becoming increasingly influential on forest stand growth.

The soil cover of floodplain forests is highly diverse, shaped significantly by floodplain and alluvial processes. The near-channel zone is characterized by light-textured alluvial soils; the central floodplain contains alluvial-meadow soils formed on sandy, sandy loam, and loamy sediments; and the terrace-adjacent zone features meadow-bog and bog soils. These different soil types exhibit varying degrees of forest suitability.

The contrasting soil-hydrological conditions across the floodplain lead to a wide range of forest types. In the near-channel floodplain, the predominant types include moist poplar stands, as well as fresh and moist elm-spindle and maple-linden oak forests. In the central floodplain, fresh and moist elm-spindle and maple-linden oak forests prevail, while in the terrace-adjacent zone, moist and wet black alder stands dominate.

The diversity of forest growing conditions and the resulting variety of forest types in the floodplains of these rivers necessitate the development of specialized management practices for their sustainable use.

References:

1. Ткач В. П., Волянський В. О., Зятьков Л. Л. Стан лісів у заплавахрік Псел і Ворскла // Лісівництво і агролісомеліорація. – К. : Урожай, 1991. – Вип. 82. – С. 14–18.

2. Ткач В. П. Заплавні ліси України. – Харків : Право, 1999. – 368 с.

3. Ткач Л. І., Бондар О. Б. Типологічне різноманіття лісів водозборів річки Псел // Науковий вісник НЛТУ України. – 2016. – Вип. 26.5. – С. 153–160.

4. Ткач Л. І., Бондар О. Б., Солодовник В. А. Типологічна структура та біорізноманіття лісів малих водозборів річки Ворскла // Науковий вісник Національного університету біоресурсів і природокористуванняУкраїни. Серія: Лісівництво та декоративне садівництво. – 2016. – Вип. 238. – С. 56–65.

5. Назаренко В. В. Лісівничо-екологічний макрокомплекс та продуктивність типів лісуЛісостепуХарківщини : дис. … канд. с.-г. наук : 06.03.03. – Харків, 2013. – 209 с.

6. Остапенко Б. Ф., Ткач В. П. Лісова типологія. – Харків : Вид-во Харківського держ. аграрного університету ім. В. В. Докучаєва, 2002. – 204 с.

Рецензент: Мазепа Василь Григорович, професор кафедри лісового господарства ЛНТУ, д.т.н., професор.