Alien and Invasive Plant Species Management Strategy in the Bohemian Switzerland National Park and the Elbe Sandstones Protected Landscape Area 2025—2041

Jan Pergl, Irena Perglová, Handrij Härtel

Institute of Botany of the Czech Academy of Sciences, v.v.i.
&
Bohemian Switzerland National Park Administration
2025

Alien and invasive plant species management strategy in the Bohemian Switzerland National Park and the Elbe Sandstones Protected Landscape Area 2024—2041

Authors:
Jan Pergl, Irena Perglová, Handrij Härtel

cooperation with:
Ivana Marková, Petr Bauer, Dana Vébrová, Petr Kočka

Front page photo: Invasive plant species in the Elbe Valley between Děčín and Dolní Žleb. Photo Jan Pergl.

Content

Abstract

Alien and invasive plant species management strategy in the Bohemian Switzerland National Park and the Elbe Sandstone Protected Landscape Area 2024—2041 sets out measures that aim to reduce the negative impacts of selected alien and particularly invasive plant species in the long term. As various management restrictions exist, the strategy prioritizes the goals according to the type of territory, the needs of nature conservation, and the type of available measures. Besides the management measures, the Strategy proposes achieving goals through mapping, monitoring, and awareness campaigns. Management measures are then further divided according to individual species or species groups and by the type of territory.

The priority goals in the area of alien and invasive plant species in the area of the Bohemian Switzerland National Park and the Elbe Sandstones Protected Landscape Area are as follows:

- Inform and involve the public and other target groups in documenting, monitoring, and managing alien and invasive species and strive to set up sustainable landscape management (Chapter 3.2).
- To improve the current state of extremely valuable sites by removing selected species, such as the Kamenice Gorges, Růžák National Nature Reserve and Elbe Canyon National Nature Reserve, and to ensure continuous monitoring and management of these sites. (Chapter 3.3).
- Prevent the 2022 fire site from becoming the centre of invasions in the BSNP due to the great potential for the spread of invasive species that formed after the bark beetle gradation and after the fire and ensure continuous monitoring of the fire site.
- For selected species, ensure monitoring and management of key sites for further spread (especially along watercourses).

*Fig. Invasion of the Jerusalem artichoke sunflower (*Helianthus tuberosus*) in the Elbe Valley. Since it is often grown as an ornamental, it is necessary to work with the public. Photo by Jan Pergl.*

1. Introduction

1.1. General background

The introduction of alien species, along with changes in habitat quality, climate change, increasing use of natural resources and environmental pollution is considered to be the main processes that significantly negatively affect global biodiversity (Roy et al. 2023; Pyšek et al. 2020; Vilà et al. 2010). Invasive species, introduced by humans outside their range of origin, are the cause of many environmental and socio-economic problems. Some introduced species reduce the diversity of native species, produce allergenic pollen or transmit diseases of livestock and cultivated plants (Pergl 2008). Although only a small number of alien species have such a significant negative impact, the estimate of the total damage caused by these species is enormous.

The number of alien species, present not only in the Czech Republic, is still growing as a result of their intentional and accidental introduction (Hulme et al. 2008; Pyšek et al. 2022; Seebens et al. 2017). The preventive approach is one of the most effective and cost-effective in terms of invasion management. Prevention action involves informing the public, experts and stakeholders in a broader context about the consequences and problems associated with alien species. These actions relate to monitoring, which falls under both professional institutions and can also use citizen science. It is very important to involve expert and vocational groups in preventive actions, which may unknowingly contribute to the undesirable spread of alien species.

Although only a part of geographically alien species are dangerous invasive species, even this minority group of introduced species causes significant problems worldwide due to its extensive impact on the environment and overall socio-economic impact (Bacher et al. 2018, Blackburn et al. 2014, Jeschke et al. 2014), not only in terms of the impact of biodiversity threats, where introduced species together with extinctions of rare species lead to the homogenization of European flora (Winter et al. 2009), but also in terms of its impact on ecosystem services (Vilà et al. 2010) and biochemical cycles in nature, and ultimately in terms of direct economic damage. Data on the economic impacts associated with alien species (losses and costs associated with invasive species control) show that globally, between 1970 and 2017, these impacts were at least around $1.3 trillion, with amounts rising from an average of $26 billion per year to nearly $162 billion per year during this period (Diagne et al. 2021). Moreover, this estimate is considered a significant underestimate (Novoa et al. 2021). Similarly, in Europe, the total costs associated with invasive species reached more than €116 billion ($140 billion) between 1960 and 2020, 60% of which were associated with direct damage in various sectors (Haubrock et al. 2021). Based on the available data, it is necessary to consider the continuing trend of increasing the number of alien species in the Czech Republic (Pyšek et al. 2012, 2022).

Plant invasions do not avoid protected areas either, despite analyses showing that protected areas function to a certain extent as barriers against the spread of invasive species (Pyšek et al. 2003, Foxcroft et al. 2011, 2013a). Thus, although examples from small-scale protected

areas have shown a significantly lower percentage of alien plant species, especially if they were part of large-scale protected areas (Pyšek et al. 2002, Foxcroft et al. 2013b), this picture is less optimistic if we focus mainly on the presence of widespread invasive plant species in protected areas (Pyšek et al. 2013). In other words, although fewer alien species are in protected areas, the most important and widespread invasive species are often also represented. At the same time, from the point of view of a possible impact on the protected area, it is not so much the number of alien species that is decisive, but rather which species are present. The case of a relatively dramatic invasion of eastern white pine (*Pinus strobus*) in the Bohemian Switzerland National Park documents well that an invasion of a single species can cause a fundamental change in the entire ecosystem (Härtel 2017).

Practical examples clearly show how an important prerequisite for the successful eradication or suppression of selected invasive species is a properly spatially and temporally set strategic framework (Pluess et al. 2012, Simberloff 2009, Veitch & Clout 2002). Resignation to the spread of some invasive species, which can be quite often encountered among nature conservationists, may not always be justified, and on a local scale it may only be the result of inconsistent or poorly set management of these invasive species, when, for example, for administrative or other operational reasons, the intervention is carried out for too short a period of time, or it is not implemented in some years, e.g. due to non-existent means, or it is applied at an inappropriate time of the year. In addition, it has been shown that some approaches presented as environmentally friendly (e.g. no use of herbicides) are worse in overall impact than single or controlled use herbicides (Hocking et al. 2023, Pergl et al. 2020).

1.2. Goals of The Strategy of management for invasive plant species in the Bohemian Switzerland National Park and the Elbe Sandstone Protected Landscape Area

The presented Invasive plant species management strategy in the Bohemian Switzerland National Park (referred to as BSNP) and the Elbe Sandstone Protected Landscape Area (referred to as ESPLA) (referred to as the "Strategy") builds on the existing positive experience with the management of alien and invasive species in this region and comparable territories with the aim of setting the procedures for the prevention, recording, monitoring and eradication/suppression of selected alien and invasive species in the medium term (2024-2041), while specifying the more general principles that presented in the draft of Management Principles for the Bohemian Switzerland National Park for the period 2024-2041 and also the Management Plan for the Elbe Sandstone Protected Landscape Area for the period 2011-2020 (with extended validity until 2025).

The strategy focuses on the entire spectrum of alien species, as the invasion process is dynamic and the naturalization and subsequent invasion of an introduced species may occur over time. Therefore, general measures, particularly prevention and monitoring, are directed at alien species in general. However, given the impact of already established alien species with significant influence, specific management measures are primarily targeted at invasive species. Invasive species are a subgroup of alien species and are characterized by rapid spread and negative impacts on biodiversity and humans.

Although the goal of nature protection in the BSNP or ESPLA cannot be only static protection of species and biotopes, it is not possible due to the significant negative impacts of some invasive species to resign and only passively observe their spread. Therefore, it is necessary to reduce some of these alien species actively. This approach is based on the fact that the mean of land use has changed significantly over the last decade; many plots are unmanaged or abandoned, ruderalization and nutrient enrichment occur in many places, or, on the contrary, in some sites is very intensive economic use with negative impacts on the surroundings. At the same time, the ever-increasing strong tourism and transport allow many species to spread quickly to new locations, from which they can spread further. The spread is also associated with the intensification of transport and road maintenance, where, for example, in terms of costs, materials are transported from distant locations and contaminated substrate may be transported.

It is clear from the above that the success of the submitted Strategy depends not only on the activities of nature conservation in the BSNP and ESPLA itself, but also on the broader geographical context, because in the Central European conditions with a typically large number of small protected areas, it is never possible to look for a solution to the problem of alien and invasive species in isolation, only within the protected areas themselves, but exclusively in broader landscape contexts. Given the fact that both regions (BSNP and ESPLA) are very strongly connected to their surroundings, whether by natural corridors (the Elbe River, smaller watercourses running from outside, adjoining forest areas) or technical infrastructure (river transport, port in Děčín, international and regional railway and road network). The invasion of alien species is a dynamic process, and therefore it is necessary to involve the surrounding landscape and its users in the implementation of the Strategy. Land owners, tenants and land managers must be involved in the implementation of the Strategy, as they are also responsible for landscape maintenance and thus significantly influence the spread of selected species. For these reasons, the Strategy also formulates goals in the field of citizen science and public relations. The need for broader cooperation between nature conservation and other stakeholders is necessary not only for successful eradication but also for prevention as the most effective way to counter alien and invasive species (Robertson et al. 2020). Due to the cross-border nature of the Saxon-Bohemian Switzerland region, cooperation and optimal alignment of the approach to management in the Saxon Switzerland National Park and Protected Landscape Area (Härtel et al. 2015) is essential, and not only for species that are on the list of invasive species with a significant impact on the EU (Regulation (EU) 2016/1141 of the European Commission and of the Council, including further updates of the lists).

2. Background

2.1. Invasive and alien plant species in the region of BSNP and ESPLA

2.1.1. Invasive and alien species in the documents of the BSNP and ESPLA

Invasive species are described in Chapter 2.9 of the Management Plan for the Protected Landscape Area. In this material, alien species are divided into two groups according to their impact on natural ecosystems and native species (text according to the management plan for the PLA).

I. Most dangerous: Species invading the territory and destroying natural ecosystems and species. The following species require elimination measures and monitoring: eastern white pine (*Pinus strobus*), japanese knotweed (*Reynoutria japonica*), sakhalin knotweed (*Reynoutria sachalinensis*), bohemian knotweed (*Reynoutria ×bohemica*), himalayan balsam (*Impatiens glandulifera*), black locust (*Robinia pseudacacia*), canadian goldenrod (*Solidago canadensis*), giant goldenrod (*Solidago gigantea*), box elder (*Acer negundo*), tree of heaven (*Ailanthus altissima*), giant hogweed (*Heracleum mantegazzianum*), the heart-leaved oxeye (*Telekia speciosa*).

II. Species with unpredictable invasive influences, locally spreading; species with need to monitor and, in the case of invasive behaviour, measures leading to eradication must be implemented. It is not possible to predict whether these species will spread or whether they are in the lag phase and are still waiting for "their" opportunity.

Furthermore, the management plan for the ESPLA sets out the goals in the area of invasive and alien species. The proposed measures are, for example, to support removing invasive trees such as white pine and black locust using economic tools for nature conservation.

The long-term goal is to have the territory of the PLA free of key invasive species and their outbreaks in the vicinity (possible source of propagules for the BSNP and ESPLA). A partial goal is to have sites with rare and endangered communities and species free of alien invasive and expansive species. Furthermore, the document describes in more detail the proposed measures included in the mapping, targeted management, and information campaigns groups.

With regard to the long-term validity of the management plan, the spread of other species cannot be ruled out in the future. At present, the newly spreading species are *Prunus serotina* or *Senecio inaequidens*.

Fig. 2.1.1. Heracleum mantegazzianum *occurs only rarely in the BSNP and ESPLA. The occurrence in the Kyjov Valley shown in the photograph was promptly eradicated (2015). Photo by Handrij Härtel.*

2.1.2. Important invasive and alien species affecting the territory of the BSNP and ESPLA

There are 1576 alien plant species reported in the Czech Republic, of which 75 are classified as invasive (Pyšek et al. 2022). In the list of Pergl et al. (2016), alien species are divided into several categories according to the negative impact and character of spread to black, gray and warning lists. Regulation (EU) 2016/1141 of the European Commission and of the Council and its annexes identify species for which monitoring and possible regulation must be ensured (according to the conditions set by the Act on Nature and Landscape Protection No. 114/1992 Coll. and its amendments). The combination of these data and field surveys allowed us to identify a group of alien species included in this Strategy (Table 1). From the Pladias database (Wild et al. 2019), the species distribution was identified in the area of the BSNP, ESPLA, and also in the neighbouring Protected Landscape Areas of the České středohoří Mts. and the Lužické hory Mts. However, it should be emphasized that the list is not definitive and immutable. It needs to be updated and revised regularly.

2.1.3. Assessment of alien and invasive species according to their impact

The definition of an invasive species does not always depend on the impact on the environment (biodiversity) or humans (socio-economy). In terms of evaluation, which is independent of the user, it is necessary to proceed from a standard methodology. The impact itself is then the result of a combination of local conditions, scale, time range, etc. There is a difference whether the results will be applied in a valuable protected area, in an open agricultural landscape or in an urban area. Similarly, the approach to results will differ between user groups, i.e. between nature managers, foresters, farmers, fishermen, the general public or gardeners (van Wilgen & Richardson 2014).

An appropriate approach to assessing the impact of species is to use the EICAT scheme (Blackburn et al. 2014). For the prioritization of species for management, we relied on work on the impact of alien species, processed for the conditions of the Czech Republic in the catalogue of alien species (Pyšek et al. 2022, Table 2.1.3), with regionally important invasive species also added to the priority species.

The impact assessment thus showed significant alien species for which it is necessary to intervene as a priority.

Table 11. Assessment of environmental impacts for invasive species for which data were available by using EICAT (Environmental Impact Classification for Alien Taxa; Blackburn et al. 2014). The maximal EICAT score recorded, the mechanisms to which the highest score refers (mechanisms of maximal impact) and other impact mechanisms exerted by the species are shown. References to papers in which the maximal scores are reported are given. EICAT scores: minimal concern (MC), minor (MN), moderate (MO), major (MR), massive (MV). Impact mechanisms identified for the species assessed: 1 – competition, 3 – hybridization, 6 – poisoning/toxicity, 9 – chemical impact on the ecosystem, 10 – physical impact on the ecosystem, 11 – structural impact on the ecosystem, and 12 – indirect impacts through interactions with other species.

Taxon	Maximal EICAT score	Mechanism of maximal impact	Other impact mechanisms	Reference
Ailanthus altissima	MR	1, 11	9	Uboni et al. 2019, Terzi et al. 2021
Ambrosia artemisiifolia	MO	1, 9, 11		Sărăţeanu et al. 2010, Qin et al. 2019
Arrhenatherum elatius	MR	1	11	Fiala et al. 2004
Asclepias syriaca	MR	3, 11	9	Dvirna 2018, Broyles & Elkins 2019
Bromus sterilis	MO	11	1	Salamon et al. 2011
Bunias orientalis	MO	1		Steinlein et al. 1996
Cirsium arvense	MO	1		Humber & Hermanutz 2011
Conyza canadensis	MR	1	11	Shah et al. 2014
Cuscuta campestris	MO	12		Lian et al. 2006
Echinops sphaerocephalus subsp. *sphaerocephalus*	MC	9, 11		Řezáčová et al. 2021
Erigeron annuus	MR	1, 11		Wang et al. 2020, Řezáčová et al. 2021
Fraxinus pennsylvanica	MR	1, 11		Schmiedel & Tackenberg 2013, Schmiedel et al. 2013
Helianthus tuberosus	MR	1	11	Filep et al. 2021
Heracleum mantegazzianum	MR	1, 9, 11	10	Hejda et al. 2009, Renčo et al. 2021
Impatiens glandulifera	MR	1, 11	9	Tanner et al. 2013, Bieberich et al. 2021
Impatiens parviflora	MO	1		Florianová & Münzbergová 2016
Juglans regia	MN	1		Loacker et al. 2007
Lupinus polyphyllus	MR	1, 11	9, 10	Ramula & Sorvari 2017, Hejda et al. 2021
Lycium barbarum	MR	11	1	Na et al. 2021
Pinus strobus	MR	9, 11	1	Hadincová et al. 2007, Podrázký & Remeš 2008
Populus ×canadensis	MV	3	11	Smulders et al. 2008
Prunus serotina	MR	1,9, 11	6	Halarewicz et al. 2017, Vegini et al. 2020, Godefroid et al. 2005
Quercus rubra	MR	1,9, 11		Chmura 2013, Gentili et al. 2019
Reynoutria japonica	MR	1, 9, 10, 11		Gerber et al. 2008, Mincheva et al. 2014, Woch et al. 2021
Reynoutria sachalinensis	MR	11		Topp et al. 2008
Reynoutria ×bohemica	MR	1, 11	9	Gerber et al. 2008, Fried et al. 2014
Robinia pseudoacacia	MV	11	1, 9, 12	Landgraf 2002, Chikowore et al. 2021
Rudbeckia laciniata	MR	1	11	Stefanowicz et al. 2017
Rumex alpinus	MR	1	9, 11	Handlová & Münzbergová 2006
Senecio inaequidens	MR	1		Vanparys et al. 2010
Setaria pumila	MO	1, 9		Tozer et al. 2008, Orlandi et al. 2017
Setaria viridis subsp. *viridis*	MO	9		Li et al. 2016
Sisymbrium loeselii	MO	6		Bainard et al. 2009
Solidago canadensis	MR	1, 9, 11	6	de Groot et al. 2007, Zhang et al. 2009, Řezáčová et al. 2021
Solidago gigantea	MR	1	9, 11, 12	Quist et al. 2014
Symphoricarpos albus	MR	1		Gilbert 1995
Symphyotrichum novi-belgii	MR	1		Hejda et al. 2021
Symphyotrichum ×salignum	MN	1		Glushakova et al. 2016
Telekia speciosa	MO	9, 11		Pergl et al. unpublished
Vulpia myuros	MO	1		Brown & Rice 2000

Table 2.1.3. Adapted from Pyšek et al. (2022). Assessment of invasive species in the Czech Republic by using the EICAT system.

2.1.4. Excerption of databases and field sampling

During the years 2020—2022, mapping of selected alien species was carried out along the roads in the BSNP and ESPLA and the adjacent part of the Saxon Switzerland National Park. Due to the fact that most of the monitored species spread along roads that act as corridors, these habitats were monitored as a priority.

During the monitored period, 1264 point occurrences and 1135 polygons of alien species were recorded.

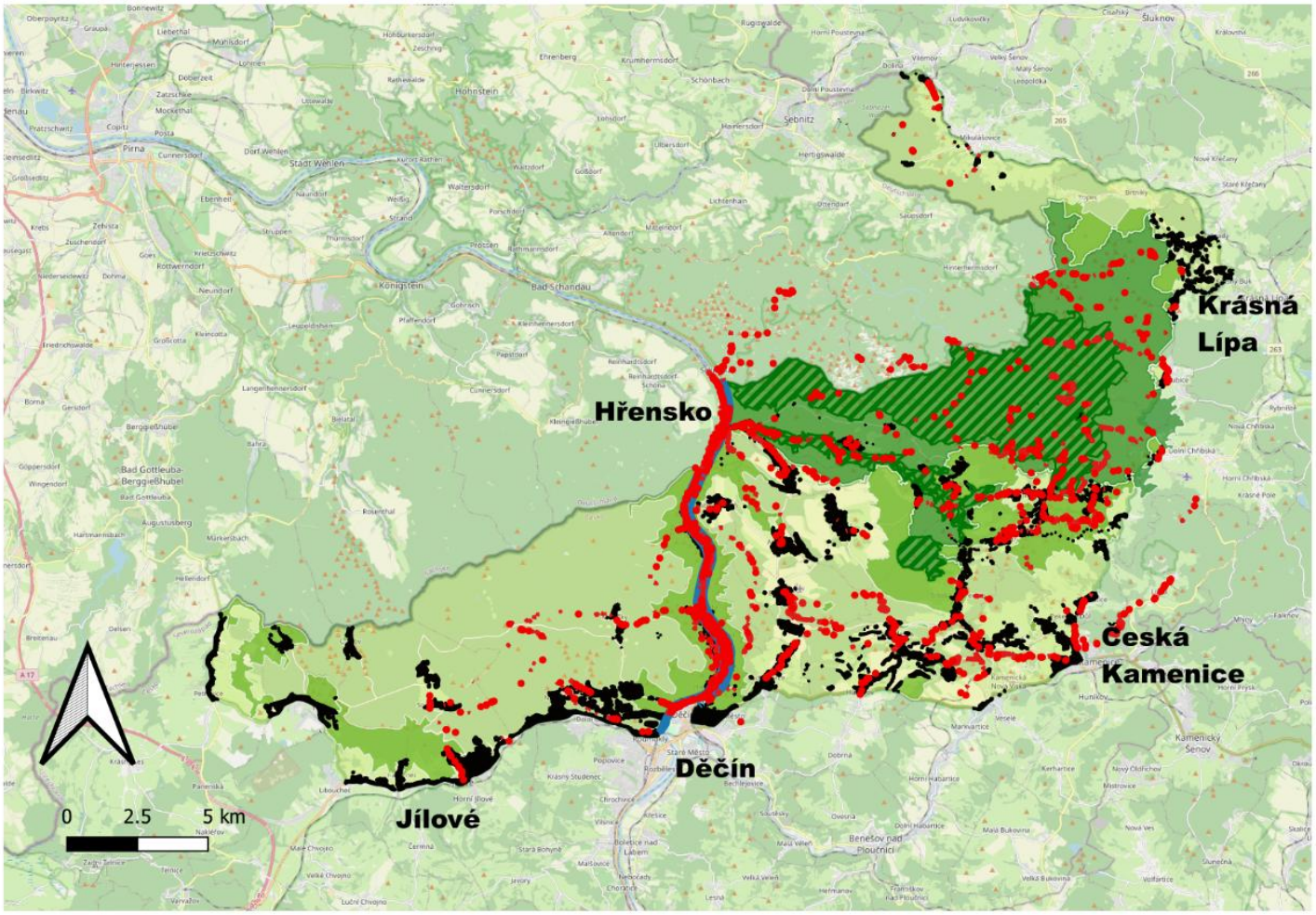


Fig. 2.1.4a. Map with mapping records highlighted (in red). Species were recorded with information about the habitat type (forest, forest edge, river bank, road, urban area, etc.).

From the mapping point of view, other sources that can be used for prioritization of management of alien species are, for example, records in the Species Occurrence Database (NDOP), the BSNP Administration's own mapping or additional and regionally focused studies, as well as data from the monitoring of river muddy banks of the Elbe River, a number of new data were acquired as part of the project focused on mapping of the path network (Pergl 2023) and on the basis of which the prioritization of invasive species was determined.

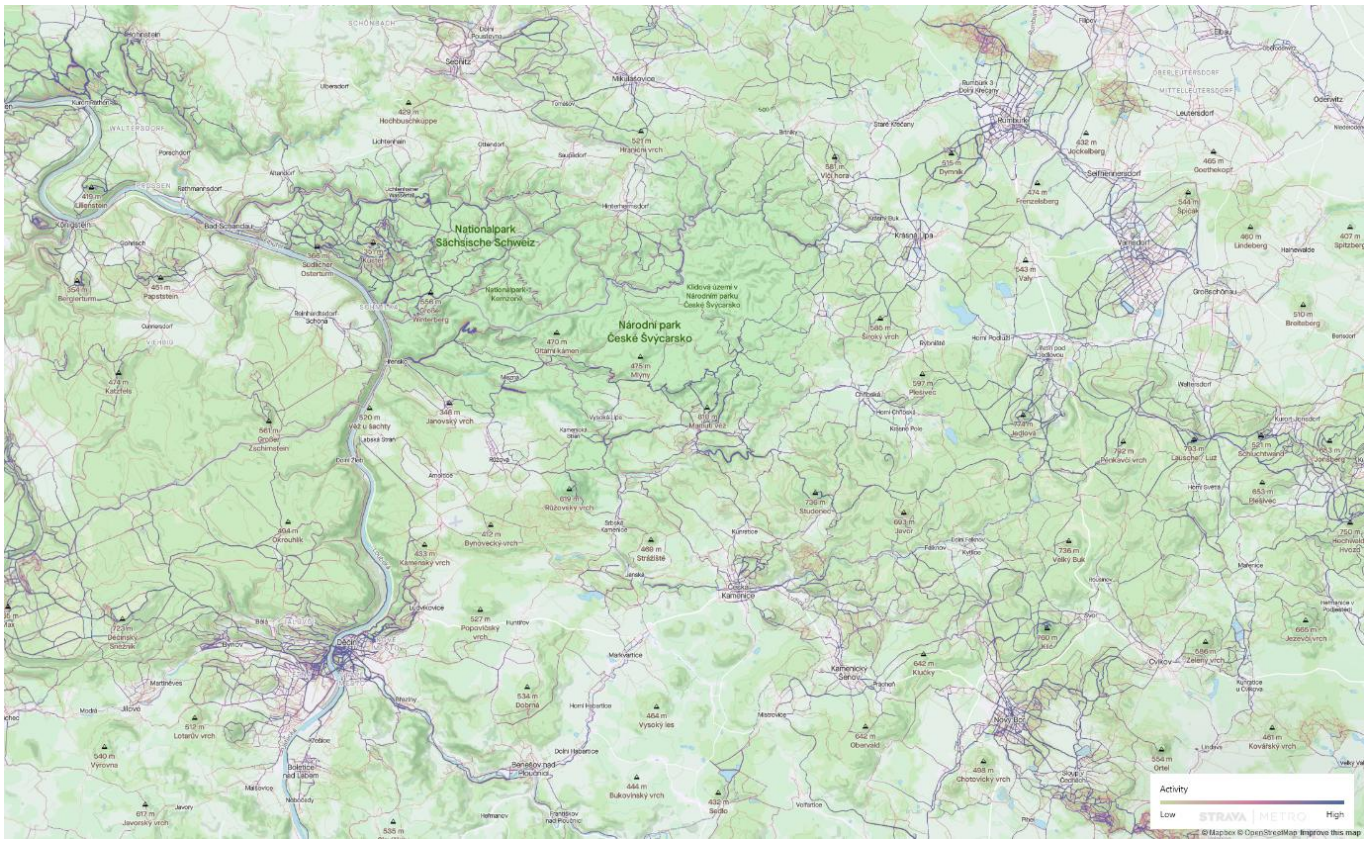


Fig. 2.1.4b. A view of the BSNP and ESPLA with the background from activity maps (walking activities in the period May 2023 - June 2024) mapped by the Strava app (https://www.strava.com/heatmap; downloaded 06/2024).

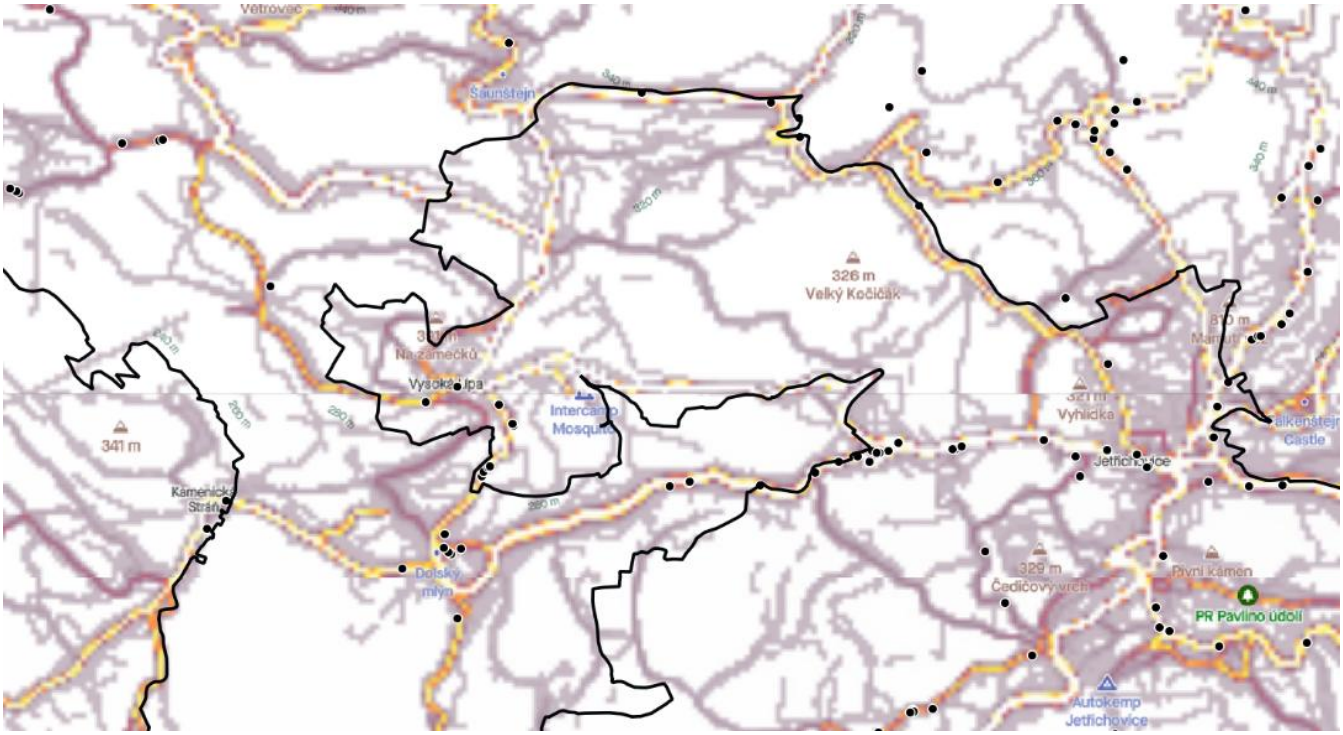


Fig. 2.1.4c. Detail of tourist activity from the Strava application with locations (black points) of mapped alien species. Monitoring data within the 2020—2022 project (Pergl 2023).

From this project, whose results correspond to data on tourist movements within the BSNP and ESPLA (Fig. 2.1.4b and 2.1.4c), it emerged, a. o., that the highest movement intensities occur in the Kamenice gorges, on the approach to Pravčická brána Arch from Hřensko, along the red tourist trail to Mezná, on the circuit around Kyjov, and in the surroundings of Jetřichovice.

However, the analysis of the records of aliens along the path network showed that even off the busy paths, the alien species also occur occasionally. In addition, the activity map (Fig. 2.1.4c) showed a high frequency of activities next to the marked paths. In connection with the bark beetle gradation since 2018 and after the fire in 2022, some paths and movement of visitors have changed.

After the fire, a shift in activities towards accessible roads can be seen. However, it can be seen that even on closed roads, the number of visitors is high (Fig. 2.1.4d).

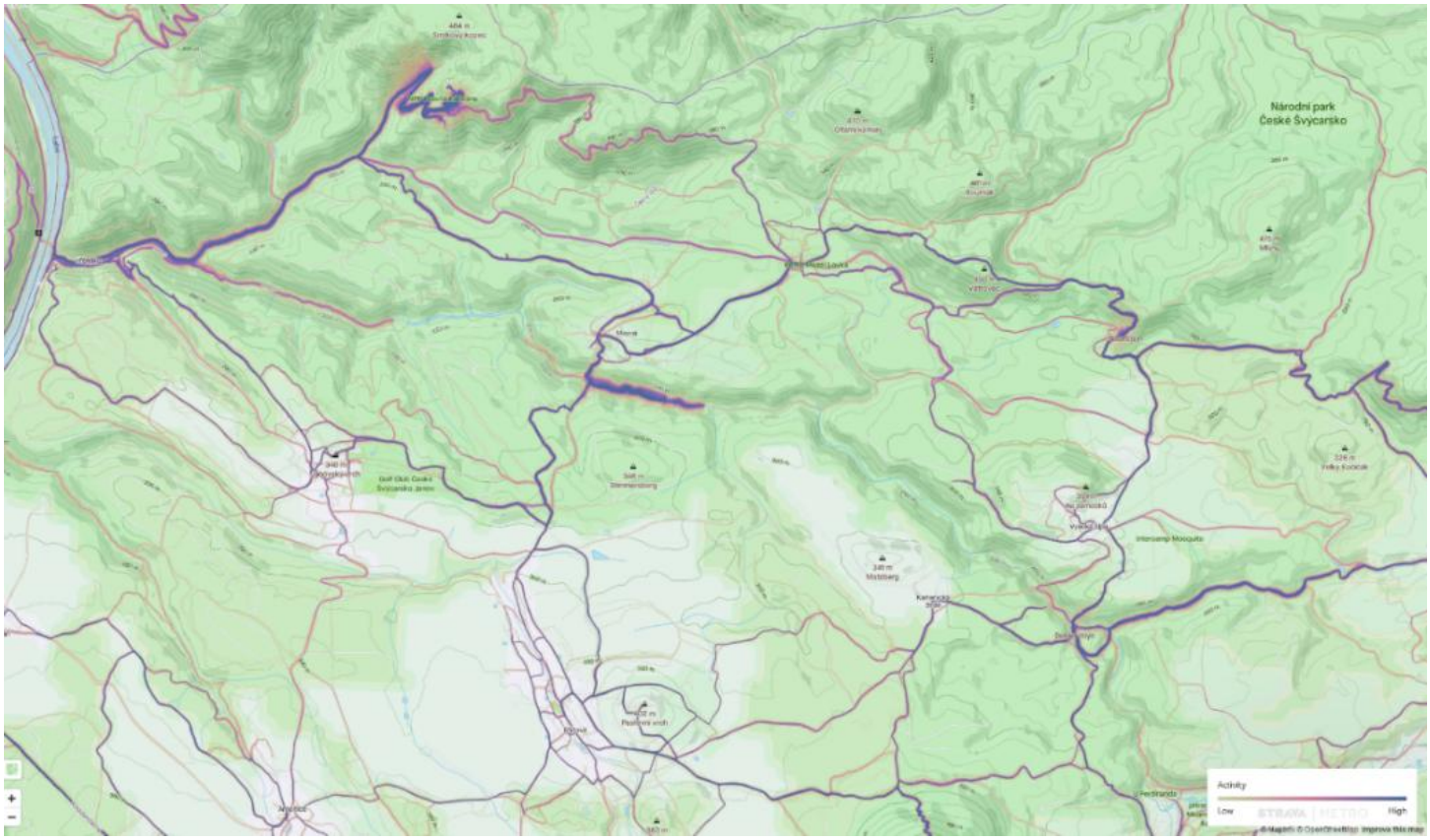


Figure 2.1.4d. Map from the Strava app from 6/2024 for the interval of past year. The data includes walking activities. There is a clear shift of activities to accessible places after the fire. However, movement on closed roads is still high.

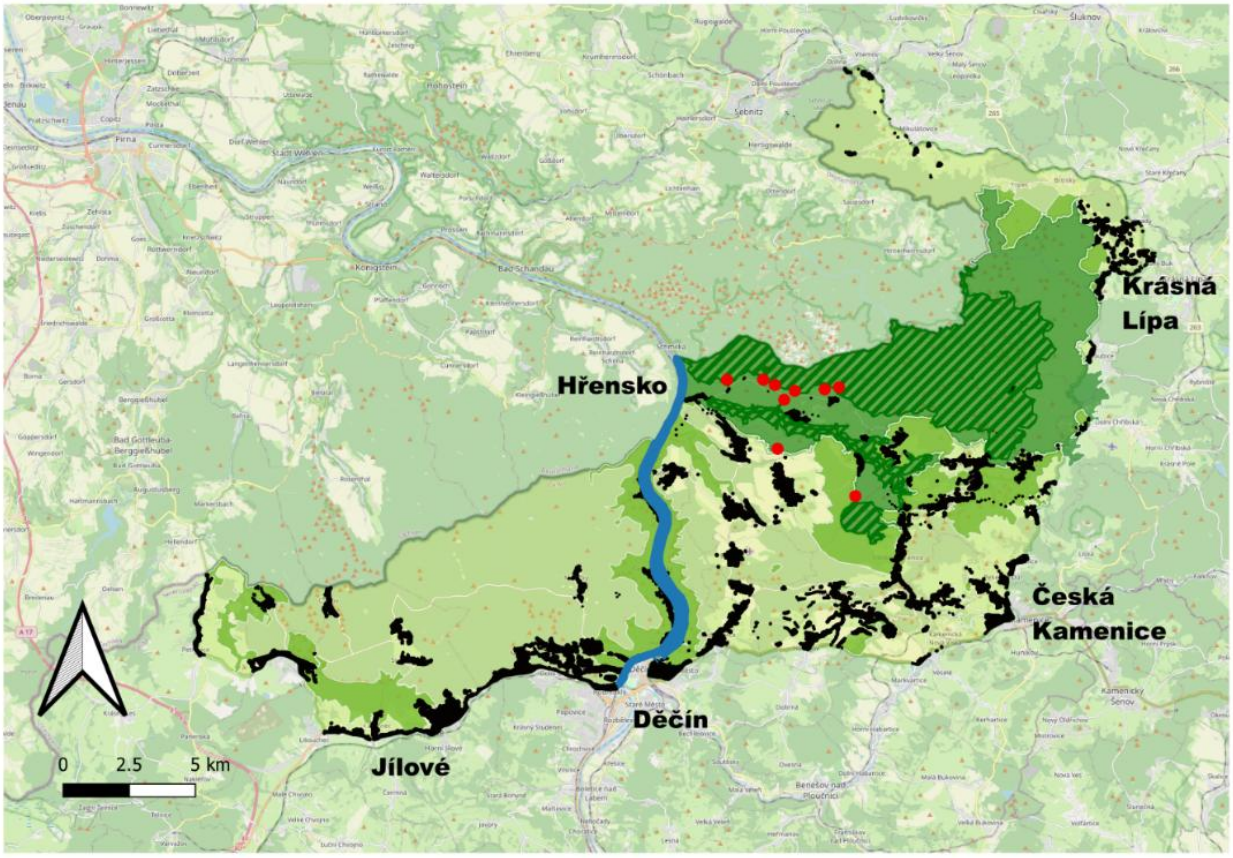


Fig. 2.1.4e. Localization of the automatic counters run by administration of the BSNP and ESPLA.

At present, the BSNP Administration has data from 22 automatic counters (Fig. 2.1.4e). The data from the Strava app can thus be standardized by the actual frequency of visits to the BSNP.

Another factor is the suitability of the surrounding habitats for establishment of propagules and the pathways of introduction (mean and intensity). Disturbed habitats, landfills, rubble sites, composts on the outskirts of settlements, where plant biomass, soil and debris from gardens, buildings, reconstructions, etc., are stored, play a major role. Thus covering them by monitoring, public involvement, education, may lead to minimizing the large number of unintentional introductions of alien species from settlements.

2.1.5. Other projects suitable for mapping and excerpting databases in the context of alien species

There are research projects in which the BSNP Administration is directly involved or coordinates them. Some projects focused on monitoring vegetation changes and recording alien species occurrence are listed in Table 2.1.5.

project	time frame	institution	note
The impact of fire on the biodiversity of forest ecosystems of the BSNP	2023—2026	Biology Centre CAS	a project focused on monitoring biodiversity and succession at the fire site and in control plots; development of monitoring plots, monitoring network, aerial photography
Vegetation restoration after fire in BSNP: importance of seed bank, dispersal of seeds and herbivorous vertebrates	2023—2024	Silva Tarouca Research Institute for Landscape and Ornamental Gardening	study of the seed bank; only partial use
Vegetation composition and microclimate	long term, since 2010	Institute of Botany CAS	dense network of microclimatic stations with phytosociological relevés repeated each year
Strategy and evaluation of invasive plant species management in ESPLA and BSNP	2020—2022	Institute of Botany	mapping of alien species along the path network in BSNP and ESPLA and adjacent parts in Germany; analyses of herbicides, management of *Reynoutria* sp.
BurnIAS – Monitoring and management of invasive species in areas affected by extensive disturbances	2023—2026	Institute of Botany	monitoring of alien species in the fire area along the road network; Monitoring of the regeneration of selected species after fire
Comprehensive monitoring - OPE	2021—2023	BSNP administration, Martin Adámek	establishment of a forest inventory network supplemented by phytocoenologic mapping

Table 2.1.5. Selected projects with usable data on alien species.

2.2. Legislation for alien species

The main legal regulation in the field of alien and invasive species is Act No. 114/1992 Coll., on Nature and Landscape Protection (hereinafter referred to as ANLP and the EU Regulation No. 1143/2014 on the prevention and management of the introduction and spread of invasive alien species. These legal instruments unify procedures for tackling invasive species and provide for the establishment of a list of invasive alien species of Union concern.

According to § 5 (4) ANLP, the intentional spread of alien species into the landscape is possible only with the permission of the nature protection authority. The obligation to obtain a permit by the nature protection authority does not apply to alien plant species if they are managed according to an approved forest management plan or a forest management plan adopted by the forest owner, and a permit is also not required when planting plants in the built-up area of the municipality. On the territory of national parks (hereinafter referred to as NPs), protected landscape areas (hereinafter referred to as PLAs), national nature reserves (hereinafter referred to as NNRs) and nature reserves, basic protection conditions apply, including a ban on the intentional spread of alien species. In these specially protected areas, the relevant nature protection authority may grant an exception to the above prohibitions under Section 43 of the ANLP.

According to § 5 (6), the nature protection authority may also determine measures to control alien species if this is necessary with regard to the local impacts on nature and landscape. These measures are determined in the form of a decision or a measure of a general nature. The specific regulation measures themselves are carried out by the user or owner as part of the normal care of the land. If they fail to implement the specified measures, if they are unable to ensure the measures or if the implementation of these measures requires an activity beyond the scope of normal care of the land, the implementation of these measures may be ensured by the nature protection authority. The user and owner of the land is then obliged to tolerate the implementation of these measures by the nature protection authority. Similar rules apply to species on the List of Invasive Alien Species of Union Concern. In the event of the identification of species from the EU list that are new to the territory of the Czech Republic and whose occurrence was detected before their spread, it is mandatory to initiate immediate removal/isolation of new populations from the environment, if technically feasible. The owner or user of the land participates in the implementation of the measures. If it fails to implement the measures or is unable to ensure them, the measures may be taken by the nature protection authority. In addition to management and regulation, monitoring and mapping are an important component, serving as a basis for subsequent interventions and prioritization.

A number of strategic documents build upon legislation in the field of invasive species (as well as instruments derived, for example, from international conventions such as the CBD and the Bern Convention). These documents also provide an important framework, including for the development of strategies at the regional or local level, such as the National action plan for climate change adaptation (https://www.mzp.cz/cz/narodni_akcni_plan_zmena_klimatu), the National Biodiversity Strategy of the Czech Republic 2016 (Mach et al. 2016), and the Action plan for addressing the issue of priority pathways of introduction and spread of invasive

alien species in the Czech Republic for the period 2023–2028 (Ministry of the Environment 2023).

3. Strategy proposals

3.1. General principles and setting priority objectives

The Strategy builds on and develops the existing strategic documents of the BSNP and ESPLA (management plans, incl. small-scale protected areas). The Strategy also serves as a basis for new documents, namely the newly approved Management principles for the BSNP and the forthcoming new Management plan for the ESPLA, both of which refer to this Strategy in matters concerning invasive species. From national and international scale it links at documents such as the Management measures announced by the Ministry of the Environment for individual species on the EU list of invasive species (according to Regulation No. 2016/1141 of the European Commission and of the Council), the Management of selected alien plant species issued by the Nature Conservation Agency of the Czech Republic (https://nature.cz/web/cz/platne-standardy, Pergl et al. 2023a.

The Strategy includes a proposal for measures that will make it possible to scale approaches between territories, species and interest groups (nature conservation, the public, forestry, agriculture, tourism). The Strategy includes so-called soft measures leading to better information and prevention of the introduction of alien organisms and so-called hard measures including management and eradication. The Strategy sets out aims for the next period. Given the fact that invasions are a very dynamic process, it is recommended that this Strategy be updated on an ongoing basis.

For the successful application of this Strategy, it is also necessary that it is supplemented by an action plan within the BSNP Administration, which specifies the necessary procedures and the responsibilities of individual departments or employees in detail. Practice shows that this operational "endgame" represents a critical phase of the entire invasive species management process. It has to be noted that despite the growing professional, legislative and financial support devoted to the issue of invasive species, there is still a significant gap (Bayliss et al. 2013) between the scientific knowledge presented by invasive biology and existing practice, and therefore the management of invasive species is not always successful and effective. Successful management of invasive species critically depends on its correct spatial and temporal distribution, so it is perhaps even more true here than in other types of conservation management that it is necessary to be based on scientific knowledge resulting from mapping and monitoring, i.e. in the sense of "evidence-based conservation" (Härtel et al. 2010) and not on subjective and only empirically based decisions.

After certain local modifications, the submitted Strategy can also be used in other comparable regions. It is also true that the principles applied here can also be applied to expansion species,

i.e. geographically native spreading species, which, however, are not the subject of this Strategy.

The priority targets in the area of invasive plant species in the territory of the BSNP and ESPLA are as follows:

- Inform and involve the public and other target groups in the documentation, monitoring and management of invasive species and strive to set up sustainable landscape management (see 3.2).
- To improve the current state of exceptionally valuable sites by removing selected invasive alien species such as the Kamenice Gorges, Růžák National Nature Reserve and Elbe Canyon National Nature Reserve, and to ensure continuous monitoring and management of these sites (see 3.3).
- To prevent the 2022 fire site from becoming the centre of invasions in the BSNP, and to ensure continuous monitoring of the fire site, given the great potential for the spread of invasive species that formed after the bark beetle gradation and the fire.
- For selected invasive species, ensure monitoring and management of sites key to further spread (especially watercourses).

The stated objectives are long-term, and in most cases, it can be expected that their fulfilment will extend beyond the validity period of the present Strategy. At the same time, given the urgency of the need to control invasive species in the target area, it is both essential and effective to begin implementing the defined objectives without delay—or to continue implementation where these objectives have already been pursued over the long term.

Furthermore, it should be emphasized that the objectives set out in this Strategy (Table 3.4) are, taken together, highly ambitious. However, the authors of the Strategy followed the principle that for all species where successful eradication or control within the selected area was deemed meaningful, such eradication or control was also set as a goal—even with the understanding that it is unlikely to achieve successful eradication or control for all selected species or areas simultaneously. The reason why the authors chose not to set less ambitious targets is that the actual feasibility of successful eradication or control for a given species or area can only be verified through future practice. This chosen approach should therefore be taken into account when evaluating the success of the Strategy's implementation. For example, if the objectives were met for half of the species or areas, this should by no means be considered a low level of achievement.

It should also be noted that the near future may reveal the need to update this Strategy before the end of its validity period—or at least to revise its core section as formulated in Table 3.4.

3.2. Awareness, public relations, citizen science

Invasions of alien species are often the result of intentional and unintentional introductions associated with the economic and hobby use of individual species (as in the case of giant hogweed (*Heracleum mantegazz*ianum), himalayan balsam (*Impatiens glandul*ifera) and a number of other plant species introduced for ornamental purposes, or the pond slider or some species of crayfish used for pet purposes). At the same time, the activities of the public, both in the position of (small) land owners and generally as "landscape users", can influence the spread of invasive alien species, either by limiting the possibilities of their spread or establishment by appropriate land management or, conversely, by increasing the risk of invasive species transmission, e.g. in connection with the transport of people or materials, etc. Therefore, it is crucial to increase public awareness of invasive alien species in the area of interest and the associated risks to humans and nature in the Czech Republic, as well as of the important ways of spreading invasive species and the possibilities of their reduction and ways to actively influence this fact.

The use of so-called citizen science for monitoring species that are at the beginning of their spread is very beneficial. The public may be instructed in the notification of certain "flagship species" and, where appropriate, in their management. In the area of interest, these may be some easily recognizable species that do not pose a risk of confusion with other protected species. These include, for example, reports of occurrence in these species (Table 3.2). Furthermore, it is necessary to take into account the restrictions on movement off the roads in the BSNP, which are both of a legislative nature (so called “quiet areas” (= core zone) of the BSNP off the marked paths), but also realistically practical due to large areas with the decay of the tree layer (this applies especially to territory A1). It is therefore desirable to support public exploration only in publicly accessible areas and in areas where there is currently no excessive risk due to standing dead trees after bark beetle gradation. In the case of species that are ornamental and cultivated (e.g. heart-leaved oxeye (*Telekia speciosa*), chestnut (*Castanea sativa*), lupine (*Lupinus polyphyllu*s)), it is necessary to emphasize why the monitoring was carried out and also that not every reported occurrence (in urban zone, cultural landscape) will be eradicated.

Activities: The aim will be fulfilled in various forms (information events, workshops, presentations in the media, targeted campaigns, exhibitions, information materials, etc.). Important for the fulfilment of the aim is the involvement of as many entities as possible in the education (multiplication), including schools, tourist and climbing organisations, environmental education centres, involvement of NGOs, scientific community, local governments, etc. At the same time, the public must be well informed about relevant and trustworthy information sources, which must be easily accessible and their form adapted to the target group. In terms of content, it is important to focus on the so-called flagship invasive species in the area (eastern white pine (*Pinus strbus*), knotweed (*Reynoutria* sp.), tree of heaven (*Ailanthus altissima*), himalayan balsam (*Impatiens glandulifera*)). In addition to these species, it is necessary to highlight the potential for public participation in easily recognisable species and species that are currently at the beginning of their invasion in the territory (narrow-leaved ragwort). At the same time, it makes sense to point out the native species or habitats that are endangered by these species (rock outcrops, gorges, restoration in the fire site).

*Fig. 3.2a,b. Narrow-leaved ragwort (*Senecio inaequidens*) is often found along roads and railways. Its spread can be slowed down by educational campaigns and public involvement in its eradication, which is simple at the beginning of the invasion. Photo by Jan Pergl.*

Furthermore, practical instructions are recommended on "how citizens themselves can help" for the correct eradication of invasive plant species, where it is realistic, or prevention of unintentional spread (e.g. when caring for land, gardening), etc. The result of the measure will be increased awareness of the negative consequences of invasive species, an active and responsible approach of the public and interest groups to the prevention or management of species, public involvement in monitoring and the early warning system.

An important group is the capture of forest management (approx. 60 % of the ESPLA) due to the nature of the territory. It is both the correct implementation of management interventions against alien species and management in areas after remediation or decay of bark beetle-infested stands so as to minimize the spread of alien species. However, the most important thing is to set up a functional and responsible approach of forest managers and owners so that the eradication of invasive alien species becomes a standard part of care and management. Consistent use of the current legal framework must also be an essential part of this set-up.

Among the land managers who have a significant influence on the landscape, farmers are included. Through education and proper management, the spread of certain invasive species occurring in meadows or pastures (such as lupine, ragworts, and knotweeds) can be significantly reduced.

Another area in terms of successful regulation of invasive and alien species and limiting their spread is, in addition to the general public's awareness, essential detailed awareness of specifically directly key entities, such as sponsors of management measures to control invasive alien species from municipalities and cities or owners and managers of large areas (e.g. forests of the Czech Republic) or areas that often form corridors for the spread of invasive alien species (transport infrastructure corridors, watercourses and their surroundings, etc., and thus entities such as Ředitelství silnic a dálnic - the Road and Motorway Directorate and other road administrators, the Správa železnic – Railway management, electricity distributors or Povodí companies – river basin management). These entities must also be informed about the negative consequences of invasive species and, in particular, about the need for correct procedures to eradicate or control these species and prevent their spread, always in a targeted manner for the given area of activity. Examples include maintenance of track and road edges, soil transfers during construction work to prevent further spread of invasive species through contaminated soil, or inappropriate management leading to lush regeneration of sprouting species. The measure will result in increased awareness of the negative consequences of invasive species, an active and responsible approach of key stakeholders involved in the prevention of the spread and control of invasive and alien species. The activities of the BSNP Administration in this area can be combined with the outputs listed in the Action Plan for Addressing the Issue of Priority Ways of Spreading Invasive Alien Species in the Czech Republic for the Years 2023 to 2028 (Ministry of the Environment 2023).

Table 3.2. Suitable species for mapping, monitoring and possible management by the public, as well as for inclusion in information campaigns about their negative impact on biodiversity (for more details on specific species and their impacts, see Chapter 3.4).

Interventions in localities where entities manage or own are considered regular management. In the case of immediate disposal, this is mainly to support actions of visitors and being larger than typical land use and management. An example is particularly the occurrence of invasive species along hiking trails, in forests, etc.

It is important that when the public is involved in the eradication/containment, the BSNP Administration has to be informed about the occurrence and type of intervention due to follow-up monitoring.

species	**activity**	**note**
chestnut tree (*Castanea sativa*)	Monitoring	The species has a great invasion potential. It is necessary to know its distribution in built-up areas and to control possible sources of spread. Except for built-up areas, where eradication is unrealistic and senseless due to deliberate cultivation, it can be effectively limited in the open countryside. Disposal must be carried out professionally. The species can be found in isolated locations (e.g. under the Pravčická brána Arch) or in the České středohoří PLA and, of course, in private gardens.
giant hogweed (*Heracleum mantegazzianum*)	Monitoring. Small incidences can also be effectively eradicated by the public, provided that they are informed about the health risks.	Well-known invasive species in the Czech Republic. It occurs only to a limited extent in ESPLA. Given that it is a highly mobile and especially distinctive species, which is also known to the public, it is good to include it in public monitoring.
himalayan balsam (*Impatiens glandulifera*)	Monitoring, immediate interventions at isolated sites	Use of the public for monitoring and, where appropriate, eradication of remote and isolated populations. Eradication by uprooting is easy. In the area immediately around the Elbe

		(territory B), eradication is not meaningful.
lupine (*Lupinus polyphyllus*)	Monitoring, immediate interventions at isolated sites	Use of the public for monitoring. A type of meadow and garden. Good information about the distribution can help identify areas at risk. The public can be involved in reducing the seeding of flowering plants.
narrow-leaved ragwort (*Senecio inaequidens*)	Monitoring, immediate interventions at isolated sites	It is a species widespread widely along the D8 highway. It occurs sporadically in the territory of the BSNP and ESPLA. So far in the form of individual plants, which are continuously disposed of by uprooting. Its further spread in the area of interest, especially at the fire site, can be expected. The priority is to prevent its widespread spread.
red oak (*Quercus rubra*)	Monitoring. Involvement in eradication efforts in areas of naturalization.	A tree species with a high impact and at the same time preferred in forestry. A good example of a species that can be presented as conflicting between nature conservation and forestry. Due to the wide distribution in plantations, the monitoring should focus on isolated occurrences (e.g. in the BSNP near Kamenická Stráň and in many other places, in ESPLA, e.g. on the Pastýřská stěna Rock).
staghorn sumac *(Rhus typhina)*	Monitoring,	A species that spreads as a result of cultivation and expansion. In settlements and areas of former cultivation, surrounding areas, and places where soil and waste from gardens have been transported, for example. Due to its great popularity among gardeners, it is a suitable species for educational purposes.

tree of heaven (*Ailanthus altissima*)	Monitoring	Disposal must be carried out professionally, as there is a risk of creating dense vegetation (Pergl et al. 2023a). It is an invasive species that is widespread e.g. in urban areas and along railways.
woad (*Isatis tinctoria*)	Monitoring and immediate interventions at isolated sites	Due to its extensive occurrence in the České středohoří PLA and along the Elbe near Ústí n. Labem and Děčín activities can be combined with the Administration of the České středohoří PLA.
yellow oxeye (*Telekia speciosa*)	Monitoring	Engaging the public in monitoring remote and isolated populations. A suitable species for tracking spread from gardens.

3.3. Landscape based approach – management in individual types of territories

The BSNP and ESPLA is a landscape with high natural values, however, it is strongly influenced mainly by forest management, which has changed a substantial part of the forest stands in the area to monocultures, while spruce cultures have been affected by bark beetle gradation in the last few years (practically the entire area in the BSNP). Along with spruce, some alien species with invasion potential were introduced in the area, which is particularly dangerous here due to the ruggedness of the relief, which worsens the possibilities of both monitoring their spread and eradication (typically by spreading on sandstone rocks).

From the point of view of conservation management, there is a big difference between the territory of the BSNP and the ESPLA. Intensive management of invasive species is carried out in the BSNP, which is facilitated by state ownership and administration of the territory. From the point of view of forests, these are, for example, the white pine stands, which are significantly restricted in the BSNP. Invasive species are also regularly managed in the ESPLA territory, but these are mainly selected species and localities, while invasive species with economic importance in forestry remain problematic, especially where their exclusion means costly intervention over a larger area. In such a case, ownership plays a major role, although even in the ESPLA territory, the majority of forests are state-owned.

The current distribution of alien and invasive species in the territory of the BSNP and ESPLA is the result of processes of gradual urbanization, colonization and changes in agriculture, as well as random factors associated with the transport of seeds and propagules. However, even here, factors associated with land use affect the likelihood of establishment (disturbed sites, rubble sites, abandoned agricultural and industrial areas, areas with an excess of nutrients), as well as the territory of the Elbe Valley with periodic disturbance. The occurrence of alien species is

therefore largely the result of current landscape change. Given that this is an area strongly influenced by humans (including forests) and alien species are associated with human activities, it is necessary to focus on minimizing the causes of their occurrence in addition to the management itself.

It is clear that the management of individual species without respect to the landscape use change is not sustainable and is not effective. To address the issue of invasions, it is necessary to address the causes of the occurrence of alien species, which are (a) globalization, (b) cultural change in landscape management, and (c) climate change. Some of these factors can be modified, some less so or not at all. Globalization includes the facilitated influx of organisms from other territories (speed of transport, density of roads), which are partly processes that can be influenced (prevention, information campaigns, setting the accessibility of the territory). A significant process that can and does make sense to influence is landscape change – management regime (regularity, intensity), urbanization/abandonment of settlements, changes in nutrient availability (wastewater management, fertilization), fragmentation of native vegetation, intentional introduction (gardening) and unintentional (tourism, cars + landfilling of "garden" biomass at the edge of the forest). Climate change brings with it an increase in average temperatures (species originally on the edge of their range are able to survive), changes in the course of temperatures and precipitation, and an increase in the frequency of extreme events (drought, storm rain). The problem is that, for example, some species take advantage of the so-called windows of opportunity (a species that normally freezes would not be able to form resistant tissues under normal conditions; under the conditions of climate change, it is enough for a year without winter, the individual creates woody tissues and is already able to resist frosts better and wait for the next year, when it can, for example, reproduce by seeds).

The occurrence of alien species in natural habitats is dangerous in terms of current damage to diversity, but in terms of further spread, occurrences in anthropogenic habitats or biotopes near settlements are worse. There is a lower frequency of monitoring, higher propagule and nutrients import, irregular management of the territory often occurs, and at the same time there is a higher proportion of disturbed areas where species can gradually become domesticated. It would not be reasonable to limit ourselves to destruction and monitoring only in natural habitats. The risk for attachment and spread is not the abandonment of farming itself, which often does not matter, but the impact maintenance - alternating severe disturbances and maintenance-free phases. It is therefore appropriate to strengthen and moderate activities "from below", i.e. from residents and land owners (users).

Definitions of the types of territories

Due to the different needs of nature conservation, the public and other entities, the different ownership structure and different land use, the area of interest was divided into five types of territories for the purposes of the Strategy:

A1: BSNP area
A2: Small-scale protected areas and Sites of Community Importance (SCI)

B: Elbe Valley
C: Settlements
D: Other parts of ESPLA

While in the BSNP area (territory A1) is easier management due to the ownership structure, the following types of territories (A2, B, C, D) have a fragmented ownership structure and thus the management is complicated. In these types of territories, cooperation between the public and owners is crucial. In the territories of the small-scale protected areas and SCI (A2), the objectives of invasive species management are generally identical to those in the BSNP (A1), however, due to the different ownership character, the ways in which the aims of the Strategy can be achieved differently.

It should be emphasized that even in the territory of the ESPLA outside the small-scale protected areas and SCI, there is regular management of invasive species, but these are mostly selected species, while the management of alien species of economic importance (especially in forestry) or some ornamental species in built-up areas and their surroundings is problematic. In the case of forest species, there is also a complication in management due to high costs. In such cases, ownership plays a major role, although even there it is often land owned by the state or municipalities.

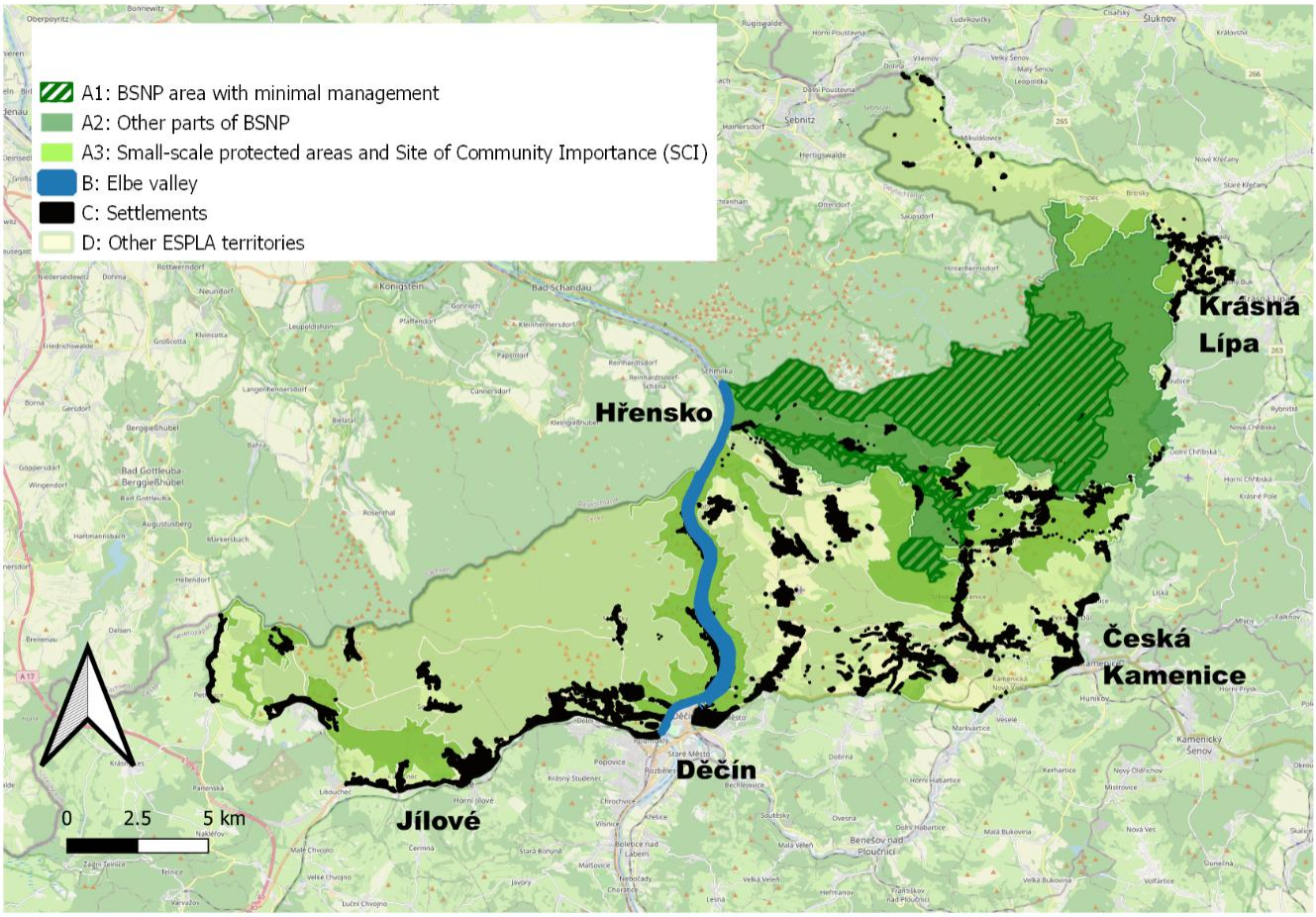


Fig. 3.3. Delimitation of the territories used for prioritization in the Strategy.

3.3.1. BSNP area (Territory A1)

Specification of the territory

This territory includes the entire area of the BSNP, with the exception of settlements, which are classified within territory C.

From the significant natural areas, this territory includes, in addition to the core compact area of the sandstone rock town, also important watercourses of the Kamenice and Křinice rivers, as well as a number of volcanic Tertiary elevations, the most powerful of which is the Růžák NNR. It also includes adjacent areas where the transport of seeds and propagules can be expected. These are mainly bank vegetation of streams heading into the defined area (more explained below).

This territory also includes a forest habitat with medium-term or permanent active management. The accessibility of the areas ranges from difficult-to-reach (rock outcrops, dead stands due to bark beetle outbreaks) with a long-term goal of ensuring the undisturbed course of natural processes (in the sense of the Nature Conservation Act) to relatively easily accessible areas (especially those with ongoing management around villages), with difficult-to-access areas prevailing."

Poor accessibility makes all activities demanding (monitoring, technology, finances, human resources), lengthy and dangerous (climbing terrains). For the part of the territory, the proposed BSNP Management Principles assume a long-term management goal of "undisturbed natural processes" within the meaning of ANLP, which basically means spontaneous development of ecosystems with some exceptions allowed by ANLP and which also include the **possibility of justified eradication/suppression of selected alien and invasive species that pose a risk of further spread and negative impact on the surrounding biota and environment**. The classification of species in terms of management is shown in Table 3.4.

Another important part of this territory is the fire site, which was created in July 2022. The total extent of the affected forest ecosystems is approximately 1060 ha on the Czech side of the NP and 115 ha on the German side. The fire site includes the area between the villages Hřensko, Mezná and Mezní Louka, its easternmost edge is formed by Hluboký důl valley (Stupňová dolina), isolated focal point then forms part of Divoká soutěska (Wild gorge) and rocky valley Soorgrund. The issue of invasive species in this area is addressed by the TA CR project (Monitoring and management of invasive species in areas affected by extensive disturbances; 2023—2026; investigator Institute of Botany CAS), which covers the spread of alien species, especially along roads and the regeneration of invasive species. The results of the monitoring will be regularly handed over to the BSNP Administration (the results of the monitoring from the first year of the project are already included in this Strategy).

In this area, as in the rest of the BSNP, secondary spruce stands prevailed, at the time of the fire already at the stage of dead stands of approximately three years of age, and part of the infested or dead spruce forests (up to 100 ha) were felled in 2018 and 2019 as part of the initial effort to stop the spread of the spruce bark beetle by clearing infested wood or to

ensure safety on roads. The fire therefore affected approximately 90 hectares of clearings. A significant proportion of the fire site is also made up of acidic beech forests adjacent to the Großer Winterberg Mt., or mixed vegetation with beech, pine and oak in the area of Pravčická brána Arch.

The fire site is geomorphologically very diverse, it includes rocky slopes to steep rock walls and canyons of various orientations, low-lying rock plateaus and higher-lying rock plateaus. Sandstone bedrock predominates here, with less affected sites affected by basaltic rocks (Větrovec, Großer Winterberg).

*Fig. 3.3.1a. Scotch broom (*Cytisus scoparius*) on the area of the fire site. Photo by Jan Pergl.*

Recommended approach to management

Because alien and invasive species benefit very well from sudden changes in nutrient availability, light and management changes and disturbances in general, the fire area and its surroundings are prone in terms of the occurrence of these species. In addition, the movement of firefighting equipment and a large number of people in the area has led to the unintentional introduction of species into sites with the strictest level of protection. Therefore, one of the goals is to monitor the fire site and the places of concentration of firefighting equipment. In places open to the public, so-called citizen sciences can also be used (see Table 3.2). These are mainly easily recognizable species and those that have easily dispersed seeds and are already present in the BSNP and its vicinity (e.g. narrow-leaved ragwort, *Senecio inaequidens*).

Given that most of the areas currently under active management outside the core zones are to be gradually converted into areas with natural development, a generally strict approach to the management of species mentioned in the table 3.4 is planned for the entire BSNP area, regardless of the current zonation of the park. The goal of the management is to maintain the NP area with minimal representation of alien and invasive species, to limit existing problematic species (e.g., knotweed, yellow oxeye, himalayan balsam). Priority should be given to species capable of easy spread (e.g., narrow-leaved ragwort, eastern white pine, himalayan balsam).

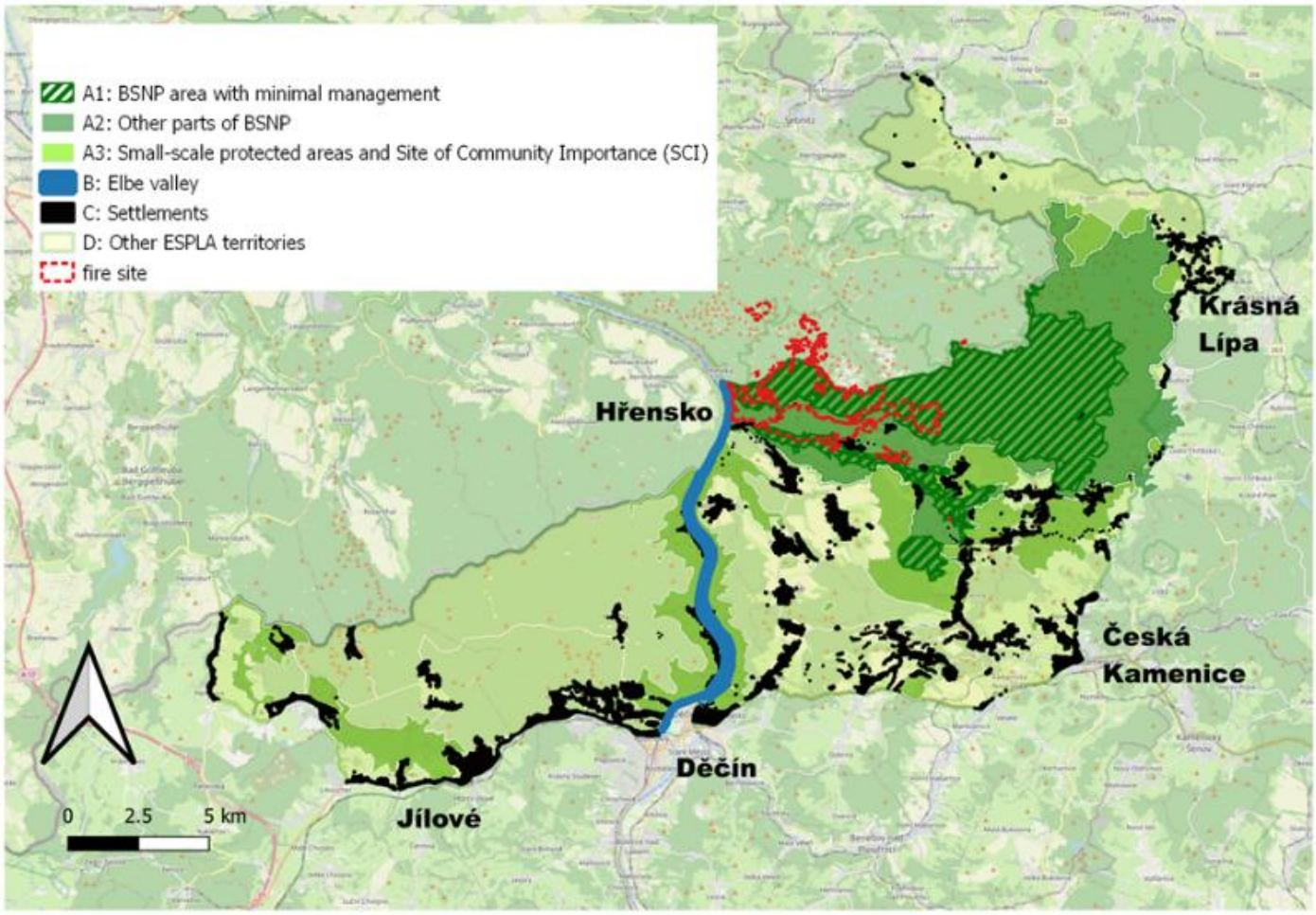


Fig. 3.3.1b. Delimitation of the area affected by fire (red) on the territory of the BSNP and the Saxon Switzerland National Park.

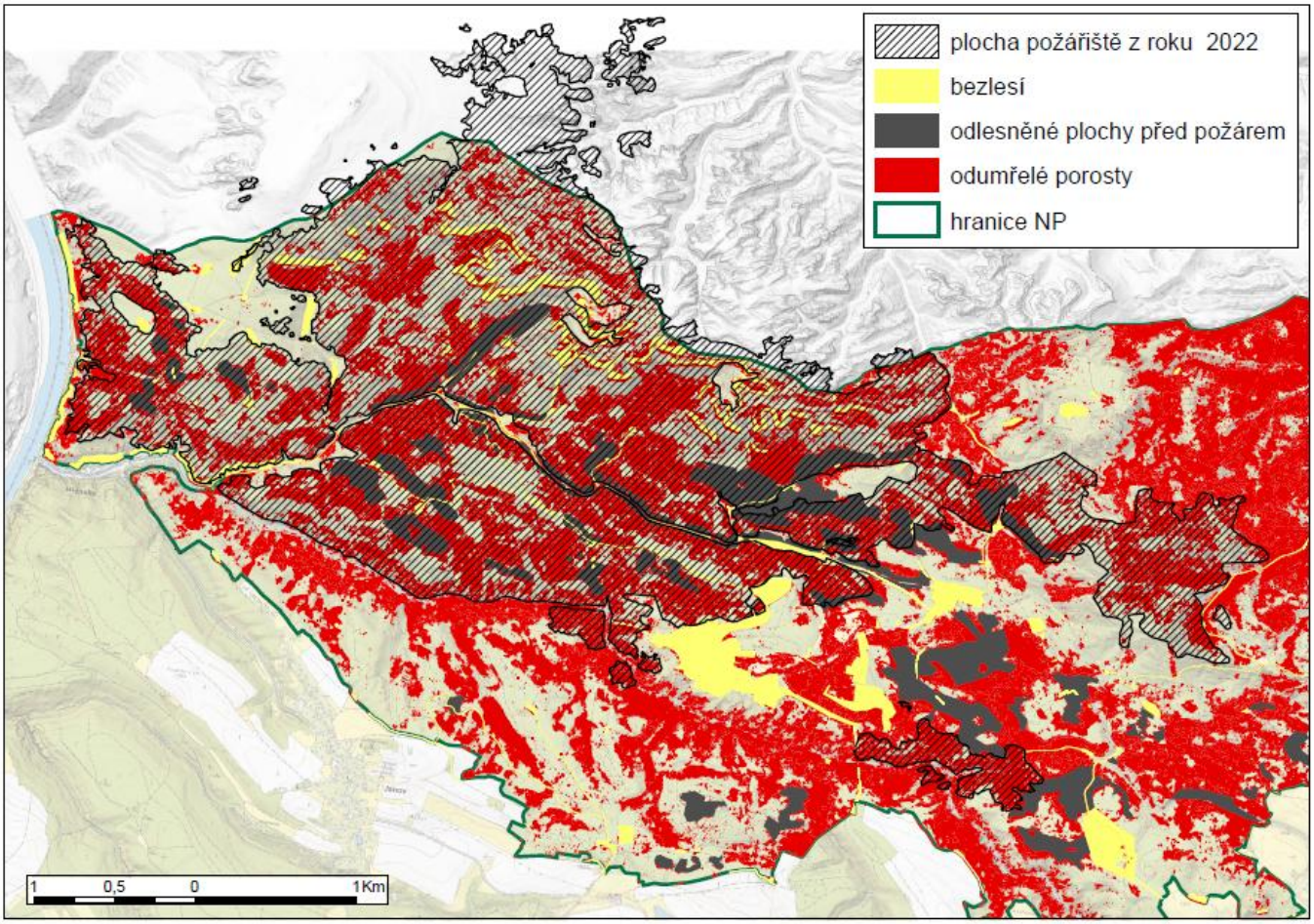


Fig. 3.3.1c. Detailed map of the fire site with stand types.

plocha požářiště z roku 2022 = the 2022 fire area, bezlesí = open (non-forest) habitats, odlesněné plochy před požárem = deforested areas (clearings before the 2022 fire), odumřelé porosity = dead stands, hranice NP = borders of the BSNP

Fig 3.3.1d. Disturbed areas such as fire sites and clearings after bark beetle outbreaks represent high-risk areas from the perspective of invasions by alien species (2023). Photo by Handrij Härtel.

Fig. 3.3.1e. Digitalis purpurea *spread intensively in the fire area from 2022 already the following year. Photo by Handrij Härtel.*

It is necessary to follow the same approach as in the source areas. These are mainly areas in the catchment area upstream of rivers and streams. Given the fact that a large number of these areas are outside this territory, it is necessary to set these rules there as well. These are mainly the rivers Kamenice (Lusatian Mountains PLA) and Křinice (Šluknov Hook, outside the PLA). There is also a connection to the Saxon Switzerland National Park in Germany; e.g. the Křinice/Kirnitzsch River is partly a border stream.

Fig. 3.3.1f. The spread of Erechtites hieraciifolius *currently represents the most dynamic invasion in disturbed areas of the Bohemian Switzerland National Park. Photo by Handrij Härtel.*

In the BSNP, the public can be involved in the eradication/suppression of invasive and alien species only to a lesser extent, within the framework of organized events. However, it is advisable to involve them in educational, preventive and monitoring events, in which they can provide valuable data (preferably in the iNaturalist application, where verification of identification is implemented). The BioLog application (sheltered by the Nature Conservation Agency of the Czech Republic) is more oriented towards experts and the more experienced public. The public can be involved in activities organized and controlled by the BSNP Administration, such as pulling out scotch broom at a fire site (similar to woad eradication in the České středohoří PLA). For details of recommended types and activities, see Table 3.2.

Fig. 3.3.1g. Solidago *sp. at the top of the Růžák National Nature Reserve before eradication (2003). Photo by Handrij Härtel.*

3.3.2. Small-scale protected areas and SCI (Territory A2)

Specification of the territory

The territory of small-scale protected areas together with SCI sites (named as EVL in the Czech Republic and as FFH in Germany), with the exception of the areas of those, which are part of the BSNP and with the exception of the bottom of the Elbe valley (part of the Elbe Valley and Porta Bohemica SCIs, lying between the Děčín-Hřensko road, state border and the Děčín-Dolní Žleb, state border railway).

It is necessary to mention the specific situation of the Elbe Canyon NNR, which is characterized by natural forest vegetation on the right slope of the Elbe River Canyon with extensive and difficult to manage rock walls, towers and debris fields. This area borders on the territory B - the Elbe Valley, which is separated from it by the Děčín-Hřensko road and has significantly different management goals.

Measures in the management plans of the small-scale protected areas generally try to address the issue of invasive and alien species. The minimum of measures is the monitoring of invasive species.

The risk of care for small-scale protected areas and SCI is the frequent proximity of settlements, roads and watercourses. These are risk factors that negatively affect the so-called propagule pressure (contribution of seeds, rhizomes, etc.), disturbances and nutrient contributions. As in the previous area (A1), it is necessary to include in the management the adjacent areas from where undesirable species can migrate. Management of non-conflicting species must be active, and of species that are used by the public (ornamental, forestry), management must be associated with an information campaign.

Recommended approach to management

The objectives of nature protection do not differ from the BSNP (territory A1) due to the fact that these are valuable areas. However, the difference is in the methods of achieving goals and management planning. In the case of non-forest small-scale protected areas and SCI, the difference is the need for permanent care. This approach allows for more targeted work with management planning, however, as mentioned above, an agreement with land owners to balance the interests of nature protection and economic aspects is a complication, in some cases the economic use is almost zero (e.g. the Elbe Canyon National Nature Reserve, or the Pavlínino údolí Nature Reserve).

As with the previous categories of territory, it is necessary to take into account the neighbouring territories, especially in the case of easily spreading species. This is especially crucial for small-scale protected areas and SCI near settlements, on watercourses or near roads.

An example is the Elbe Canyon National Nature Reserve, adjacent to the Elbe Valley (territory B), where a tolerance regime for most alien species is set. From the point of view of nature conservation interests, it is important to monitor the border areas along the Děčín-Hřensko road in order to prevent the spread of alien species. The same conditions must be had on the left bank of the Elbe River in the vicinity of the railway, where it has been shown how extensive

repairs of the railway corridor can start an invasion of some species. These are mainly easily spread species such as balsam, or species that can spread during the movement of contaminated soil, restoration of ditches, etc. (knotweed). Along with the species spreading through the water corridor of the Elbe River, the Elbe Canyon NNR is endangered by invasive tree species, especially white pine, which invades rock formations, and red oak, which spreads to all communities from the sandstone plateaus (especially from territory D).

With regard to the value of the area, it is recommended that the activities of the public associated with involvement in monitoring and management be the same as in the BSNP (A1 territory). It is important to have an active information campaign and established cooperation with landscape managers in the buffer area around the small-scale protected areas and SCI.

3.3.3. Elbe Valley (Territory B)

Specification of the territory

The Elbe valley is demarcated by the Děčín-Hřensko road on the right bank and by the Děčín-Dolní Žleb, state border railway line on the left bank. It is an area characterized by a high contribution of seeds, water level fluctuations, the occurrence of species bound to gravel alluviums, frequent disturbances and a large amount of nutrients. In the case of the Elbe gravel alluvium, it is one of the rarest and most endangered types of biotopes in the Czech Republic (habitat 3270, Natura 2000), but at the same time it is a habitat with the most complicated conditions for successful management of alien and invasive species.

On the left bank, this area is also characterized by a significant settlement effect with the introduction of ornamental plants and sudden management (disturbance). It is followed by the heavily urbanized area of Děčín, which contributes to the strong contribution of propagules. The effect of ship and rail transport including the related infrastructure is significant, along which alien species spread in the territory of the ESPLA (Jehlík 1998), of which there are large numbers in the area.

Recommended approach to management

Due to the high benefit of propagules from the surrounding area, which cannot be prevented, most species in the Elbe Valley can be tolerated or restricted as part of routine landscape maintenance (see Table 3.4, categories 3 and 4) and efforts can be directed mainly to prevent their spread to valuable areas (e.g. himalayan balsam, *Impatiens glandulifera)*. From the point of view of prevention, it is necessary to eradicate any satellite populations of tolerated species outside the boundaries of the territory (roads, railways).

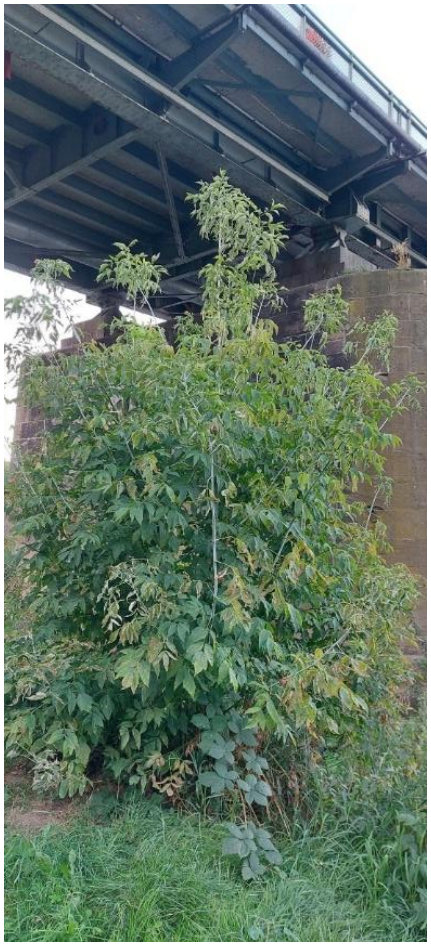
A stricter approach is required by species that may threaten the area of the BSNP (territory A1) and small-scale protected areas and SCI (territory A2), as well as species that do not yet occur widely in the area; It is recommended to eradicate these species immediately. In the Elbe Valley from Děčín, preferably in the city itself, it is necessary to intervene against the glandular, ash maple and pennsylvania ash (species capable of colonizing fragments of

floodplain forest) due to the high dispersal capacity and high impact, immediate eradication is also desirable in the case of the newly spreading black chokeberry in the Elbe Valley.

Another exception to the tolerance approach is the management of species that have a significant negative impact, and their management has proven to be effective in the past; e.g. gradual reduction of *Reynoutria* vegetation. It is advisable to continue the suppression of their extensive vegetation gradually according to the available funds. Since even long-term management does not lead to complete eradication, it is necessary to treat individual regenerating occurrences in the long term. Great emphasis must be placed on any soil movements/construction activities.

As with the previous two categories of areas, the public may be used for eradication in appropriate cases (e.g. along a cycle path on the shore), but always under the coordination of the Administration. For example, in the case of Jerusalem artichoke (*Helianthus tuberosus*), it is realistic to gradually suppress selected areas on the right bank of the river. However, due to the popularity of the species in ornamental gardens, it is necessary to initiate an information campaign (especially not to spread it into nature with garden waste).

Since the Elbe Valley is a transport corridor (river, road and railway), coordination is necessary mainly with the administration ot the Elbe River Basin (Povodí Labe, State Enterprise), upstream towns and the Nature Conservation Agency of the Czech Republic/Administration of the České středohoří PLA. This applies both to the eradication of seed sources and to the identification of species not yet present in the area of interest.



In terms of priorities, the following are key:

1) New, easily spreading species, with a large impact, not yet widespread in the area (e.g. *Senecio inaequidens, Amorpha fruticosa, Isatis tinctoria* – species abundant along the Elbe River in the České středohoří Mts., in the Elbe Sandstones so far only along the Elbe, with the risk of invasion of valuable localities. With regard to the ongoing climate change, it is not possible to identify a complete list of species in advance.

2) Eradication of already widespread species that have the potential to threaten areas with spontaneous regeneration (intolerant species); especially on the outskirts of the territory.

A lower priority is given to the long-term management of alien and invasive species with subsequent care of habitats (knotweed, *Reynoutria* sp.).

It is not a priority to exhaust oneself on repeated interventions against highly mobile and widespread species, e.g. against the himalayan balsam (*Impatiens glandulifera*).

Fig. 3.3.4a. Acer negundo *spreads mainly in the Elbe Valley. Děčín, under the old bridge (2024). Photo by Handrij Härtel.*

Fig. 3.3.4b. Amorpha fruticosa *in the Elbe Valley near Děčín (2024). Photo by Handrij Härtel.*

Fig. 3.3.4c. Fraxinus pennsylvanica *is spreading in the Elbe Valley (2024). Photo by Handrij Härtel.*

Fig. 3.3.4d,e. Echinocystis lobata *in the Elbe Valley near Děčín (2024). Photo by Handrij Härtel.*

3.3.4. Settlements (Territory C)

Specification of the area

The settlements and their immediate surroundings include settlement formations with scattered recreational buildings, and solitudes are also part of them. The map delimitation is based on the defined built-up areas of municipalities, and we use the term settlement for simplicity below. Although only part of the city of Děčín is part of the ESPLA, the same recommendations apply to the entire territory of Děčín for the purposes of the Strategy. The same applies to settlements such as Česká Kamenice, Chřibská, Krásná Lípa, Mikulášovice and other settlements adjacent to ESPLA and BSNP. This type of territory is characterized by relatively easy accessibility and intensive human influence, who introduces (intentionally and unintentionally) alien species into the area and creates suitable conditions for them. These are both regularly cultivated areas (gardens, parks) and abandoned, desolate gardens, or irregularly and occasionally managed land (repeatedly but roughly mowed road edges, impact felling under high-voltage lines, landfills of plant waste in the vicinity of allotment gardens, etc.). It is important to mention intermittent and irregular farming, which is very beneficial to alien species and facilitates their naturalization.

Areas can be characterized as areas that are or can be regularly managed under ideal conditions and any undesirable spread of cultivated or introduced species can be controlled (at least successfully for some species). There are significant differences in the approach to nature conservation and the motivation to cooperate between permanent residents and cottagers.

Recommended approach to management

In all settlements, it is crucial to involve the public and convince them of the need to deal with invasions. It is advisable to use the so-called flagship species, which can show the possible negative impact on nature, health and the economy. As in territory B, it is necessary to inform construction companies and contractors about the risk of invasion and transmission of soil propagules.

Some cultivated ornamental and useful species that have invasive potential (e.g. *Buddleja davidii, Telekia speciosa, Helianthus tuberosus, Paulownia tomentosa, Amorpha fruticosa, Castanea sativa*) can be left in the plantings, but it is necessary to eradicate all wild occurrences (marked as 2# in the table 3.4). It is necessary to proceed even more strictly in the case of lupin (*Lupinus polyphyllus*), where, in addition to the eradication of wild occurrences, we recommend clearly defining the conditions of cultivation, handling flowering and fruiting plants and plant waste by issuing a Regulation Measure (see the procedure of the Šumava National Park; https://www.npsumava.cz/dokument/verejna-vyhlaska-opatreni-obecne-povahy-lupina).

Fig. 3.3.5. Telekia speciosa *is a frequent ornamental plant grown in settlements, from where it spreads further into the landscape. Photo by Jan Pergl.*

In the case of non-ornamental species that threaten the interests of nature conservation and are introduced unintentionally (e.g. *Symphoricarpus albus, Laburnum anagyroides, Rhus typhina*, etc.), it is necessary to eradicate them immediately. In these species, the risk of conflict is small. Immediate eradication is also necessary for species on the EU list for which this obligation arises from the valid Measures of a General Nature (*Ailanthus alissima, Heracleum mantegazzianum*).

3.3.5. Other parts of the ESPLA (Territory D)

Specification of the area

These are the so-called open landscape, outside the areas with increased interest in nature protection (SCI, small-scale protected areas) on the one hand, and the urban landscape, which is in the viewfinder of the population, on the other. These are mainly meadows, pastures, fields and mainly economically used forests. These areas form the so-called cultural matrix of the landscape and are of great importance in terms of the spread of alien species. It is a complex of areas with near-natural ecosystems up to a landscape that has developed close to humans over a long period of time. It also includes abandoned and uncultivated areas outside municipalities. It also includes watercourses and their riparian areas, which are often unmaintained and can be a source of alien species for other areas.

Recommended approach to management

It is important to maintain sustainable management in this area and, in particular, to avoid irregular management, which results in the spread of alien species. In the event that the current management/use is abandoned, it is crucial to ensure that undesirable species do not settle on the area that could threaten other territories. This should be addressed by the gradual introduction of a new type of farming, there must be an effort to avoid sudden abandonment of arable land, brownfields, especially in areas where the occurrence of problematic species is already known, which can quickly occupy the areas. It is often a combination of occupying areas with sufficient nutrients and plenty of propagules (e.g. fields invaded by whole plants). Similar conditions apply to forest areas, especially after the bark beetle calamity.

The recommended regime is common and, above all, repeated care of the land. Do not plant species with a high potential for spread in the open landscape. An important factor is the road network and the maintenance of ditches or banks. During all construction or maintenance work and reconstructions, it is necessary to take into account invasive species that are already present in the vicinity. If it is not realistic to actively intervene (eradicate), then the minimum condition is not to allow and support these species in spreading, i.e. to limit the movement of soil contaminated with seeds or rhizomes (e.g. *Impatiens glandulifera, Reynoutria* sp.*, Senecio inaequidens, Ailanthus altissima*) to a minimum and, if necessary, to store it in already invaded places.

The other parts of the ESPLA are a suitable area where the activities of the public and especially land owners (agricultural and forestry) can help in the prevention (early detection) and management of invasive species. Owners must be informed about the negative consequences of invasions and for many species they can find a common language with nature conservation, e.g. in the eradication of *Reynoutria* and *Lupinus polyphyllus*.

3.4. Species based approach – prioritization of invasive species and proposal of their management for the purposes of the Strategy

With regard to the risks to nature conservation, population health and economic damage, species have different management priorities. This is also accompanied by a distinction between nature conservation needs and risks for specified areas. There are species that occur in the area, form dominant stands, spread invasively (currently and are expected in the future) and pose a great risk to biodiversity: *Reynoutria* sp.*, Impatiens glandulifera, Pinus strobus, Lupinus polyphyllus, Ailanthus altissima, Pseudotsuga menziesii, Acer negundo, Qeurcus rubra, Solidago* sp.*, Ambrosia artemisiifolia*. There are also species that currently occur in a limited area in the area but have a great invasion potential and pose a great risk to biodiversity: *Prunus serotina, Senecio inaequidens, Fraxinus pennsylvanica, Amorpha fruticosa, Castanea sativa*. Other species are actively grown, i.e. difficult to control, but with a high invasion potential and threat to biodiversity – such species should be restricted even in settlements with regard to their ability to spread: *Helianthus tuberosus, Telekia speciosa, Echinocystis lobata, Rudbeckia* sp. There may also be overlap with other groups, as in the case of the *Castanea sativa*. There are also cultivated species, but with little influence or ability to spread into natural communities: *Symphoricarpos albus, Syringa vulgaris, Aster* sp. (*Symphyotrichum* sp.)*, Rhus typhina, Pinus nigra*, and finally species that are not very widespread, with relatively little influence.

However, it is not possible to approach these broadly defined groups of species in the same way throughout the BSNP and ESPLA area. Some areas have a high priority for nature conservation, others have other aspects (especially cultural and social). The combination of impact assessment, distribution, conservation needs, and management skills is the basis for the species assignment in Table 3.4. The species listed here are the output of mapping and research of available sources from the literature and existing databases. Table 3.4 contains only those alien and invasive species that show priority 1, 2 or 3 in at least one of the five territories (A1, A2, B, C, D), i.e. a certain type of management is desirable. Alien species that are tolerable (priority 4) or tolerated (priority 5) in all five territories are therefore not included in the table. Unlike tolerable species, tolerated species are species that show a negative impact in the given territory, but their eradication is no longer realistic due to the stage of invasion. For a few species, a different priority was distinguished for the so-called local occurrences (priority with *), these are species that may make sense to suppress with high priority, but only in the case of very isolated and small populations are found.

Table 3.4. Prioritization of species for management.

The division of the territory (A1, A2, B, C, D) corresponds to the description in text 3.1.
Prioritization in a given area is indicated by a semi-quantitative scale:
1 - species with priority eradication;
2 - species requiring eradication, but due to e.g. lower spreading capacity, its eradication can be postponed;
3 – species that can be suppressed as part of routine landscape maintenance;
4 - tolerable species that does not need to be eradicated and can be left in the territory under the condition of absence of signs of negative impact;
5 – tolerated species, i.e. a species with a negative impact, which is tolerated in the given area due to the impossibility of its practical eradication.
The asterisk (*) indicates cases where eradication is recommended only in the case of completely isolated occurrences.
A cross (#) indicates that this type of management applies only to occurrences escaped outside culture (e.g. gardens)

scientific plant name	**common plant name**	**life form**	**priority in territories A1 (BSNP area), and A2 (Small-scale protected areas and Sites of Community Importance)**	**priority in territory B (Elbe Valley)**	**priority in territory C (Settlements)**	**priority in territory D (Other parts of the ESPLA)**	**clonality**	**rate of spread by using propagules (seeds, rhizomes, roots, etc.)**	**occurrence in the BSNP**	**occurrence in the ESPLA**	**occurrence in the Lužické hory PLA**	**occurrence in the České středohoří PLA**
Acer negundo	box elder	tree	1	2	3	3	resprouting	yes		x		x
Acer saccharinum	silver maple	tree	2	3	4	3	resprouting	limited	x	x		
Ailanthus altissima	tree of heaven	tree	1	1	1	1	clonal spread	yes		x		x
Ambrosia artemisiifolia	ragweed	annual	1	3	2	1	no	yes		x		x
Amorpha fruticosa	false indigo bush	shrub	1	2	2#	2	resprouting	yes		x		
Buddleja davidii	butterfly bush	shrub	1	2	2#	2	resprouting	limited		x		
Bunias orientalis	turkish warty-cabbage	perennial	1*/3	3	5	3	resprouting	yes		x	x	x

scientific plant name	common plant name	life form	priority in territories A1 (BSNP area) and A2 (Small-scale protected areas and Sites of Community Importance)	priority in territory B (Elbe Valley)	priority in territory C (Settlements)	priority in territory D (Other parts of the ESPLA)	clonality	rate of spread by using propagules (seeds, rhizomes, roots, etc.)	occurrence in the BSNP	occurrence in the ESPLA	occurrence in the Lužické hory PLA	occurrence in the České středohoří PLA
Castanea sativa	sweet chestnut	tree	1	2	2#	3	resprouting	yes	x	x	x	x
Catalpa bignonioides	indian bean tree	tree	1	3	4	3	no	yes		x	x	x
Cornus sericea	redosier dogwood	shrub	2	3	4	3	clonal spread	yes		x		x
Cytisus scoparius	scotch broom	shrub	2*/3	3	4	4	clonal spread	limited	x	x	x	x
Echinocystis lobata	wild cucumber	annual	1	3	2	3	no	yes		x	x	x
Fraxinus pennsylvanica	green ash	tree	1	2	2#	4	resprouting	yes		x	x	x
Helianthus tuberosus	Jerusalem artichoke	perennial	1	2	2#	3	clonal spread	yes		x		x
Heracleum mantegazzianum	giant hogweed	perennial	1	1	1	1	resprouting	yes		x	x	x
Impatiens glandulifera	himalayan balsam	annual	1	3	2	2	no	yes	x	x	x	x
Impatiens parviflora	small balsam	annual	1*/5	5	5	5	no	yes	x	x	x	x
Isatis tinctoria	woad	perennial	1	3	2	2	resprouting	yes		x		x
Juglans nigra	black walnut	tree	1	2	4	3	no	yes		x		
Juglans regia	common walnut	tree	2	3	4	4	resprouting	yes		x		
Laburnum anagyroides	common laburnum	shrub	2	3	4	3	resprouting	no		x		
Larix kaempferi	japanese larch	tree	2	4	4	4	no	no	x	x		
Lupinus polyphyllus	lupine	perennial	1	2	1#	2	resprouting	yes	x	x	x	x

scientific plant name	common plant name	life form	priority in territories A1 (BSNP area) and A3 (Small-scale protected areas and Sites of Community Importance)	priority in territory B (Elbe Valley)	priority in territory C (Settlements)	priority in territory D (Other parts of the ESPLA)	clonality	rate of spread by using propagules (seeds, rhizomes, roots, etc.)	occurrence in the BSNP	occurrence in the ESPLA	occurrence in the Lužické hory PLA	occurrence in the České středohoří PLA
Lycium barbarum	chinese wolfberry	shrub	2	4	4	3	clonal spread	limited		x		x
Lychnis coronaria	rose campion	perennial	2	3	4	4	clonal spread	yes		x		
Mahonia aquifolium	oregon grape	shrub	2	3	4	3	resprouting	limited		x		
Parthenocissus inserta	thicket-creeper	shrub	2	4	4	3	clonal spread	yes		x		x
Parthenocissus quinquefolia	virginia creeper	perennial	2	3	4	3	clonal spread	yes		x		
Paulownia tomentosa	princess tree	tree	1	2	2#	3	resprouting	yes	x			
Phytolacca sp.	pokeweed	perennial	1	1	1#	1	resprouting	yes		x		x
Pinus nigra	black pine	tree	2	4	4	4	no	limited	x	x	x	x
Pinus strobus	eastern white pine	tree	1	1	1#	1	no	yes	x	x	x	x
Populus ×canadensis, Populus balsamifera	canadian poplar, balsam poplar	tree	1	2	3	3	clonal spread	yes		x		x
Prunus serotina	black cherry	tree	1	1	1	1	clonal spread	yes		x		x
Pseudotsuga menziesi	Douglas fir	tree	1	2	3	3	no	yes	x	x	x	x
Quercus rubra	red oak	tree	1	2	3	2	resprouting	yes	x	x	x	x
Reynoutria ×bohemica	bohemian knotweed	perennial	1	2	2	2	clonal spread	yes		x		x
Reynoutria japonica	japanese knotweed	perennial	1	2	2	2	clonal spread	yes	x	x	x	x
Reynoutria sachalinensis	sakhalin knotweed	perennial	1	2	2	2	clonal spread	yes	x	x	x	x

scientific plant name	common plant name	life form	priority in territories A1 (BSNP area) and A2 (Small-scale protected areas and Sites of Community Importance)	priority in territory B (Elbe Valley)	priority in territory C (Settlements)	priority in territory D (Other parts of the ESPLA)	clonality	rate of spread by using propagules (seeds, rhizomes, roots, etc.)	occurrence in the BSNP	occurrence in the ESPLA	occurrence in the Lužické hory PLA	occurrence in the České středohoří PLA
Rhus typhina	staghorn sumac	shrub	2	3	4	3	clonal spread	limited		x		x
Robinia pseudoacacia	Black locust	tree	1	2	3	3	clonal spread	limited	x	x	x	x
Rudbeckia hirta	black-eyed Susan	annual	1	3	4	3	no	limited		x		
Rudbeckia laciniata	cutleaf coneflower	perennial	1	3	4	3	clonal spread	yes	x	x		x
Senecio inaequidens	narrow-leaved ragwort	perennial	1	1	1	1	resprouting	yes	x	x	x	x
Solidago canadensis	canadian goldenrod	perennial	1	3	3	3	resprouting	yes	x	x	x	x
Solidago gigantea	giant goldenrod	perennial	1	3	3	3	clonal spread	yes	x	x	x	x
Symphoricarpos albus	common snowberry	shrub	2	3	4	3	clonal spread	limited	x	x	x	x
Symphyotrichum sp.	aster	perennial	2	3	4	4	clonal spread	yes	x	x		x
Syringa vulgaris	common lilac	shrub	2	4	4	4	clonal spread	limited		x	x	x
Telekia speciosa	heart-leaved oxeye	perennial	1	2	2#	2	resprouting	yes	x	x	x	x

If we try to depict individual species and their management priorities in the ordination space (Fig. 3.4), then we can see a distinct group with species that are to be eradicated always and everywhere *Prunus serotina, Pinus strobus*, etc.) and a continuum of species from very limited tolerance (e.g. in the Elbe valley, or with a lower priority given, for example, by a lower ability to spread rapidly) through species tolerable in settlements to species that are tolerated in settlements, to those that can be tolerated everywhere.

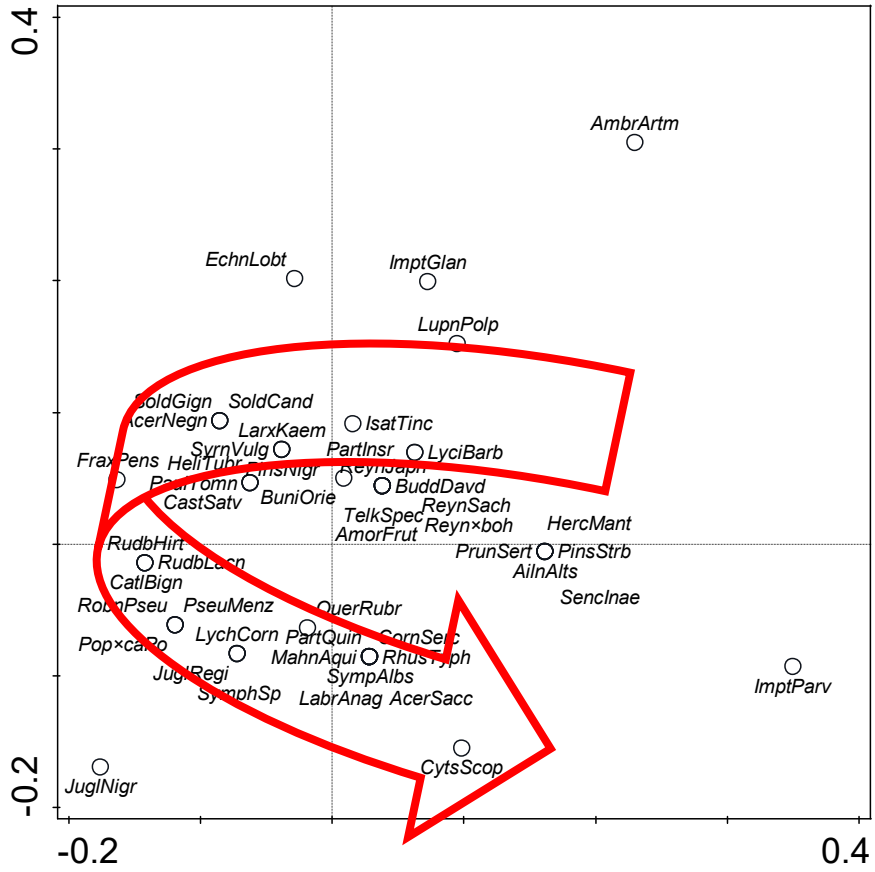


Fig. 3.4. Ordination diagram showing the needs of management and the individual alien species included in the Strategy. The red arrow shows the continuum and direction from complete eradication in all areas of the BSNP and ESPLA to tolerance.

Goals for individual species

The chapter includes **selected species** with the recommended prioritization of goals according to the type of territory and realistic achievability. Management techniques are not described here in detail, as they are described in the Management of selected alien plant species issued by the Nature Conservation Agency of the Czech Republic (Pergl et al. 2023a), in the Management Measures for selected species *(Impatiens glandulifera, Ailanthus altissima*) or other information sources (e.g. ochranarskaprirucka.cz).

The listed non-native species were selected to represent species important for the BSNP and ESPLA and at the same time species representing different approaches to management in the area.

3.4.1. Ragweed (*Ambrosia artemisiifolia*)

It is an annual plant that reproduces exclusively by seeds. Its pollen is highly allergenic and can cause irritation of the respiratory tract and skin. In addition, it is a troublesome weed in the fields and can cause poisoning to grazing cattle. It is weak in terms of competition, so it occupies mainly uncultivated habitats with little vegetation. It typically spreads along railways, in places treated with herbicides, and recently it has also been spreading along roads, from where there is a risk of further spread by agricultural machinery. The seeds are also successfully propagated through water. In the area of interest, it is scattered on the alluvial deposits in the Elbe Valley, where the seeds are transported by the river.

*Fig. 3.4.1. Ragweed (*Ambrosia artemisiifolia*) on the alluvial deposits of the Elbe River. Photo by Jan Pergl.*

The management's goals are:

1) **To ensure the complete eradication of all detected occurrences (so-called rapid eradication) in the entire area of the BSNP and ESPLA, except for the Elbe Valley (territory B)** – preferably in places where there is an increased risk of further spread (along watercourses, roads, railways).

2) **Occurrences in riparian vegetation and alluvial deposits in the Elbe Valley (territory B) must be tolerated**, because it is not possible to prevent the supply of seeds by the Elbe River. Eradication would only make sense here as a coordinated action with upstream locations. However, in order to prevent the spread to valuable areas, it is necessary to eradicate any satellite populations outside the boundaries of the Elbe Valley (roads, railways).

An effective way to eradicate small to medium ragweed populations is pulling, preferably before flowering begins, until it produces highly allergenic pollen but in any case before producing seeds, part of which is able to survive heat treatment by composting. Protective clothing is necessary to prevent skin irritation. The seeds persist in the seed bank, so if they have already borne fruit at the site in previous years, it is necessary to repeat the intervention in the following years. Seed germination can be prevented by creating a dense vegetation cover. Any management of large populations must be aimed at preventing seeding. A highly effective way is mowing followed by spraying the regenerating plants with herbicide (regenerating plants usually cannot be effectively mowed again because they bear fruit on branches close to the ground). This procedure is also suitable for the edges of roads with ragweed. Large populations can also be sprayed with herbicide alone. Some forms of ragweed have shown resistance to different types of herbicides, however, it has been shown that the best results are achieved with glyphosate-based products. In places where possible, revegetation by native perennial species is very effective, as ragweed has very little competitive ability. Details on individual management methods are provided in the handbook Buttenschøn et al. (2010).

With ragweed, the timing of the first mowing is crucial. If done early (June), ragweed will gain an advantage and grow vigorously. Therefore, it is advisable to maintain competition with other species in stands where it occurs.

3.4.2. Eastern white pine (*Pinus strobus*)

Eastern white pine (Weymouth pine) occurs scattered almost throughout the territory of ESPLA and also BSNP, where it has been intensively suppressed since the establishment of the NP (2000). The problem is inaccessible locations and rock outcrops, where eradication is very difficult.

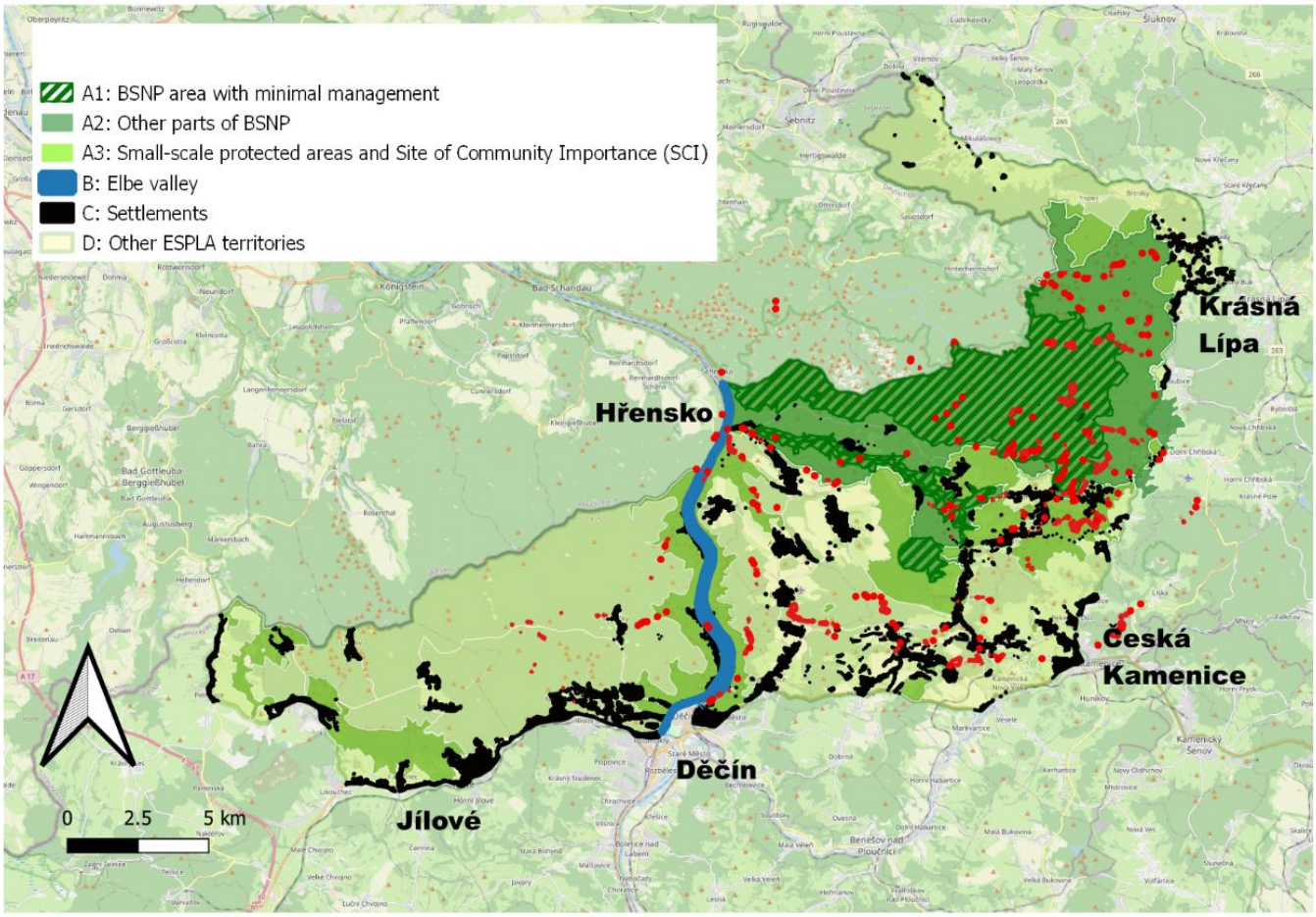


Fig. 3.4.2a. Records of eastern white pine (red) from mapping along the road network in 2020-2022 (Pergl 2023).

The management's goals are:

1) **On the area of the BSNP (territory A1), in the small-scale protected areas and SCI (territory A2), the priority is to eradicate all individuals** of eastern white pine. The suppression of eastern white pine in the territory of the BSNP in previous years was effective and led to a reduction of eastern white pine vegetation and a slowdown of the invasion. However, its frequent occurrences on hard-to-reach rocky outcrops and juvenile individuals from the as yet unsuppressed dispersed regeneration remain a problem. The situation is complicated by the decay of dead spruce stands, where it can now be assumed that the possibilities of completing the eradication in some areas will be reduced, which will again lead to the development of invasion. Since it is a known problem species of the area, the public can also be used to report occurrences.

2) **In the rest of the ESPLA, in settlements** and their surroundings, the goal is also the complete eradication of eastern white pine. However, due to ownership relations (mainly Lesy ČR (State Forest Authority)), economic demands and partly economic interests, the achievement of the goal is very complicated. Primarily, in accordance with point 1, it is

necessary to remove the eastern white pine (both mature trees and regeneration) along the borders of the national park to a distance of at least 50 meters.

Eastern white pine reproduces very well by seeds and suppresses scots pine in particular. From the management point of view, it is important that it spreads only by seeds, it does not form root or stump sprouts. The key is to remove fertile trees first (they start fruiting around 15 years of age). The seeds spread very well by the wind. In the case of gradual eradication over several years, it is necessary to proceed from the source populations in the upper parts of the slopes, on plateaus, rock outcrops and ridges towards the populations in the valleys.

The recommended management is the felling of fertile trees using classic forestry methods (selective or clear-cut felling, forest intervention management, The site should of course be checked for several years, and any later emerging individuals should be eradicated.

Fig. 3.4.2b. Eastern white pine on rocks above the Kamenice Gorge in the Bohemian Switzerland National Park in 2002. Today, this stand has been completely eradicated. Photo by Handrij Härtel.

Fig. 3.4.2c. Former dense stands of eastern white pine in the Bohemian Switzerland National Park before eradication. Photo by Václav Sojka.

Fig. 3.4.2d. Solitary eastern white pine in a clear-cut area in the Lužické hory PLA (Bukovina near Chřibská). Photo by Handrij Härtel.

3.4.3. Red oak (*Quercus rubra*)

Red oak is a species used in forestry. Despite its large negative impact, a significant reduction in stands in commercial forests cannot be expected. It is necessary to focus on its eradication in BSNP (territories A1 and A2) and small-scale protected areas and SCI (territory A3). With regard to the occurrence of red oak in the upper parts of the German part of the NP, it would be appropriate to ensure continuity of management on the German territory as well.

The management's goals are:

1) **On the BSNP area (territory A1), in the small-scale protected areas and SCI (territory A2), all occurrences of red oak are to be eradicated**.
2) **In the Elbe Valley (territory B) and in the rest of the ESPLA area (territory D), to strive for the reduction of red oak stands** in agreement with the State Forest Authority of the Czech Republic (LČR) and other owners.
3) **In settlements (territory C), its occurrence can be tolerated**, but it is necessary to map its occurrence and monitor the surroundings of its plantations.
4) **Eradicate spontaneous occurrences** outside plantings, monitor the surroundings of growing sites where eradication has not occurred.

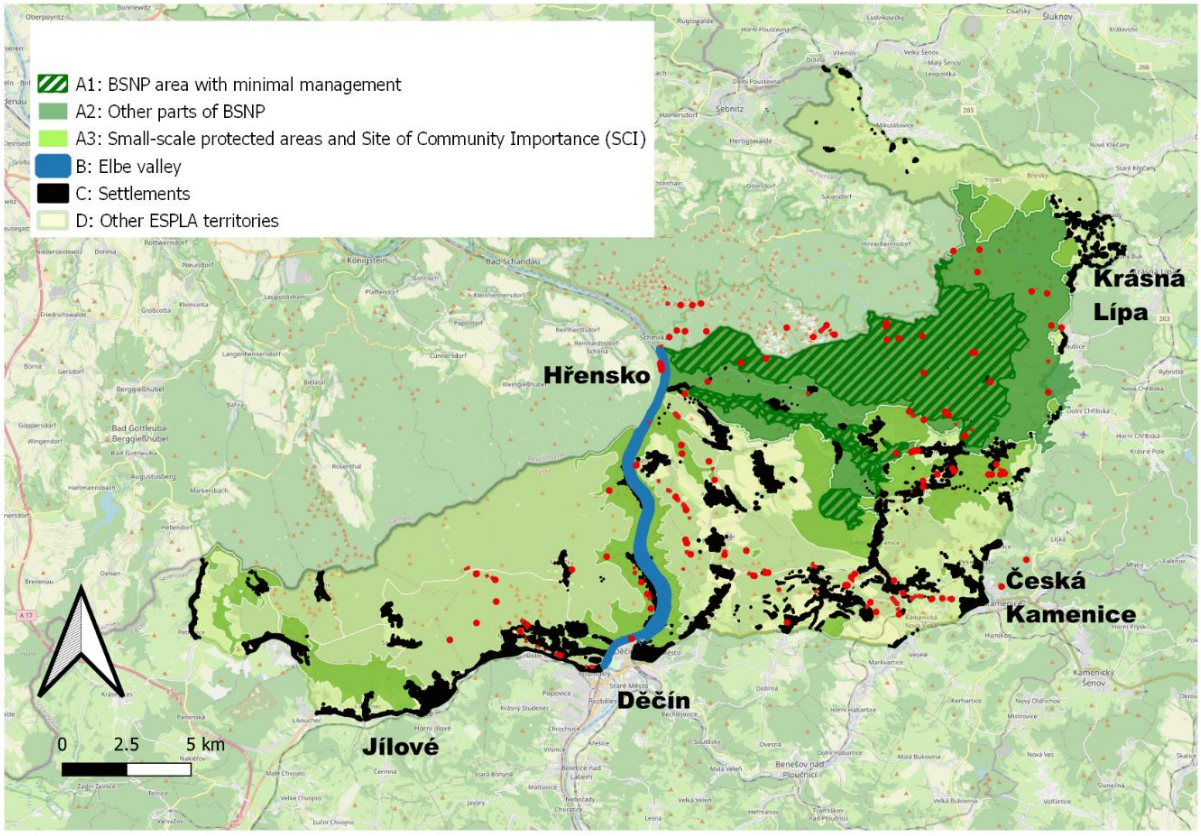


Fig. 3.4.3. Records of red oak (red) from mapping along the road network in 2020-2022 (Pergl 2023).

The recommended methods of eradication require the use of herbicide, because due to its stump sprouting capacity, felling alone is not effective. In most cases, it is sufficient to apply the herbicide on the stump, or it is possible to use a targeted application of the herbicide to the trunk (see the methodology for eradication of the tree of heaven).

3.4.4. Scotch broom (*Cytisus scoparius*)

Scotch broom occurs scattered throughout the area of interest. It has heavy seeds that do not spread easily over long distances and is not tolerant of shade. However, in areas where there has been a drastic change in vegetation (clearings after logging, fire), there is a risk of its massive regeneration from underground organs and seeds. If it occurs as part of the edges of existing stands, there is probably no need to intervene against it. It is a risk in newly vacated areas and in areas with limited management, where it can be expected to disrupt the course of succession. In addition, it is a species that is from the legume family, so by fixing nitrogen, it changes oligotrophic habitats into nutritious ones.

The management's goals are:

1) **On newly disturbed large areas (fire sites, clearings) on the territory of the BSNP, to quickly suppress large stands of scotch broom seedlings in places where succession has not yet formed a cover of young native trees. Primarily reduce also in stands in the target state in the core area of the NP (territory A1)**. After the fire, the scotch broom grows considerably, both from seeds and as a regeneration of individuals that grew here before the fire. The suppression is supposed to be a preventive action aimed at preventing the occupation of newly disturbed areas by scotch broom before the natural regeneration of native species takes place. Young seedlings must be removed immediately by pulling them out. Older and regenerating individuals can no longer be removed by pulling them out, and if their disposal is needed, it is necessary to apply a herbicide to the cut. In areas where succession by native species is already occurring, it can be tolerated (it does not tolerate shade).
2) **In other places in the BSNP and ESPLA**, it is necessary to monitor this species and in case of a significantly negative impact on the surrounding species/communities to suppress it.
3) **In the small-scale protected areas and SCI (territory A2)** it is desirable to suppress/eradicate isolated stands of this species (e.g. Hofberg Nature Reserve).

3.4.5. Box elder (*Acer negundo*)

The box elder is often intentionally planted, especially along roads and railways. It is not currently present in the BSNP. Due to its rapid growth, it outcompetes other tree species,

disrupts ecosystems, and, by shading the water surface, can displace aquatic vegetation. It also affects bank stability and accelerates erosion. It reproduces mainly by seeds, which spread easily by wind and water. When mechanically damaged, it regenerates well from stump and trunk sprouts.

The species is most widespread in the area of interest along the Elbe River.

The management's goals are:

1) **In the BSNP (territory A1), in small-scale protected areas and in sites of Community importance (territory A2), all occurrences of box elder must be eradicated** as soon as they are detected.
2) **In the Elbe Valley (Area B), efforts should be made to eliminate all occurrences** to prevent the overgrowth of rare and endangered habitats of gravel and sand **river banks**—one of the rarest and most threatened habitat types in the Czech Republic.
3) **In settlements (Area C) and the rest of the ESPLA (territory D), intentional plantings may be tolerated**. However, surrounding areas must be monitored, and **spontaneous occurrences outside plantings must be eradicated**. If trees in territories C and D serve as a direct seed source for territories A or B, their removal is advisable.

Recommended Eradication Methods:

Effective eradication requires the use of herbicides, as cutting alone is ineffective due to the species' ability to sprout from stumps. The most effective methods include targeted herbicide application into the trunk (injection) or making incisions and partially peeling the bark, followed by immediate herbicide application. If trees are felled, the cut surface must be treated with herbicide immediately. Despite this, some stumps may still sprout. Seedlings and young trees can be pulled out manually. Herbicide spraying on leaves is effective for young trees and stump sprouts.

3.4.6. Sweet chestnut (*Castanea sativa*)

The sweet chestnut tree occurs mainly under the Pravčická brána in the BSNP (as a remnant of the sale of roasted chestnuts), from where it spreads, and is also locally grown in gardens. The species is easily propagated by fruits. It is a popular edible plant, however it has the ability to quickly form dense stands.

The management's goals are:

1) **To ensure complete eradication in the entire territory of the BSNP and ESPLA except for settlements (territory C)**. It is primarily the locality below the Pravčická brána. Given that it is a species that is economically used mainly by small growers, it is necessary to inform the public about its ability to colonize the surroundings and create dense vegetation.

2) **In settlements (territory C), its occurrence can be tolerated**, but it is necessary to map its occurrence and monitor the surroundings of its plantations. **Any spontaneous occurrences should be eradicated**.

It is a species with good stump regeneration. Very young seedlings can be pulled out. Taller individuals are recommended to be eradicated similarly to the tree of heaven (*Ailanthus altissima*, methods of targeted application of the herbicide directly into the trunk), but the regenerative ability is not so high. Therefore, treatment of the shoots or the cut area with herbicide can also be used for eradication.

3.4.7. Heart-leaved oxeye (*Telekia speciosa*)

Heart-leaved oxeye occurs sporadically in the territory of the BSNP in the valley of the Kamenice River from Dolský mlýn Mill downstream, in ESPLA grows e.g. in villages Růžová and Chřibská from where it spreads to Pavlínino údolí Nature Reserve, one occurrence was recorded near village Doubice.

The management's goals are:

1) With regard to the high invasion potential and the subsequent difficult eradication of the invaded stands, it is a priority to **ensure complete and prompt eradication of the species in the BSNP**.
2) It is a species grown as an ornamental plant in settlements. An important goal is therefore to **map its distribution in villages** (its distribution is known in Chřibská along Chřibská Kamenice River), to convince the public about the risks of cultivation and benefits of its eradication.
3) **Eradicate spontaneous occurrences** outside plantings in settlements and their surroundings, monitor the surroundings of growing sites where eradication has not occurred.

Due to its high regenerative capacity, the heart-leaved oxeye has only a small response to mowing, which can prevent seed formation, but does not destroy individual plants. Experience with heart-leaved oxeye management in the Orlické hory Mts. and Šumava Mts. confirms that mowing alone is insufficient and herbicide spraying is necessary before flowering. The reaction to the herbicide itself takes a long time (up to 8 weeks) in this species, so it often has time to bloom after spraying and it is necessary to pluck the flowers.

Heart-leaved oxeye is a species cultivated for decorative purposes, and since it also has an extensive invasive history, e.g. in the Orlické hory Mts., it has the potential to become a good exemplary species for the public when arguing about the risks of some ornamental species. When working with the public, it is suitable both for educational activities and for its involvement in monitoring. It is also appropriate to present heart-leaved oxeye as a slightly allergenic and toxic species (Patočka and Jakl 2011).

Due to the limited distribution, it is not yet a priority to issue measures for regulation "Opatření k regulaci", which could be issued by the BSNP Administration and would be an effective tool to limit the spread from garden cultures (by setting conditions for handling biomass containing seeds).

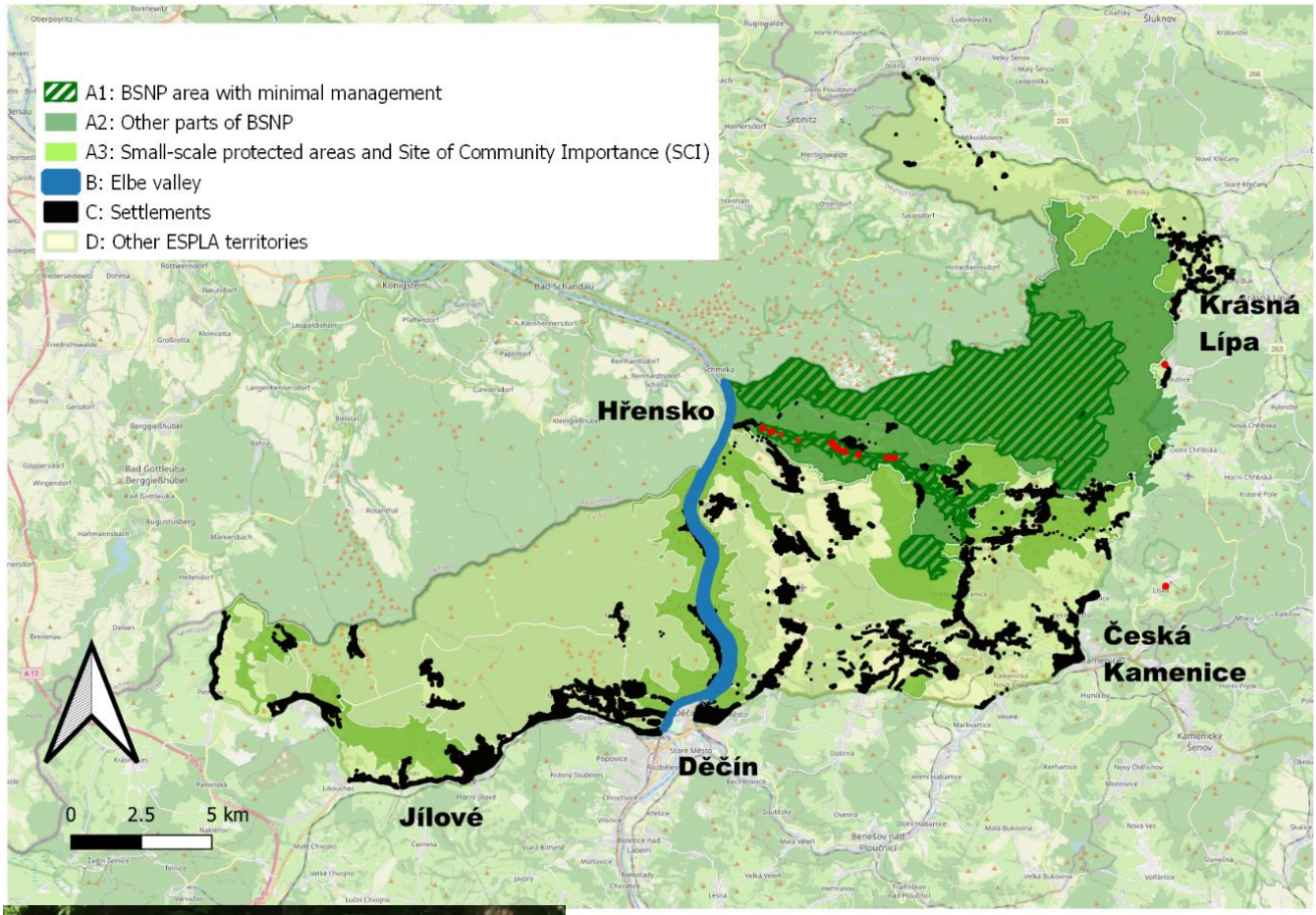


Fig. 3.4.7a. Records of the heart-leaved oxeye (red) from mapping along the road network in 2020-2022 (Pergl 2023).

Fig. 3.4.7b. Telekia speciosa*. Kamenice at the Dolský mlýn Mill (2019). Photo by Handrij Härtel*

3.4.8. Knotweeds (*Reynoutria* sp.)

All three species of *Reynoutria* and their backcroses are found in the area of interest, which makes their identification difficult. For the management strategy, they are considered as a whole, also due to the fact that management methods and their response to them are very similar (with the exception of *Reynoutria sachalinensis*, for which a satisfactory effect can be achieved earlier than for other species and hybrids).

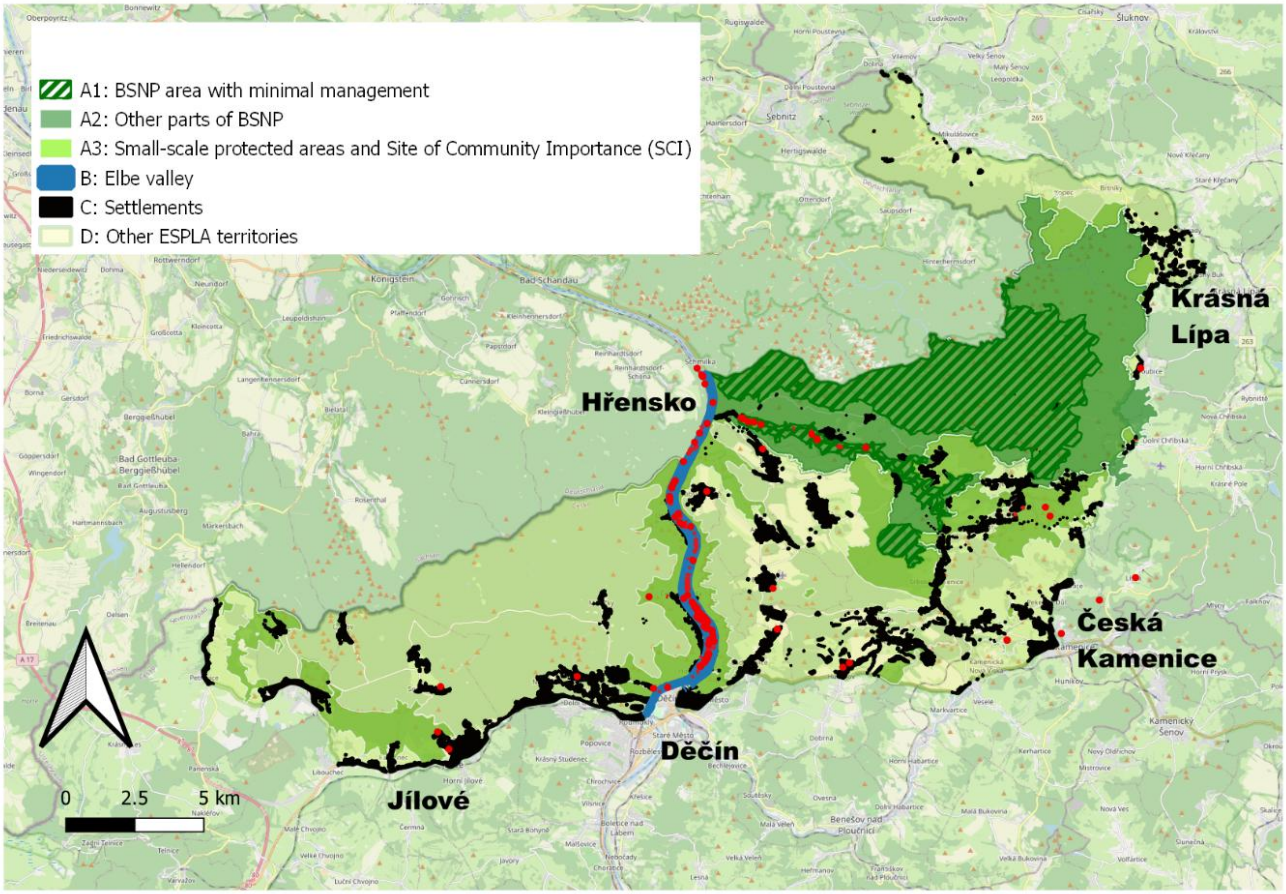


Fig. 3.4.8a. Records of knotweeds (red) from mapping along the road network in 2020-2022 (Pergl 2023).

The management's goals are:

1) **On the entire territory of the BSNP and ESPLA, immediately intervene against new isolated occurrences** that typically arise as a result of the transfer of soil contaminated with *Reynoutria* rhizomes. Ensure long-term management by herbicide until needed – rapid eradication will result in less regeneration (less developed massive underground rhizome system), so a good result will be achieved faster and with a lower amount of herbicide and financial resources. The highest priority is given to places where there is an increased risk of further spread (along watercourses, roads, rubble sites, abandoned buildings; in general, places with a high probability of soil movement).

2) **On the territory of the BSNP (territory A1), in the small-scale protected areas and SCI (territory A2), all *Reynoutria* stands should be eradicated as a priority**. Eradication can only be achieved by repeated application of the herbicide, including subsequent long-term control and treatment of individual regenerating shoots with herbicides.

3) **In the Elbe Valley (territory B), in settlements (territory C) and in the rest of the ESPLA (territory D), the eradication of *Reynoutria* stands has a lower priority than in points 1 and 2**. In the case of large older stands, it is practically impossible to achieve their complete eradication and it is more a matter of suppression. The relatively slower ability to increase the size of *Reynoutria* stands makes it possible to proceed gradually in the management of large stands according to the available financial resources (of course, with the awareness of the ability to spread by rhizome fragments during disturbance events). After a significant reduction of such stands in the first years (the time increases with the robustness of the rhizome system), it is possible to intervene in regenerating stands only in period of every 3-5 years due to the financial demands and due to the reduction of the impact of herbicides on the surroundings (Švec et al. 2024).

Fig. 3.4.8b. Spraying of Reynoutria *with herbicide leads to a reduction of stands but must be repeated over a long period of time. Photo by Jan Pergl.*

Reynoutria spreads mainly through fragments of rhizomes. Propagation by seeds is also possible (as shown by the occurrence of hybrids), but it does not play a significant role in dispersal, so there is no need to focus in management planning on the timing of intervention prior to seed production. However, great emphasis must be placed on preventing the spread of soil contaminated by rhizomes during any soil movements and construction activities. It is necessary to raise public awareness of *Reynoutria,* especially the way they are spread, their impact and their very difficult eradication. The methods of management are listed in the Management of selected alien plant species issued by the Nature Conservation Agency of the Czech Republic (Pergl et al. 2023a) and are based on application of herbicide to the leaf. Injection may be appropriate at biologically valuable sites or in the vicinity of water sources and in their protection zones. In the case of management actions in the border area, it is advisable to ensure the continuity of management on the German territory, especially in the case of stands located higher up on streams.

*Fig. 3.4.8c. Japanese knotweed (*Reynoutria japonica*) near Dolský Mill on the banks of the Kamenice River in 1992, now within the Bohemian Switzerland National Park. Photo by Handrij Härtel.*

Fig. 3.4.8d. The same location in 2015, after the previous removal of knotweed and several floods. Photo by Petr Bauer.

Fig. 3.4.8e. Stands of japanese knotweed on the banks of the Elbe River near Podskalí in the ESPLA in 2010. Photo by Petr Bauer.

Fig. 3.4.8f. The same location after the removal of knotweed. Photo from 2014, by Petr Bauer.

*Fig. 3.4.8g. Sakhalin knotweed (*Reynoutria sachalinensis*) on the banks of the Křinice River at the entrance to the Kyjov Valley from Kyjov in 1994 (now within the Bohemian Switzerland National Park). Photo by Handrij Härtel.*

Fig. 3.4.8h. The same location in 2015. The eradication was carried out in the past with 100% success. Photo by Petr Bauer.

3.4.9. Lupine (*Lupinus polyphyllus*)

Lupine is scattered throughout the ESPLA, and also in several places in the BSNP (e.g. Mezná). Extensive occurrences in ESPLA can currently be found, for example, in the meadows between Ludvíkovice and Popovičský vrch and in the vicinity of Mikulášovice, in some places lupine shows a tendency to penetrate into the small-scale protected areas (Niva Olšového potoka Nature Reserve). It is a problematic invasive species causing considerable problems in protected areas, mainly due to its negative impact on the structure and composition of communities and their diversity, especially in nutrient-poor habitats. It enriches the soil with nitrogen, which in turn favours competitively strong eutrophic grasses and contributes to vegetation change. Lupine is spread by seeds – unintentionally mainly along watercourses and transport corridors, intentionally still by cultivation.

The management's goals are:

1) **On the territory of the BSNP (territory A1), in the small-scale protected areas and SCI (territory A2), priority should be given to eradicate all occurrences of lupin**. Since it is an easily recognizable species, the public can be involved in reporting occurrences.
2) **In the Elbe Valley (territory B), in settlements (territory C) and in the rest of the ESPLA territory (territory D), the goal is also the complete eradication of lupine, but it has a lower priority** than in point 1.
3) **In settlements, it is possible to tolerate the intentional cultivation of lupine for ornamental purposes on maintained areas defined according to the Land Registry as gardens, courtyards or built-up areas**, but under specified conditions for the handling of flowering and fruiting plants. **Any spontaneous occurrences must be eradicated**.

Mechanical management can prevent seed formation and reduce lupin cover with the right timing. However, due to its high regenerative capacity, the application of herbicides is recommended for effective eradication, if local conditions allow it. Seedlings and small plants can be pulled out or dug up (recommended procedure for small populations only).

On newly detected and isolated stands of a smaller extent in the open countryside (typically roadsides, path, forest and meadow edges), which often serve as a source for further spread, we recommend rapid and complete eradication. This can be achieved by herbicides application to the leaf or by digging individual plants.

In the case of more extensive stands, it is advantageous to first significantly reduce the stand using a herbicide, and then mechanically eliminate the surviving plants and newly germinated seedlings (Vacátková 2008). This will significantly reduce the time required to eradicate the stand compared to mechanical treatment by mowing/cutting, which requires proper timing over many years to prevent seeding.

In gardens or elsewhere in settlements, we recommend tolerating lupine as an ornamental plant only under strict conditions of biomass handling. These must be set out through the measures for regulation (“Opatření k regulaci”) issued by the BSNP Administration. If the owner prefers eradication, then digging is the appropriate method, if not feasible, weakening by pulling or cutting before the seed formation begins. If the garden is used extensively and

there is a risk of non-compliance with the principles of mechanical treatment, then herbicide is the most appropriate method.

For details on individual management methods, see documents for the control of lupin (*Lupinus polyphyllus*) (Perglová et Pergl 2024).

Fig. 3.4.9. Lupine in the Olšový potok Valley near Rájec (2024). Photo by Handrij Härtel.

3.4.10. Small balsam (*Impatiens parviflora*)

The small balsam invades a large number of habitats. However, it does not have a very strong impact, as it is weak in terms of competition (Hejda 2012). The negative impact on native vegetation is caused by competition for light and is manifested mainly by the impact on early flowering species with a low height, not adapted to worse light conditions.

The management's goals are:

1) **On the territory of the Růžák National Nature Reserve and the Pravčická brána National Nature Monument**, where these are isolated sites, **continue the long-term management of the small balsam by pulling it out along the tourist trail**.
2) **In the other areas of the BSNP and ESPLA, there is no point in intervening due to the low impact of the species** and the high labour intensity of management. An exception could be the occurrences inside the BSNP, which would turn out to be very isolated and with a very limited number of individuals, where a simple intervention could help to preserve a larger compact area without the presence of this species, given that this species almost does not occur on the sandstone substrate and its occurrence in the BSNP is bound to richer substrates, typically gravel roads or around watercourses. For these reasons, a more detailed mapping within the BSNP would be useful.

The recommended method of disposal is pulling. This is followed by a rapid regeneration of the original vegetation. Small balsam does not form a seed bank (all seeds germinate the following year; Perglová at al. 2009), and so its eradication in isolated localities without intensive seed supply is achievable.

Fig. 3.4.10. Impatiens parviflora *below Pravčická brána Arch (2015) before eradication. Photo by Handrij Härtel.*

3.4.11. Himalayan balsam (*Impatiens glandulifera*)

The himalayan balsam is widespread in the BSNP and ESPLA especially in the Elbe valley, along the Kamenice River and Gorge and is also spreading in the Mikulášovice area (partially from Saxony).

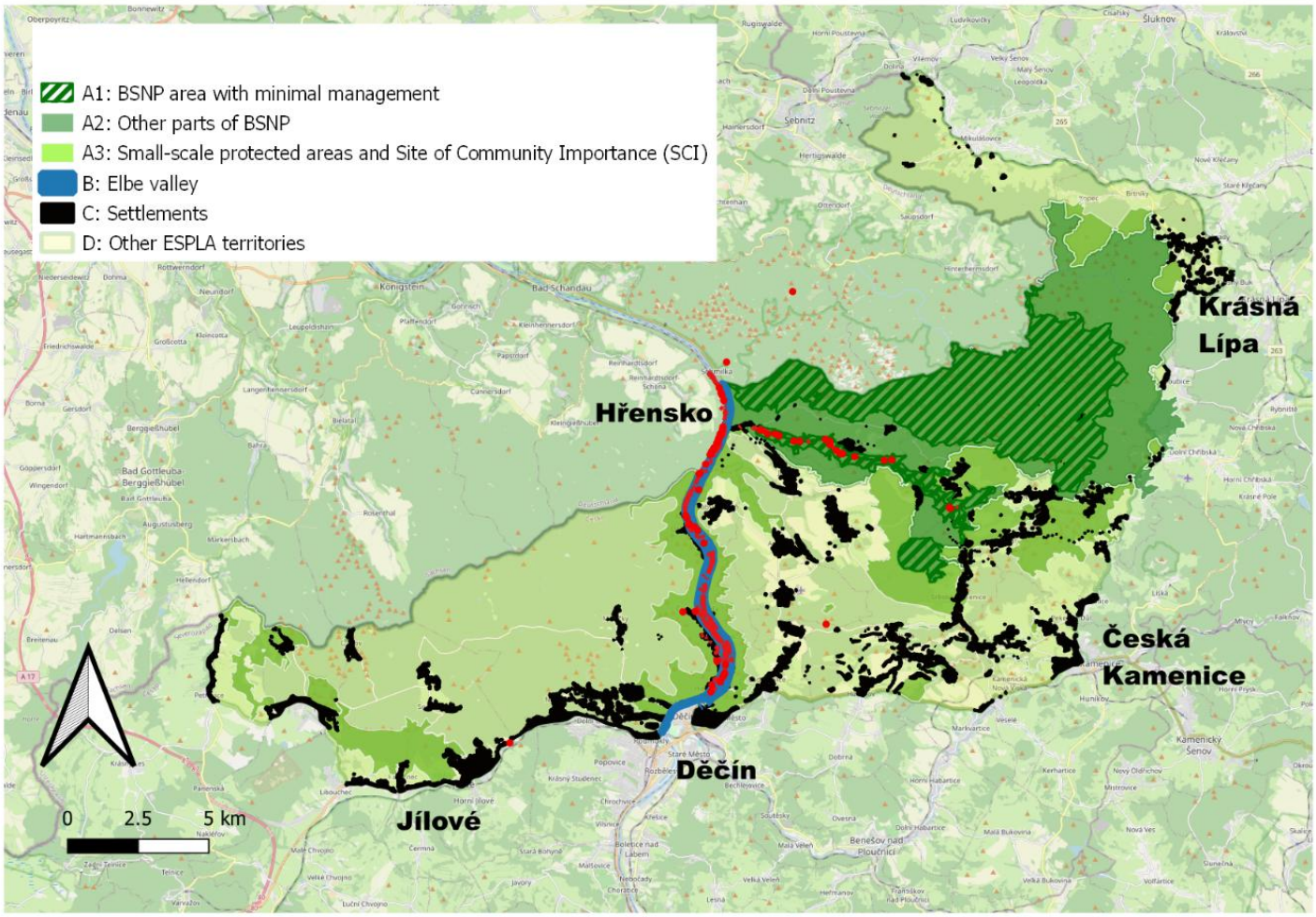


Fig. 3.4.11a. Records of the himalayan balsam from mapping along the road network in 2020-2022 (Pergl 2023).

The management's goals are:

1) **Ensure the complete eradication of newly identified and isolated stands throughout the BSNP and ESPLA** that do not have an intensive supply of seeds (so-called rapid eradication) – preferably in places where there is an increased risk of further spread (along watercourses, roads).

2) **In established stands in the BSNP (territory A1), in the small-scale protected areas and SCI (territory A2), in which there is no intensive supply of seeds** from the surrounding environment, or where the supply of seeds can be effectively stopped (e.g. by eradication of all sites upstream in the case of riparian sites), **intervene with the aim of complete eradication**.

3) **In established stands in the BSNP (territory A1), in the small-scale protected areas and SCI (territory A2) with an intensive supply of seeds**, where it is not possible to achieve eradication of the species even in the long term, **ensure permanent active management** (plant removal). Prioritize management actions in the vicinity of these sites so that seed supply to the valuable area is significantly reduced. These are e.g. places where streams from Germany flow into these areas or where roads come from the surrounding area (Křinice valley).

4) **In the rest of the ESPLA area, in settlements and their surroundings, with the exception of the Elbe Valley (territory B),** the eradication of established stands has a lower priority than in the above-mentioned cases.

5) **In established stands in the Elbe Valley (territory B),** limit flowering and **reduce seed production** as much as possible in the long term as **part of normal management** and landscape care. Due to the massive seed input through the Elbe River, it does not make sense to strive for eradication in this area but reducing seed production will have a positive effect on management efforts in the rest of the ESPLA and BSNP areas (reduction of diaspore supply).

The priority of the control of the himalayan balsam is to prevent its spread in previously unaffected or poorly affected sites (rapid eradication) and to ensure the removal or long-term active management of naturally valuable sites where it is necessary to limit the impact on biodiversity. With regard to the method of spread, it is necessary to prioritize locations around watercourses and transport infrastructure (roads, railways, etc.) - measures should be taken from these areas with a high risk of spread to less risky areas. In places near the border, it is necessary to ensure cooperation with the German side so that the effectiveness of management is not reduced.

The individual types of management are described in detail in the Management measures of *Impatiens glandulifera* in the Czech Republic (Pergl et Perglová 2024) and the Management of selected alien plant species issued by the Nature Conservation Agency of the Czech Republic (Pergl et al. 2023a). In locations without an intensive seed supply, complete eradication can be achieved relatively easily and thus prevent new outbreaks of spread. The recommended method is to pull out whole plants with roots. Interventions must be properly timed, precise and repeated. It is important to have zero tolerance, consistency, avoid the supply of seeds and maintain management for several years (about five) until the eradication is complete.

When ensuring permanent active management of already established balsam stands, where it is not possible to prevent the seed supply, it is advisable to define protective "buffer" zones in which management will be carried out so that the supply of seeds to the valuable area is significantly reduced (regular and repeated mowing at the beginning of plant flowering, etc.). The width of the buffer zone depends on local conditions, but it should always be at least 500 m (an overlap into a neighbouring country is also desirable, the species is on the European list), while higher intensity of management in the buffer zone may reduce its size.

In stands where, for reasons of meaningfulness and feasibility, no eradication measures are taken (Elbe Valley, territory B), it is advisable to aim at limiting seed production as much as

possible in the long term (e.g. by mowing or grazing in suitable places), both in the stands themselves and especially at the edges of the stands and in their vicinity, to prevent them from spreading to other habitats further away from the source of the seed supply.

Specifically, it is necessary to pay attention to the spread of seeds from the affected areas through transport and the movement of construction, forestry or other machinery, and on the shoes of tourists. When working with the public, it is necessary to focus on preventing accidental introduction and spreading, e.g. with organic material from gardens. A necessary prerequisite for successful management is monitoring of the occurrence, to which the public can also contribute.

Fig. 3.4.11b. Impatiens glandulifera. Foto by Petr Bauer.

3.4.12. Tree of heaven (*Ailanthus altissima*)

Tree of heaven is currently found near the Děčín – Dolní Žleb railway line, from where there is a risk of its spread, especially along the Elbe River further into the territory of the ESPLA and BSNP. It is a species for which a complete eradication throughout the Czech Republic is proposed in the Management measures of *Ailanthus altissima* in the Czech Republic (Pergl et al. 2023b).

The management goal is:

1) **To ensure complete eradication of tree of heaven throughout the territory of the BSNP and ESPLA**. Priority is given to locations along corridors (rail, roads and watercourses) where there is an increased risk of further spread.

It is a fast-growing tree with an early onset of fruiting (at 4 years in seedlings and even earlier in individuals resulting from regeneration). It spreads by winged seeds, which are easily dispersed by wind and water. Vegetative spread by root sprouts is important only on a small scale, but it is very important for the ability to regenerate after damage and the formation of dense stands. The tree of heaven reacts to damage by quickly rejuvenating from the roots, trunk or stump.

In newly colonized areas and isolated individual trees outside areas with extensive occurrences, it is essential to prevent seeding. This must be done in such a way that massive vegetative regeneration does not occur, i.e. avoid purely mechanical removal of tree of heaven – e.g. when maintaining the site by mowing, young trees of tree of heaven must be excluded from maintenance and treated separately immediately after foliage using a suitable method (partial peeling of the trunk with herbicide treatment, spraying, etc.).

Management is based on the removal of mature individuals by a combination of mechanical and chemical treatments. The most effective methods are targeted application of the herbicide directly into the trunk of the tree of heaven with the subsequent leaving of the treated trees to spontaneous death, i.e. injection in the case of adult trees or partial peeling of the bark followed by application of the herbicide in the case of young trees up to about 2 m in height (for details, see, for example, the Management measures (Pergl et al. 2023b) and the Management of selected alien plant species issued by the Nature Conservation Agency of the Czech Republic (Pergl et al. 2023a). Removal of individuals only after they have completely died is preferred wherever conditions allow. Follow-up management, in which it is necessary to treat surviving or new individuals with an appropriate method, is necessary for at least 2-3 years.

Dense infestations of seedlings can be controlled by spraying with herbicide or later by mechanical-chemical methods of targeted application, if it is certain that time and conditions allow it.

Fig. 3.4.12a,b. Ailanthus altissima. Dolní Žleb, 2024. Photo by Handrij Härtel.

3.4.13. Narrow-leaved ragwort (*Senecio inaequidens*)

Narrow-leaved ragwort is a short-lived (5-10 years) perennial. Synanthropic habitats are typical (railway stations, edges of railways, roads and motorways, urban areas and transshipment points), but it can be assumed that it will spread to meadows and pastures. It is capable of colonizing a wide range of habitats and soil types with different moisture conditions, but prefers permeable and disturbed soils. In Germany, it has also been recorded in near-natural habitats such as rock outcrops and coastal dunes. So far, its negative economic or environmental impact has not been described (probably because it invades mostly ruderal habitats so far). However, due to its toxicity and potential for spread to arable land, a significant negative impact on livestock and human health (possible contamination of crops) is expected in the near future.

It gets to the territory of ESPLA and BSNP from the D8 motorway along the road to Děčín and probably along the railway. It has been recorded sporadically in the area of interest, even in the fire area. It is particularly vulnerable to invasion by the narrow-leaved ragwort, given that this species colonizes open and disturbed areas and disturbances (including fire) promote its spread.

The management's goals are:

1) **To ensure complete and prompt eradication of all detected occurrences throughout the BSNP and ESPLA**. Due to the very limited distribution so far, eradication is possible.
2) **To monitor new sites throughout the entire area of BSNP and ESPLA**. Eradicate immediately upon detection. Due to the fact that it is an easily recognizable species, involve the public in monitoring.

For smaller stands, hand-pulling before the start of flowering, repeated over several years (depletion of the seed bank) is effective. Already flowering plants are important to collect and destroy after pulling, as seeds may develop on them. According to some sources, mowing may even promote invasion as a result, as it increases the competitive advantages of the ragwort compared to other ruderal species. The species is not sensitive to commonly used glyphosate-based herbicides (GISD – Global Invasive Species Database).

3.4.14. Black cherry (*Prunus serotina*)

The black cherry does not occur in the territory of the BSNP yet and its distribution in the ESPLA is very limited (a local strong invasion was found in the vicinity of Česká Kamenice). However, it is a species that is very widespread in neighbouring Germany and its invasion in the Czech Republic is beginning (it has already been recorded in the neighbouring Šluknov Uplands). It is a species with a high negative impact on forestry. The species is very well spread by birds even over longer distances. If it gets into hard-to-reach locations (rock edges), then its eradication will be very difficult.

The management's goals are:

1) **To ensure complete and prompt eradication of all detected occurrences throughout the BSNP and ESPLA**. Due to the very limited distribution so far, eradication is possible.

2) **Monitor new sites throughout the BSNP and ESPLA**. Eradicate immediately after detecting the occurrence. To attempt eradication already in the areas adjacent to the BSNP and ESPLA. Due to the fact that it is a species important for its negative impact in forestry, to involve forestry groups in monitoring.

Recommended methods of disposal are felling with application of herbicide (glyphosate-based) on the stump or application of herbicide to the trunk by injection / after partial peeling of the bark.

Fig. 3.4.14. Prunus serotina*. Fukov near Šluknov (2019). Photo by Handrij Härtel.*

3.4.15. Black locust (*Robinia pseudoacacia*)

Black locust is an invasive species with a large negative impact on natural communities. It occurs only sporadically in the territory of the BSNP, its occurrence is more abundant in ESPLA (use as a pasture for bees). It is a species with high sprouting capacity, stimulated by damage even in older individuals. Thanks to its light-loving nature, it does not spread to the dense forests. Seedlings only establish on disturbed bare soil or in burn areas - so they can currently pose a risk to the 2022 fire area. On sandbanks and in open slope forest stands, it is able to spread aggressively by means of root and stem sprouts and change the species composition of the herb layer, sensitive to its nitrification effect.

The management's goals are:

1) **On the territory of the BSNP (territory A1), in the small-scale protected areas and SCI (territory A2) to eradicate all occurrences of black locust**. Priority is given to individuals from which black locust seeds could spread to the fire area.
2) **In the Elbe Valley (territory B), in settlements (territory C) and in the rest of the ESPLA area (territory D), it is possible to tolerate black locust plantations**, however, it is necessary to map its occurrence and monitor their surroundings.
3) **Eradicate spontaneous occurrences** outside plantings, monitor the surroundings of growing sites where eradication has not occurred.

When disposing of the black locust, it is always necessary to proceed according to the Management of selected alien plant species issued by the Nature Conservation Agency of the Czech Republic (Pergl et al. 2023a). This applies not only to management aimed at the eradication of black locust, but also to felling, which is an accompanying phenomenon of various construction activities, reconstruction of railway lines, etc. After felling the black locust, a rapid rejuvenation follows up to 15 m from the removed individual, so mechanical treatment must always be combined with the application of herbicide. The most suitable and effective is targeted application of the herbicide by injection into holes or cuts in the trunk or application of the herbicide to the wound after partial peeling off of the bark (in young individuals).

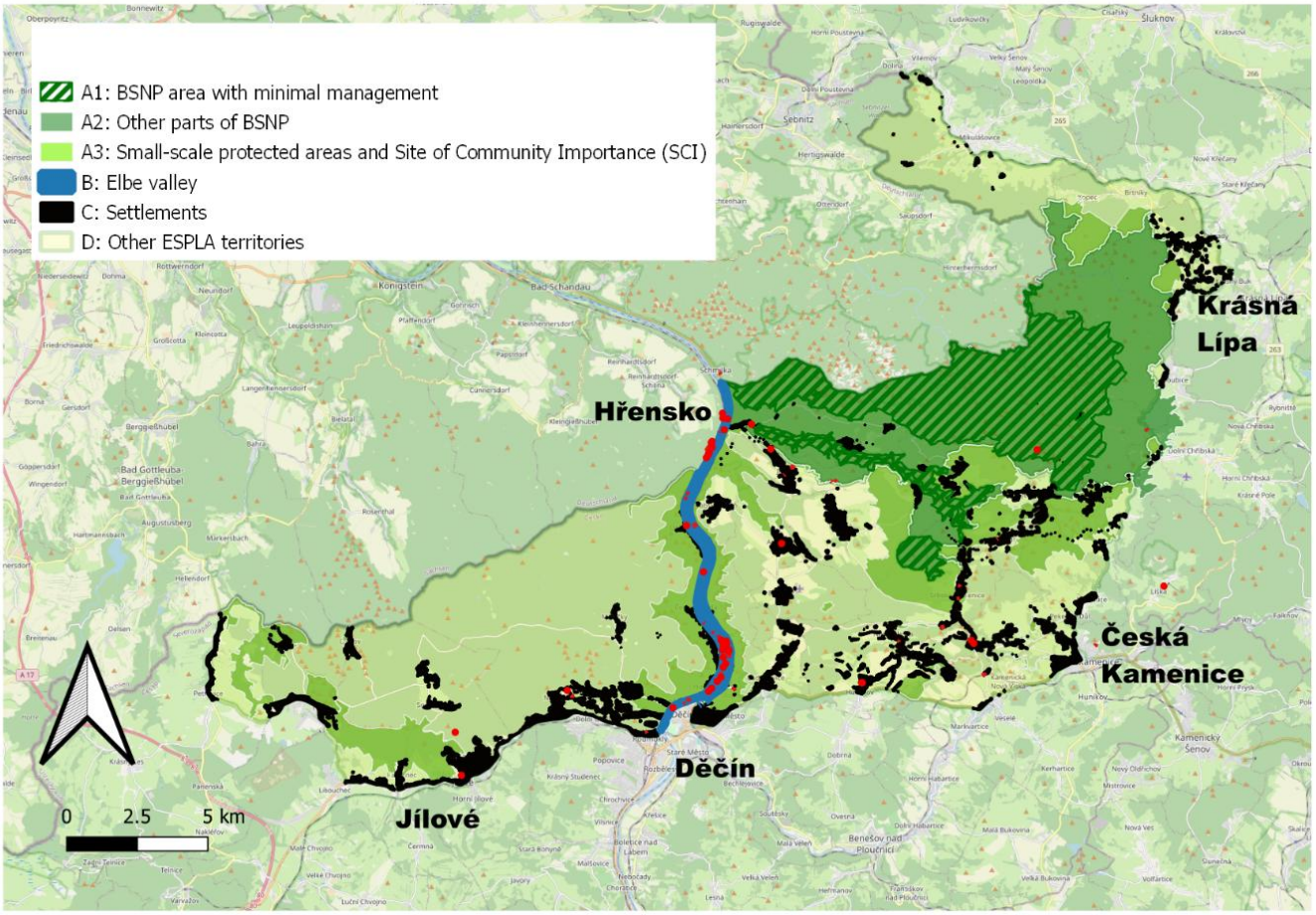


Fig. 3.4.15. Records of black locust (red) from mapping along the road network in 2020-2022 (Pergl 2023).

3.5. Mapping, monitoring and research

A very important component of prevention and regulation is the monitoring of the occurrence of alien and invasive species. In the territories administered by the BSNP Administration, these data are usually well captured by various activities of the Administration (see above). However, there is still a difference between the territory of the BSNP and small-scale reserves, or SCIs, and parts of the ESPLA with a lower category of protection, where the information is available, but its quality is often insufficient for management planning. There is a great lack of information in the peripheral areas of the protected areas and neighbouring regions and in settlements. The advantage of the area of interest is that it is largely surrounded by the České středohoří and Lužické hory Protected Landscape Areas and also by the Saxon Switzerland National Park and Protected Landscape Area, where information about the occurrence of alien and invasive species also exists. From the point of view of their spread, it is also necessary to monitor habitats heavily influenced by humans, where species are often introduced and from where they spread. In addition, it is necessary to systematically monitor not only already established species and species that are already being actively intervened against (invasive

and naturalized), but also newly introduced species that can be expected to behave invasively based on experience from other regions and countries (see, for example, the warning list in Pergl et al. 2016a). Unfortunately, this warning list is not inherently complete and is rather indicative. Good documents are provided by the series of publications "Additamenta ad floram Reipublicae Bohemicae", which have been regularly reported in the journal Zprávy České Botanické Společnosti since 2002, among other things, on newly found species in the Czech Republic.

Data on findings need to be collected uniformly from different entities so that possible management interventions can be planned. The Species Occurrence Database of the Nature Conservation Agency of the Czech Republic (NDOP) is a suitable source that includes data from both professional botanists and informed users via the BioLog application. In addition, records from the iNaturalist application intended for citizen science for the general public are transferred to NDOP at regular intervals, and from 2023 the "Czech Flora" project of te Czech Botanical Society has been implemented on the iNaturalist platform. Another important source is the Pladias database of Czech flora and vegetation managed by the Institute of Botany CAS, Průhonice. There is considerable potential for the public in collecting data on invasive alien species in the open countryside and especially species that are only at the beginning of their spread. Many of these species are very distinctive and easily determinable, which, together with their widespread occurrence, underlines the importance of collecting this data by the general public (see chap. 3.2). It is suitable to use the public for collecting from large areas and easily recognizable species. Furthermore, for identification, if, for example, there is a wildfire of the species grown so far and potentially the development of invasive behaviour.

Mapping

The primary database and application for monitoring the occurrence and spread of alien and invasive species is NDOP with the BioLog application, the advantage of which is in the wide availability of professionals and the general public, including easy usability.

The BSNP Administration also uses a system for monitoring the occurrence of selected invasive species, which simultaneously records the occurrence of the management and thus offers an insight into the development of the locality and species over time, at the same time it also allows to evaluate the effectiveness of the management used. This application is available to field workers of the BSNP at the level of "first gatherer" – the possibility of simple records of occurrence, and advanced levels, where it is possible to record management measures and refine the data. The ArcGis Esri system and the Field Maps application are used for the application. At the same time, a project on the same platform designed by the Czech University of Life Sciences staff within the project NF RAGO (https://ragoinvaze.fzp.czu.cz/cs) is being tested.

Research of invasive and alien species takes place in the area of interest within a number of institutions and with the support of various grant agencies and departments. This differentiation makes it possible to cover various aspects of the study of alien species from

purely basic research to application research. There are also individual studies or field experience, e.g. of the BSNP Administration staff, with the management of selected invasive alien species. The BSNP Administration has an overview of most of the activities (see Chap. 2.1.5), but at the same time it is necessary to clearly specify the needs of nature protection for research. Therefore, it is necessary to use resources efficiently and to avoid repeating research in different forms (e.g. different design of data collection, but similar methods, goals, etc.) through appropriate coordination. For cross-border Czech-Saxon cooperation, it is effective to use existing platforms such as the Transboundary Scientific Board for Saxon-Bohemian Switzerland, the Elbe Parks initiative, etc.

For management decision-making purposes, it is necessary to have well-founded information about the distribution and behaviour of individual species. This is done by mapping and monitoring. Mapping includes determining the current distribution of species. The aim of the mapping is to determine the overall distribution or size of the population. Monitoring includes processes of regular and long-term monitoring of the status of populations, which may or may not lead to distribution maps. Monitoring is about capturing changes in distribution (on different scales) and can only be based on a representative sample from populations. We don't even have to know the overall distribution or size of the population.

For individual species and types of territories, Table 3.4 shows the proposed prioritization of mapping and monitoring. Generally speaking, mapping must be carried out repeatedly throughout the area of interest and especially in unmapped habitats of the Natura 2000 system, which are key for the occurrence and capture of the spread of alien species. If possible, mapping of the neighbouring areas is very appropriate (the advantage is the neighbourhood with the Lužické hory Mts. and České středohoří Mts.). However, due to the fact that invasions are associated with human activity, it is recommended to monitor the areas of settlements; see Pergl et al. (2016b): "... on the other hand, the biotopes of group X in the Habitat Catalogue of the Czech Republic (Chytrý et al. 2010) are important, namely the following types: urbanized areas (X1 urbanized areas), fields (X2 intensively managed fields, X3 extensively managed fields, X5 intensively managed meadows, X6 anthropogenic areas with sparse vegetation outside human settlements, X7 ruderal herbaceous vegetation outside human settlements) and woody vegetation strongly influenced by humans (X8 shrubs with ruderal or alien species, X9 forest plantations of allochtonous trees, X10 forest clearings, X11 clearings with nitrophilous vegetation, X12 stands of early successional woody species , X13 woody vegetation outside forest and human settlements)."

Monitoring

Monitoring of changes in occurrence and possible impact - for species at the beginning of their spread or in atypical localities is crucial. However, a common mistake is the procedure where monitoring is not followed by the necessary action (eradication, etc.). In case of any indications or information about a possible negative impact, the species must be eradicated immediately. Especially in areas with spontaneous development, non-intervention can only be justified for species where it is known that the invasion cannot be prevented and the species becomes a dispersed part of the ecosystem over time (e.g. *Erechtites*). However, in the event that succession is blocked, for example, local interventions are justified.

Monitoring for priority species that cannot be eradicated or that are in lower categories should be carried out mainly in the area of spontaneous regeneration. Other species will be monitored in areas including the Elbe Valley and other areas of the ESPLA ("open landscape"). In settlements, monitoring is intermittent, especially for cultivated species. The mapping applies to all the mentioned species, with the list being extended to include species from the vicinity of the BSNP and ESPLA.

3.6. Monitoring of management interventions

To evaluate the effectiveness of management, it is necessary to be able to compare the situation before and after the intervention. Unfortunately, most of the metrics available are based on many factors and are not easily applicable in the field. The procedures proposed here concern the unified mapping of the initial state of the site of interest and the state after the application of management. It is not necessary for the initial state of the site to correspond to the non-intervention state. In these cases, however, it is necessary to interpret the success of the project according to the knowledge of the conditions (the difference between the initial state with dense stands and stands where management has been taking place for a long time; in this case, comparable efficiency cannot be required with projects that are just beginning).

For the subsequent evaluation of management effectiveness, it is possible to use the procedures specified in the Nature Conservation Agency of the Czech Republic manual for simplified reporting methods (https://dotace.nature.cz/web/dotace/opzp-v-prs-aopk-cr; Annex No. 8 - Manual for the Preparation and Evaluation of Projects for the Eradication of Invasive Plant Species).

4. Conclusions

The aim of the Strategy is to create a proposal for an optimal and effective management strategy for invasive and alien species within the limits of the current legislative framework and financial and personal capacities of the BSNP Administration and with regard to land use. The Strategy also includes a general vision for the management of invasive and alien species.

In particular, it is necessary to focus on the territory of the BSNP, the small-scale protected areas and SCI and species that have a large impact in the area, or are species related to legislation (Regulation No. 2016/1141 of the European Commission and Council), or are species that have a small distribution in the area so far, but need to be monitored based on knowledge from the surroundings and their high potential impact. However, from the point of view of the effectiveness of the funds spent and balancing interests other than nature protection, it is necessary to take into account different types of areas, where the recommended management and objectives may differ.

To achieve the target state, it is necessary to involve the public and users and land managers. Prevention is always the cheapest solution, but even in management, cooperation with the public is crucial. Especially on land managed by organizations other than nature conservation.

5. References

Bacher S., Blackburn T. M., Essl F., Genovesi P., Heikkilä J., Jeschke J. M., Jones G., Keller R., Kenis M., Kueffer C., Martinou A. F., Nentwig W., Pergl J., Pyšek P., Rabitsch W., Richardson D. M., Roy H. E., Saul W. C., Scalera R., & Kumschick S. (2018): Socio-economic impact classification of alien taxa (SEICAT). Methods in Ecology and Evolution 9 (1): 159–168. https://doi.org/10.1111/2041-210X.12844

Bayliss H., Stewart G., Wilcox A. & Randall N. (2013): A perceived gap between invasive species research and stakeholder priorities. NeoBiota 19: 67-82. https://doi.org/10.3897/neobiota.19.4897

Blackburn T. M., Essl F., Evans T., Hulme P. E., Jeschke J. M., Kühn I., Kumschick S., Marková Z., Mrugała A., Nentwig W., Pergl J., Pyšek P., Rabitsch W., Ricciardi A., Richardson D. M., Sendek A., Vilà M., Wilson J. R. U., Winter M., Genovesi P. & Bacher S. (2014): A unified classification of alien species based on the magnitude of their environmental impacts. PLOS Biology 12: e1001850. https://doi:10.1371/journal.pbio.1001850

Buttenschøn R. M., Waldispühl S. & Bohren C. (2010): Guidelines for management of common ragweed, *Ambrosia artemisifolia*. (available online: (PDF) Guidelines for management of common ragweed, Ambrosia artemisiifolia. http:/www.EUPHRESCO.org (researchgate.net))

Chytrý M., Kučera T., Kočí M., Grulich V. & Lustyk P. (eds) (2010): Katalog biotopů České republiky. Ed. 2. Agentura ochrany přírody a krajiny ČR, Praha.

Diagne C., Leroy B., Vaissière A.C. et al. (2021): High and rising economic costs of biological invasions worldwide. Nature 592: 571–576. https://doi.org/10.1038/s41586-021-03405-6

Foxcroft L.C., Jarošík V., Pyšek P. et al. (2011): Protected-area boundaries as filters of plant invasions. Conserv. Biol. 25: 400–405.

Foxcroft L. C., Pyšek P., Richardson D. M., Pergl J. & Hulme P. E. (2013a): The bottom line: impacts of alien plant invasions in protected areas. In: Foxcroft L. C., Pyšek P., Richardson D. M. & Genovesi P. (eds), Plant invasions in protected areas: patterns, problems and challenges, pp. 19–41, Springer, Dordrecht. https://doi:10.1007/978-94-007-7750-7_2

Foxcroft L. C., Richardson D. M., Pyšek P. & Genovesi P. (2013b): Plant invasions in protected areas: outlining the issues and creating the links. In: Foxcroft L. C., Pyšek P., Richardson D. M. & Genovesi P. (eds), Plant invasions in protected areas: patterns, problems and challenges, pp. 3–18, Springer, Dordrecht. https://doi:10.1007/978-94-007-7750-7_1

GISD – Global Invasive Species Database): (available online: https://www.iucngisd.org/gisd/speciesname/Senecio+inaequidens)

Härtel H., Křenová Z., Hruška J. et Dušek J. (2010): Je současná ochrana přírody postavena na výsledcích výzkumu? Ochrana přírody 2010/6: 22-23. (available online: Je současná ochrana přírody postavena na výsledcích výzkumu? (ochranaprirody.cz))

Härtel H., Bauer P., Šíma J. & Pergl J. (2015): Invazní rostliny v chráněných územích. Fórum ochrany přírody 2015/3: 16–24. (available online: Časopis | Fórum ochrany přírody (forumochranyprirody.cz))

Härtel H. (2017): Conservation of Botanical Diversity in the Czech Republic. In: Chytrý M., Danihelka J., Kaplan Z. et Pyšek P. (eds), Flora and Vegetation of the Czech Republic, pp. 401-444. Springer International Publishing.

Haubrock P., Turbelin A., Cuthbert R., Novoa A., Taylor N., Angulo E., Ballesteros-Mejia L., Bodey T., Capinha C., Essl F., Golivets M., Kirichenko N., Kourantidou M., Leroy B., Renault D., Verbrugge L., & Courchamp F. (2021): Economic costs of invasive alien species across Europe. NeoBiota 67: 153–190. https://doi.org/10.3897/neobiota.67.58196

Hejda M. (2012): What Is the Impact of *Impatiens parviflora* on Diversity and Composition of Herbal Layer Communities of Temperate Forests? PLoSONE 7(6): e39571. https://doi:10.1371/journal.pone.0039571

Hocking S., Toop T., Jones D. et al. (2023): Assessing the relative impacts and economic costs of Japanese knotweed management methods. Sci. Rep. 13, 3872 (2023). https://doi.org/10.1038/s41598-023-30366-9

Hulme P. E., Bacher S., Kenis M., Klotz S., Kühn I., Minchin D., Nentwig W., Olenin S., Panov V., Pergl J., Pyšek P., Roque A., Sol D., Solarz W. & Vila M. (2008): Grasping at the routes of biological invasions: a framework for integrating pathways into policy. Journal of Applied Ecology 45: 403–414.

Jehlík V. (1998) Cizí expanzivní plevele České republiky a Slovenské republiky [Alien expansive weeds of the Czech Republic and Slovak Republic]. Academia, Praha.

Jeschke J. M., Bacher S., Blackburn T. M., Dick J. T. A., Essl F., Evans T., Gaertner M., Hulme P. E., Kühn I., Mrugala A., Pergl J., Pyšek P., Rabitsch W., Ricciardi A., Richardson D. M., Sendek A., Vilà M., Winter M. & Kumschick S. (2014): Defining the impact of non-native species. Conservation Biology 28: 1188–1194. https://doi:10.1111/cobi.12299

Mach J., Pojer F., Plesník J., Hošek M., Dušek J. et Trubačíková R. (2016): Strategie ochrany biologické rozmanitosti České republiky 2016–2025. Ministerstvo životního prostředí, Praha. SOBR_CR_2016-2025.pdf (available online: mzp.cz)

Ministry of the Environment (2023): Akční plán pro řešení problematiky prioritních způsobů šíření invazních nepůvodních druhů v České republice 2023–2028. Ministerstvo životního prostředí, Praha.

Novoa A., Moodley D., Catford J., Golivets M., Bufford J., Essl F., Lenzner B., Pattison Z. & Pyšek P. (2021): Global costs of plant invasions must not be underestimated. NeoBiota 69: 75–78. https://doi:10.3897/neobiota.69.74121

Patočka J. & Jakl J. (2011): Kolotočník ozdobný: obsahové látky. (available online: https://www.toxicology.cz/modules.php?name=News&file=print&sid=435)

Pergl J. (2008): Co víme o vlivu zavlečených rostlinných druhů? Zprávy Čes. Bot. Spol. 43, Mater. 23: 183–192.

Pergl J. (2023): Zpráva k projektu "Strategie a vyhodnocení managementu invazních druhů rostlin v CHKO Labské pískovce a NP České Švýcarsko".

Pergl J. & Perglová I. (2024): Zásady regulace pro netýkavkyu žláznatou (*Impatiens glandulifera*) v České republice. Ministerstvo životního prostředí, Praha. (available online: https://invaznidruhy.nature.cz/zasady-regulace)

Pergl J., Dušek J., Hošek M., Knapp M., Simon O., Berchová K., Bogdan V., Černá M., Poláková S., Musil J., Sádlo J & Svobodová J. (2016b): Metodiky mapování a monitoringu invazních (vybraných nepůvodních) druhů. BÚAVČR, Průhonice, ČZÚ Praha & DHP Conservation, https://doi:10.13140/RG.2.2.22891.13604

Pergl J., Härtel H., Pyšek P., Stejskal R. (2020): Don't throw the baby out with the bathwater: the use of herbicides depends on context. NeoBiota 56: 27–29.

Pergl J. Perglová I., Bauer P., Görner T., Jurek V. & Stejskal R. (2023a) Standardy péče o přírodu a krajinu: D 02 007 Likvidace vybraných invazních druhů rostlin (vč. následné péče o lokality). (available online: https://nature.cz/web/cz/platne-standardy)

Pergl J, Perglová I. & Stejskal R. (2023b): Zásady regulace pro pajasan žláznatý *(Ailanthus altissima*) v České republice. Ministerstvo životního prostředí, Praha. available online: https://invaznidruhy.nature.cz/zasady-regulace

Pergl J., Sádlo J., Petrusek A., Laštůvka Z., Musil J., Perglová I., Šanda R., Šefrová H., Šíma J., Vohralík V. & Pyšek P. (2016a): Black, Grey and Watch Lists of alien species in the Czech Republic based on environmental impacts and management strategy. NeoBiota 28: 1 – 37.

Perglová I. & Pergl J. (2024): Podklady pro regulaci lupiny mnoholisté (*Lupinus polyphyllus*) podle § 5 odst. 6 ZOPK. BÚAVČR Průhonice.

Perglová I., Pergl J., Skálová H., Moravcová L., Jarošík V. & Pyšek P. (2009): Differences in germination and seedling establishment of alien and native Impatiens species. Preslia 81: 357–375.

Pluess T., Cannon R., Jarošík V., Pergl J., Pyšek P. & Bacher S. (2012): When are eradication campaigns successful? A test of common assumptions. Biological Invasions 14: 1365–1378. https://doi:10.1007/s10530-011-0160-2

Pyšek P., Danihelka J., Sádlo J., Chrtek J. Jr., Chytrý M., Jarošík V., Kaplan Z., Krahulec F., Moravcová L., Pergl J., Štajerová K. & Tichý L. (2012): Catalogue of alien plants of the Czech Republic (2nd edition): checklist update, taxonomic diversity and invasion patterns. Preslia 84: 155–255.

Pyšek P., Genovesi P., Pergl J., Monaco A. & Wild J. (2013): Plant invasions of protected areas in Europe: an old continent facing new problems. In: Foxcroft L. C., Pyšek P., Richardson D. M. & Genovesi P. (eds), Plant invasions in protected areas: patterns, problems and challenges, pp. 209–240, Springer, Dordrecht. https://doi:10.1007/978-94-007-7750-7_11

Pyšek P., Hulme P. E., Simberloff D., Bacher S., Blackburn T. M., Carlton J. T., Dawson W., Essl F., Foxcroft L. C., Genovesi P., Jeschke J. M., Kühn I., Liebhold A. M., Mandrak N. E., Meyerson L. A., Pauchard A., Pergl J., Roy H. E., Seebens H., van Kleunen M., Vilà M., Wingfield M. J. & Richardson D. M. (2020): Scientists' warning on invasive alien species. Biological Reviews 95: 1511–1534. https://doi:10.1111/brv.12627

Pyšek P., Jarošík V. & Kučera T. (2002): Patterns of invasion in temperate nature reserves. Biol. Conserv. 104: 13–24.

Pyšek P., Jarošík V. & Kučera T. (2003): Inclusion of native and alien species in temperate nature reserves: an historical study from Central Europe. Conserv. Biol. 17: 1414–1424.

Pyšek P., Sádlo J., Chrtek J. Jr., Chytrý M., Kaplan Z., Pergl J., Pokorná A., Axmanová I., Čuda J., Doležal J., Dřevojan P., Hejda M., Kočár P., Kortz A., Lososová Z., Lustyk P., Skálová H., Štajerová K., Večeřa M., Vítková M., Wild J. & Danihelka J. (2022): Catalogue of alien plants of the Czech Republic (3rd edition): species richness, status, distributions, habitats, regional invasion levels, introduction pathways and impacts. Preslia 94: 477–577. https://doi:10.23855/preslia.2022.447

Roy H. E., Pauchard A., Stoett P. & Renard Truong T. (eds) (2023): Thematic Assessment Report on Invasive Alien Species and their Control of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. IPBES secretariat, Bonn, Germany. https://doi.org/10.5281/zenodo.7430723

Seebens H., Blackburn T. M., Dyer E. E., Genovesi P., Hulme P. E., Jeschke J. M., Pagad S., Pyšek P., Winter M., Arianoutsou M., Bacher S., Blasius B., Brundu G., Capinha C., Celesti-Grapow L., Dawson W., Dullinger S., Fuentes N., Jäger H., Kartesz J., Kenis M., Kreft H., Kühn I., Lenzner B., Liebhold A., Mosena A., Moser D., Nishino M., Pearman D., Pergl J., Rabitsch W., Rojas-Sandoval J., Roques A., Rorke S., Rossinelli S., Roy H. E., Scalera R., Schindler S., Štajerová K., Tokarska-Guzik B., van Kleunen M., Walker K., Weigelt P., Yamanaka T. & Essl F. (2017): No saturation in the accumulation of alien species worldwide. Nature Communications 8: 14435. https://doi:10.1038/ncomms14435

Simberloff D. (2009): We can eliminate invasions or live with them. Successful management projects. Biol. Invas. 11: 149–157.

Švec P., Perglová I., Fröhlich V., Laštovička J., Seidl J., Růžičková K., Horáková I., Lukavský J., Ferko M., Štych P., Pergl J. (2024): Perseverance of management is needed – Efficient long-term strategy of Reynoutria management. NeoBiota 94: 261-288. https://doi.org/10.3897/neobiota.94.122337

Veitch C.R. & Clout M.N. (2002): Turning the Tide of Biological Invasion: The potential for Eradicating Invasive Species. IUCN SSC Invasive Species Specialist Group. Gland, Switzerland and Cambridge, UK.

Vacátková A. (2008): Management invazních porostů *Lupinus polyphyllus* v Krkonoších. Theses, Přírodovědecká fakulta, Univerzita Karlova, Praha.

Vila M., Basnou C., Pyšek P., Josefsson M., Genovesi P., Gollasch S., Nentwig W., Olenin S., Roques A., Roy D., Hulme P. E. & DAISIE partners (2010): How well do we understand the impacts of alien species on ecological services? A pan-European cross-taxa assessment. Frontiers in Ecology and the Environment 8: 135–144.

Wild J., Kaplan Z., Danihelka J., Petřík P., Chytrý M., Novotný P., Rohn M., Šulc V., Brůna J., Chobot K., Ekrt L., Holubová D., Knollová I., Kocián P., Štech M., Štěpánek J. & Zouhar V. (2019) Plant distribution data for the Czech Republic integrated in the Pladias database. Preslia 91: 1–24.

Winter M., Schweiger O., Klotz S., Nentwig W., Andriopoulos P., Arianoutsou M., Basnou C., Delipetrou P., Didžiulis V., Hejda M., Hulme P.E., Lambdon P. W., Pergl J., Pyšek P., Roy D. B. & Kuhn I. (2009): Plant extinctions and introductions lead to phylogenetic and taxonomic homogenization of the European flora. Proceedings of the National Academy of Sciences of the United States of America 106: 21721–21725.

6. List of abbreviations

ANLP	Act No. 114/1992 Coll., on Nature and Landscape Protection
BSNP	Bohemian Switzerland National Park
ESPLA	Elbe Sandstones Protected Landscape Area
NNR	National Nature Reserve
PLA	Protected Landscape Area
SCI	Site of Community Importance