JENER Journal of Empirical and Non-Empirical Research
Volume 2, Issue 3, Page 311-315 | Article No. 43
DOI: 10.4898/jener.v2i3.a43
ISSN: 7895-9216
Journal homepage: https://jenerjournal.com
Journal email: editor@jenerjournal.com

JENER Journal
JENER Journal of Empirical and Non-Empirical Research

Monitoring of *Elodea canadensis* Michx. Expansion in the Floodplain Water Bodies of the Middle Desna River and Ways of Regulating Its Abundance

Oleksandr Lukash[1], Volodymyr Mulach[2], Yulia Oleksienko [3], Anastasia Burenok[4], Ilya Kham[5] & Vladyslav Stavytskyi[6]

[1,2,3,4,5,6]Department of Ecology, Geography and Nature Management, T.H. Shevchenko National University "Chernihiv Colehium", 53 Hetmana Polubotka Street, Chernihiv,14013, Ukraine

ARTICLE INFORMATION

Article history:
Published: March 2026

Keywords:
Elodea canadensis
Floodplain lakes
Grass carp
Biological reclamation
Phytocoenosis

ABSTRACT

The article analyzes the ecological consequences of the massive expansion of the invasive species *Elodea canadensis* Michx. in the floodplain lakes of the middle reaches of the Desna River (Harmashove, Karashnya, Yamochka). It was established that the studied water bodies are at the stage of active overgrowth with a predominance of monodominant *Elodea* communities, leading to the degradation of indigenous phytocoenoses and accelerated eutrophication. The advantages of using grass carp (*Ctenopharyngodon idella*) as a biological reclamation agent in comparison with the local ichthyofauna are justified. Optimal stocking rates were calculated for each object, and a post-reclamation monitoring system was proposed to maintain the ecological balance of the water bodies.

1. Introduction

The global transformation of freshwater ecosystems is increasingly driven by the combined effects of climate change and the rapid spread of non-native biological species. These processes lead to significant structural shifts in aquatic phytocoenoses, often resulting in the loss of native biodiversity and the degradation of water body functions.

1.1 Background and Relevance

The current state of Ukraine's freshwater ecosystems is characterized by the intensification of anthropogenic eutrophication processes and the uncontrolled spread of adventive hydrophyte species. The transformation of floodplain water bodies under the influence of biological invasions is one of the key environmental problems requiring the development of effective biodiversity management strategies. Among the most aggressive introduced species, special attention is drawn to Canadian waterweed (*Elodea canadensis* Michx.), which is capable of forming stable monodominant communities in water bodies with slowed water exchange (Fig. 1).

Figure 1: Canadian waterweed (*Elodea canadensis* Michx.) – "water plague". Source: author's photograph, 16.08.2024

1.2 Problem Statement

Lakes Harmashove (also known as Pchelske), Karashnya, and Yamochka, located in the floodplain of the middle reaches of the Desna River (Chernihiv Raion, Chernihiv Oblast, Ukraine), are important elements of the local hydrological network and centers of biodiversity in the Chernihiv Polissya. However, the intensive overgrowth of these lakes by *Elodea* leads to the deterioration of their hydrochemical regime, accelerated siltation, and loss of economic value. The need to find environmentally safe methods for regulating macrophyte abundance under these specific territorial conditions determines the relevance of this study.

1.3. Aim of the Study

The aim of the work is to assess the current phytocoenotic state of the Desna River floodplain lakes under the conditions of E. canadensis expansion and to scientifically justify the parameters of their biological reclamation.

1.4. Objectives

To achieve this goal, the following objectives were defined: to analyze the dynamics of lake overgrowth and identify the main stages of aquatic phytocoenosis succession; to provide a geobotanical characterization of monodominant Elodea communities in the studied water bodies; to justify the choice of a biological agent for macrophyte control among the existing ichthyofauna; to calculate the optimal stocking rates for Lakes Harmashove (Pchelske), Karashnya, and Yamochka; to develop practical recommendations for monitoring water bodies in the post-reclamation period.

2. Literature Review

Elodea canadensis, a perennial hydrophyte native to the temperate regions of North America, has become one of the most widespread invasive aquatic plants globally. Its introduction into European freshwater ecosystems began in the mid-19th century, with the first records in the British Isles (1836), followed by a rapid expansion across the continent. In Ukraine, the species was first officially documented in 1894, subsequently naturalizing in most river basins, including the Dnieper and its tributaries (Protopopova, 1989). In the floodplain of the middle reaches of the Desna River, the spread of *E. canadensis* was facilitated by its high capacity for vegetative propagation and its ability to occupy vacant ecological niches in stagnant and slow-flowing water bodies. Currently, this species acts as a key transformer of local aquatic habitats, forming massive thickets that initiate significant changes in the hydro-biological regime of floodplain lakes.

2.1 The problem of Elodea canadensis invasion in Europe

The expansion of *E. canadensis* in European countries has remained a subject of active discussion over the last century. First recorded in Great Britain in 1836, the plant demonstrated an unprecedented rate of dispersal, covering most of the continent's freshwater bodies. According to studies by Strayer (2010), the success of the invasion is due to high phenotypic plasticity and the ability to survive in a wide range of trophicity and temperatures. In Central and Eastern European countries, particularly Ukraine, *Elodea* forms dense monodominant thickets that radically change the architecture of the aquatic environment (Dubyna et al., 2017). This leads to shading of the lower water layers, reduced gas exchange intensity, and displacement of local macrophyte species, which is classified as a serious threat to biodiversity (Protopopova & Shevera, 2019).

2.2 Analysis of ways to reduce the abundance of Elodea canadensis in water bodies

In global practice, three main approaches to regulating *Elodea* abundance have been developed: mechanical, chemical, and biological. Mechanical removal (mowing) provides only a short-term effect, as shoot fragmentation during the process often stimulates further dispersal of the plant. Chemical methods (herbicides) have limited application in Europe due to high ecological risks to ichthyofauna and drinking water supplies. As noted by Zub and Karpova (2012), the most effective and environmentally safe method is biological control, specifically the use of phytophagous fish. Grass carp (*Ctenopharyngodon idella*) is recognized as the most effective agent, as its diet consists of 90% or more higher aquatic vegetation. The experience of monitoring protected areas of the Desna floodplain confirms that proper management of phytophage populations allows for a balance between reservoir cleaning and the preservation of its ecosystem functions (Onyshchenko & Andrienko, 2012).

3. Methodology

Despite the extensive global and regional data on the invasive behavior of *E. canadensis*, the ecological dynamics of this species within the specific conditions of the middle Desna floodplain remains insufficiently addressed in current literature. The hydrological connectivity of these lakes during seasonal flooding and their isolated nature during the summer period create a unique environment for the development of monodominant phytocoenoses. Consequently, a comprehensive field assessment of the current vegetation structure and the calculation of biological management parameters are essential to prevent the further degradation of these local ecosystems. The following sections outline the specific methodological framework and analytical procedures employed to evaluate the ecological state of Lakes Harmashove (Pchelske), Karashnya, and Yamochka (Fig. 2).

a b c

Figure 2: Floodplain lakes of the Desna River (Chernihiv region) – study objects: Harmashove (Pchelske) (a), Karashnya (b), and Yamochka (c). Source: author's photograph, 2025.

3.1 Object and Methods of Research

The object of the study consists of floodplain lakes in the middle reaches of the Desna River, located within the Chernihiv district of the Chernihiv region between the villages of Vybli and Pisky. Three water bodies with similar hydromorphological characteristics were included in the sample: Lake Harmashove (10 ha), Lake Karashnya (5 ha), and Lake Yamochka (10 ha). The maximum depths of the studied lakes range from 2.0 to 2.5 meters, which, combined with moderate flow during flood periods, creates optimal conditions for the vegetation of submerged hydrophytes.

3.2 Research methods

The analysis of the aquatic vegetation cover was carried out through field geobotanical surveys during the period of maximum phytomass development (July–August). The methodological basis for the inventory and classification of vegetation followed the approaches developed by Yakubenko et al. (2018). According to this methodology, the study of phytocoenoses was conducted on representative sample plots, recording species composition, projective cover, and the tier structure of communities. Special attention was paid to identifying monodominant communities of *Elodea canadensis*, analyzing their transformational activity and their capacity to displace indigenous associations of the *Potamogetonetea* and *Lemnetea* classes.

To justify measures for regulating the abundance of *E. canadensis*, the method of biological reclamation was applied. The calculation of the required stocking density of grass carp (*Ctenopharyngodon idella*) was based on an assessment of the actual phytoproductivity of the lakes, considering the trophic requirements of the reclaiming fish. The projected stocking rates were calculated based on the need for the gradual removal of excess biomass without disrupting the overall oxygen balance of the water bodies (Zub & Karpova, 2012).

4. Findings

The synthesized field data provide a precise representation of the successional dynamics and spatial distribution of E. canadensis across the studied floodplain ecosystem. These empirical observations form the basis for the subsequent phytocoenotic analysis and the mathematical modeling of biological reclamation parameters. The following section details the specific vegetation structures identified in the target lakes and justifies the proposed management strategies.

4.1 Phytocoenotic characterization of water bodies with Elodea canadensis

The analysis of the vegetation cover of the floodplain lakes Harmashove, Karashnya, and Yamochka revealed dynamic processes of eutrophication and overgrowth, which at the current stage can be structured into three successive stages. At the first stage of phytocoenosis formation, free-floating vegetation dominates. The main dominants and co-dominants here are *Lemna minor*, *L. trisulca*, *Hydrocharis morsus-ranae*, as well as submerged hydrophytes *Ceratophyllum demersum*, *Elodea canadensis*, and *Stratiotes aloides*. The second stage, characterized by the development of floating-leaved and emergent rooted vegetation, covers the largest area of the studied water bodies. The dominant complex of this stage includes *Nuphar lutea*, *Sparganium emersum*, and *Schoenoplectus lacustris*, with significant participation of pleuston (*Lemna minor*, *L. trisulca*). Aquatic vegetation at this stage is represented by free-floating hydrophytes (*Lemna minor*, *Hydrocharis morsus-ranae*, *Ceratophyllum demersum*, *Stratiotes aloides*), whose participation in the coenoses ranges from 25% to 50%. The submerged tier is typically formed by *Elodea canadensis*, and less frequently by *Lemna trisulca* and *Ceratophyllum submersum*. At the third stage, an expansion of emergent rooted vegetation occurs. Communities are formed with the participation of *Typha latifolia*, *T. angustifolia*, *Phragmites australis*, and *Glyceria maxima*. In the final stages of this succession, tall helophytes (*Phragmites australis*, *Typha latifolia*, etc.) occupy the dominant position, indicating the gradual transformation of the lakes into wetlands. The massive development of *E. canadensis* in the submerged tier during the second stage of overgrowth plays a key role in stabilizing these communities, while simultaneously creating conditions for the accelerated accumulation of organic silt.

4.2 Selection of Biological Agent for Reclamation and Discussion Aspects

The selection of an optimal fish species for controlling the abundance of *E. canadensis* requires a detailed analysis of the local ichthyofauna structure. In the Desna floodplain lakes (Harmashove, Karashnya, Yamochka), ichthyocoenoses are represented by a typical complex of freshwater species, including Prussian carp (*Carassius gibelio*), common bream (*Abramis brama*), European perch (*Perca fluviatilis*), and common rudd (*Scardinius erythrophthalmus*). However, despite high species diversity, the capacity of indigenous species to restrain the expansion of *Elodea canadensis* is extremely limited. In contrast to omnivorous species such as Prussian carp or bream, which feed primarily on benthos and detritus, grass carp (*Ctenopharyngodon idella* Valenciennes, 1844) is a specialized macrophytophage (Fig. 3).

Figure 3: Grass carp (*Ctenopharyngodon idella* Valenciennes, 1844) – biological agent for macrophyte regulation. Source: U.S. Geological Survey [USGS] (2023).

As noted by Zub and Karpova (2012), grass carp possesses a unique anatomical apparatus (powerful pharyngeal teeth) that allows it to effectively grind the tough cellulose of aquatic plants, whereas most local species consume only soft filamentous algae or young shoots in limited quantities. The role of the common rudd (*S. erythrophthalmus*), often categorized as a phytophilic species, deserves separate consideration. However, studies by Strayer (2010) and domestic ichthyologists indicate that the share of higher aquatic vegetation in the rudd's diet rarely exceeds 15–20%, with preference given to zooplankton and insect larvae. Consequently, it cannot provide significant removal of *Elodea canadensis* biomass under conditions of its monodominant growth. Thus, the introduction of grass carp remains an unrivaled method of biological reclamation for water bodies with high rates of macrophyte overgrowth. This is due to its ability to consume a volume of vegetation daily equal to 100–120% of its own body weight, a trait not characteristic of any representative of the local ichthyofauna (Onyshchenko & Andrienko, 2012).

4.3 Justification and Calculation of Biological Reclamation Parameters

To regulate the excessive phytomass of *Elodea canadensis* in the studied lakes, the most rational approach is the application of biological reclamation via the introduction of grass carp (Ctenopharyngodon idella). The choice of this species is dictated by its high trophic selectivity towards submerged soft vegetation and its intensive metabolism. The calculation of the required number of fish is performed using the formula (Hrynzhevskyi, 1998):

$N = (P \times S \times K) / (W \times D)$,

where N – total number of fish (pcs); *P* – average biomass of *Elodea* per unit area (kg/ha); *S* – surface area of the water body (ha); K – consumption coefficient (fraction of biomass to be removed, typically 0.5–0.7); W – average weight of the fish (kg); D – feed conversion ratio (amount of vegetation consumed per 1 kg of fish weight gain; for *Elodea canadensis*, D ≈ 30–40).

Taking into account the second stage of overgrowth and significant projective cover (up to 50%), the average stocking density for the Desna floodplain lakes is set at 200 individuals per hectare (with a weight of 0.5 kg).

Calculation for the studied objects:

1. Lake Karashnya (5 ha):

$N_1 = 200\ pcs/ha \times 5\ ha = 1000\ pcs.$

To achieve a reclamation effect within one season, stocking with 1000 individuals is recommended.

2. Lake Harmashove (10 ha):

$N_2 = 200\ pcs/ha \times 10\ ha = 2000\ pcs.$

Given the large area, it is advisable to use 2000 individuals of two-year-old grass carp.

3. Lake Yamochka (10 ha):

$N_3 = 200\ pcs/ha \times 10\ ha = 2000\ pcs.$

Similarly to the previous object, the calculated quantity is 2000 individuals.

4.4 Practical Recommendations for Post-Stocking Monitoring

The effectiveness of biological reclamation of floodplain lakes with grass carp depends not only on the accuracy of stocking density calculations but also on systematic monitoring of the ecosystem during the post-reclamation period. Based on the hydro-ecological characteristics of Lakes Harmashove, Karashnya, and Yamochka, the following measures are proposed:

Firstly, it is necessary to ensure hydrochemical regime control. During the first two years after stocking, monthly monitoring of dissolved oxygen content should be conducted, especially during pre-dawn hours in July and August. Massive consumption of *Elodea* and subsequent fish defecation increase the organic load on the water body, which may trigger secondary pollution and oxygen deficiency.

Secondly, regular assessment of phytomass dynamics is essential. Following the methodology of Yakubenko et al. (2018), annual surveys of *E. canadensis* projective cover should be performed. If the cover drops to 10–15%, the stocking intensity should be reduced or temporarily suspended to avoid the complete destruction of aquatic vegetation, which could lead to shoreline destabilization and the loss of spawning grounds for indigenous fish.

Thirdly, constant ichthyological supervision should be carried out. It is crucial to monitor the linear and weight growth rates of the introduced grass carp. A lack of growth despite the presence of a food base may indicate disease or high competition from local species (e.g., rudd at early stages).

Fourthly, flood risk management is a critical aspect. Given the connection of the lakes to the Desna riverbed during floods, the installation of temporary fish-blocking structures (mesh screens) at outflow points is recommended to prevent the migration of the reclaimer beyond the study areas

5. Conclusion and Recommendations

The comprehensive analysis of the Desna River floodplain water bodies confirms a critical level of ecosystem transformation under the influence of *E. canadensis*, necessitating the immediate implementation of scientifically based biological reclamation methods to preserve the hydrological status of these sites.

5.1 Conclusion

Firstly, it has been established that the floodplain lakes of the middle reaches of the Desna River (Harmashove, Karashnya, Yamochka) are in an active stage of eutrophication, with the majority of their water area at the second stage of overgrowth. A characteristic feature of these ecosystems is the formation of monodominant submerged communities of *Elodea canadensis*, leading to the displacement of indigenous hydrophytes and accelerated siltation of the water bodies.

Secondly, an analysis of the local ichthyofauna structure demonstrated that indigenous species (Prussian carp, bream, rudd, etc.) are unable to effectively restrain the expansion of "water plague" due to the lack of narrow specialization in macrophyte consumption. This justifies the necessity of applying biological reclamation via the introduction of grass carp (*Ctenopharyngodon idella*).

Thirdly, based on the morphometric data of the lakes and the assessment of Elodea projective cover (25–50%), optimal stocking rates were calculated. For Lakes Harmashove (10 ha) and Yamochka (10 ha), the recommended quantity is 2000 individuals each; for Lake Karashnya (5 ha) – 1000 individuals (assuming the use of two-year-olds with an average weight of 0.5 kg).

5.2 Recommendations

The successful implementation of reclamation measures requires the introduction of a post-reclamation monitoring system. This involves regular control of the hydrochemical regime (especially oxygen content), annual assessment of phytomass dynamics following the methodology of Yakubenko et al. (2018), and management of flood risks to prevent the migration of the reclaiming fish beyond the study areas.

References

[1] Dubyna, D. V., Dziuba, T. P., Dvoretzkiy, T. V., Zolotariova, O. K., Taran, N. Yu., Mosyakin, A. S., Iemelianova, S. M., & Kazarinova, G. O. (2017). Invasive aquatic macrophytes of Ukraine. *Ukrainian Botanical Journal*, *74*(3), 248–262. https://doi.org/10.15407/ukrbotj74.03.248.

[2] Hrynzhevskyi, M. V. (1998). *Akvakultura Ukrainy* [Aquaculture of Ukraine]. Vilna Ukraina. {Book}

[3] Protopopova, V. V. (1989). *Roslyny-mandrivnyky* [Traveler plants]. Radianska shkola. {Book}

[4] Protopopova, V. V., & Shevera, M. V. (2019). Invaziini vydy u flori Ukrainy. I. Hrupa vysokoaktyvnykh vydiv [Invasive species in the flora of Ukraine. I. The group of highly active species]. *Geo&Bio, 17*, 116–135. https://doi.org/10.15407/gb.2019.17.116

[5] Onyshchenko, V. A., & Andrienko, T. L. (Eds.). (2012). *Fytoriznomanittia zapovidnykiv i natsionalnykh pryrodnykh parkiv Ukrainy. Ch.2. Natsionalni pryrodni parky* [Phytodiversity of nature reserves and national nature parks of Ukraine. P.2. National nature parks]. Phytosociocentre.

[6] Strayer, D. L. (2010). Alien species in fresh waters: Ecological effects, interactions with other stressors, and prospects for the future. *Freshwater Biology*, *55*(s1), 152–174. https://doi.org/10.1111/j.1365-2427.2009.02380.x

[7] U.S. Geological Survey. (2023). *Elodea canadensis (Canadian waterweed) fact sheet*. Nonindigenous Aquatic Species Database. https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=2843

[8] U.S. Geological Survey. (2023). *Ctenopharyngodon idella (Valenciennes in Cuvier and Valenciennes, 1844)*. Nonindigenous Aquatic Species Database. https://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=514

[9] Yakubenko, B. Ye., Popovych, S. Yu., Ustymenko, P. M., Dubyna, D. V., & Churilov, A. M. (2018). Heobotanika: Metodychni aspekty doslidzhen [Geobotanics: Methodical aspects of research]. Lira-K. {Book}

[10] Zub, L. M., & Karpova, H. O. (2012). Biotopy pryrodnykh vodoim ta vodotokiv Ukrainy, shcho potrebuiut okhorony [Biotopes of natural water bodies and watercourses of Ukraine that require protection]. In *Biotopy (oselyshcha) Ukrainy: naukovi zasady ikh doslidzhennia ta praktychni rezultaty inventaryzatsii* [Biotopes (habitats) of Ukraine: scientific principles of their research and practical results of inventory] (pp. 168–175). Kyiv.