

Invasive species in ecosystems are a cause of their transformation, and in some cases, even degradation. With the aim of an in-depth study of the invasion of *Cydalima perspectalis* (Walker, 1859) and *Arion lusitanicus* sensu lato, we analyzed their global distribution, invasion in Ukraine, and the massive damage caused by these invasions.

The chronology of their spread was studied using literature sources and international databases: Global Biodiversity Information Facility (GBIF), Delivering Alien Invasive Species Inventories for Europe (DAISIE), and European and Mediterranean Plant Protection Organization (EPPO). The history of the species' penetration into Ukraine and specifically into the Chernivtsi region was determined from literature sources, the National Biodiversity Information Network (UkrBIN) database, through surveys, and personal observations made via route surveys.



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The most significant animal invasions in Chernivtsi region (Ukraine)

Cydalima perspectalis (Walker, 1859) and *Arion lusitanicus* sensu lato, and the formation of their secondary ranges

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INTRODUCTION

Biological invasions contribute significantly to the decline in global biodiversity (Logvynenko, 2020), with their impact increasing due to globalization. Insects are ranked as the second most dangerous group of invasive organisms, after vascular plants (Bradshaw et al., 2016; Canelles et al., 2021). They have severe negative effects on ecological systems (Balashov et al., 2018; Pfenninger et al., 2014; Rowson et al., 2014; Pimentel et al., 2000), making monitoring their spread essential.

The growing attention to invasive species projects in Europe stems from their significant ecological impact in recent years (Roques et al., 2010). Uncontrolled expansion of adventive pests is now a pressing global issue (Meshkova et al., 2014), particularly for phytophagous insects, which thrive in urban ecosystems (Kardash, 2021).

Biodiversity underpins ecosystem stability and the functioning of natural processes. Its loss is a major ecological threat, affecting both ecosystems and human well-being. Biological invasions disrupt ecosystems by reducing native species, altering ecological niches, and disturbing natural balance. Invasions occur when species are introduced into new habitats, often due to human activity, climate change, and other environmental conditions. Alien species disrupt local biodiversity, outcompeting native species and altering food webs and ecosystem services.

In Ukraine, invasive species are an increasing concern, particularly in the Chernivtsi region, which is rich in biodiversity. Its varied landscapes, including forests, rivers, and mountains, support many native species but also make it vulnerable to invasive species.

Among the most concerning invasives in Chernivtsi are *Cydalima perspectalis* (box tree moth) and *Arion lusitanicus* (Spanish slug). The box tree moth, a major pest of boxwood plantations, damages plants by feeding on leaves and bark. The Spanish slug disrupts agriculture by feeding on a wide variety of crops, causing significant harm to both cultivated and natural ecosystems. Human activities,

including trade, transportation, and habitat alteration, play a significant role in the spread of invasive species. Combined with environmental changes like climate warming and land use change, these factors create conditions that allow invasives to thrive. Understanding these dynamics is crucial for developing strategies to prevent further spread and protect native biodiversity.

Research on biological invasions has increasingly relied on mathematical models and computational simulations to understand the drivers and dynamics of invasive species spread (Parnell et al., 2017; Montgomery et al., 2023), which requires comprehensive, up-to-date data.

We provide the results of analysis of the most harmful invasive species in Chernivtsi region, examining their biology, ecological distribution, and the damage they cause to ecosystems. The research focuses on understanding the dynamics of these invasions and by analyzing their historical and current spread and ecological impacts contributes to efforts to mitigate biological invasions in Ukraine. With the aim of an in-depth study of the invasion of *Cydalima perspectalis* (Walker, 1859) and *Arion lusitanicus* sensu lato, we analyzed their global distribution, invasion in Ukraine, and the massive damage caused by these invasions. The chronology of their spread was studied using literature sources and international databases: Global Biodiversity Information Facility (GBIF), Delivering Alien Invasive Species Inventories for Europe (DAISIE), and European and Mediterranean Plant Protection Organization (EPPO). The history of the species' penetration into Ukraine and specifically into the Chernivtsi region was determined from literature sources, the National Biodiversity Information Network (UkrBIN) database, through surveys, and personal observations made via route surveys.

The spread of *Cydalima perspectalis* and *Arion lusitanicus* in Chernivtsi region, Ukraine underscores the need for comprehensive research and management strategies to address the challenges posed by these species.

Keywords: *Cydalima perspectalis* (Walker, 1859), *Arion lusitanicus* sensu lato, invasive species, pest damage, expansion.

CHAPTER I. THE CHALLENGE OF BIODIVERSITY CONSERVATION

Biodiversity represents the life that surrounds us: genes that reflect intraspecific diversity, species of plants and animals, and ecosystems that provide a variety of services. However, among the key environmental challenges of the 21st century, the reduction of biological diversity holds a prominent and special place.

The issue of biodiversity conservation has received significant attention through international conferences, and several documents and conventions have been adopted. The most significant is considered to be the 1992 UN Framework Convention on Biodiversity Conservation, which includes the Strategic Plan for the Conservation of Global Biological Diversity (Convention on Biological Diversity..., 1992).

In 2016 in Cancun (Mexico), hosted the Conference of the Parties to the Convention on Biological Diversity. As a result, the Cancun Declaration was adopted, obligating countries to address biodiversity issues at all levels and sectors. These efforts include sectoral and cross-sectoral policies, plans, and programs, as well as legal, administrative, and budgetary measures, aimed at regulating, utilizing, and restoring biodiversity and ecosystems (Yakymchuk, 2014).

In May 2020, the European Commission presented an important conservation document – “EU Biodiversity Strategy for 2030: Bringing Nature Back into Our Lives”. This document outlines concrete commitments and actions to be undertaken across the EU by 2030 (Biodiversity strategy for 2030 ..., 2020).

In 2022 the UN Biodiversity Conference (COP15) took place in Montreal (Canada), where significant agreements were made: the International Agreement to protect 30% of land and oceans by 2030 and the Kunming-Montreal Global Biodiversity Framework. The goals and indicators of the program are described in detail by Chinese researchers Alice C. Hughes and R. Edward Grumbine (Hughes & Grumbine, 2023).

Global biodiversity loss is driven by factors typically associated with human activity, which either operate independently or in various combinations. These factors include deforestation and habitat degradation, environmental pollution, climate change, urbanization and infrastructure development, overexploitation of natural resources, and invasive species. Invasive species, in particular, cause significant harm and economic damage to countries worldwide. The negative impact of alien species on biodiversity is most acutely felt in regions where plant cover is fragmented (Protopopova et al., 2009).

Human activity provokes a decline in the population of some organisms and an increase in others, leading to modifications and transformations in the interactions between organisms and their environment. In general, all sectors that use natural resources – whether for raw materials or as a place for waste – contribute to the reduction and extinction of natural species. A particular focus is placed on the impact of agricultural activities on biodiversity, as natural ecosystems are transformed into artificial ones. These agro-systems are characterized by limited nutrient cycles, closed systems, short food chains, low diversity of living organisms, and severe erosion. Ultimately, due to pollutant emissions into the atmosphere, discharge of wastewater into various water bodies, burial of solid and toxic waste, and extensive use of natural resources, the functionality of ecosystems is disrupted.

Biological invasions - a global threat to biodiversity

Over the past decade, the processes of biological invasion have accelerated globally. This refers to the invasion of alien species into new habitats. These invasions are currently very active and have a range of negative consequences. Biological invasions are one of the reasons for the decline in biodiversity on Earth (Logvynenko, 2020), and their role is increasing due to the acceleration of globalization. In terms of their impact on ecosystems, insects are classified as the second most dangerous group of invasive organisms after vascular plants (Bradshaw et al., 2016; Canelles et al., 2021).