



GOZDARSKI INŠTITUT SLOVENIJE
SLOVENIAN FORESTRY INSTITUTE

ALIEN PLANT SPECIES IN SLOVENIAN FOREST ECOSYSTEMS

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Slovenian Forestry Institute, Ljubljana

REUFIS Webinar and Annual Meeting,
13-17 October 2025, Ljubljana, Slovenia



LIFE integrirani projekt za okrepljeno upravljanje Nature 2000 v Sloveniji

www.natura2000.si



REPUBLIKA SLOVENIJA
MINISTRSTVO ZA NARAVNE VIRE IN PROSTOR

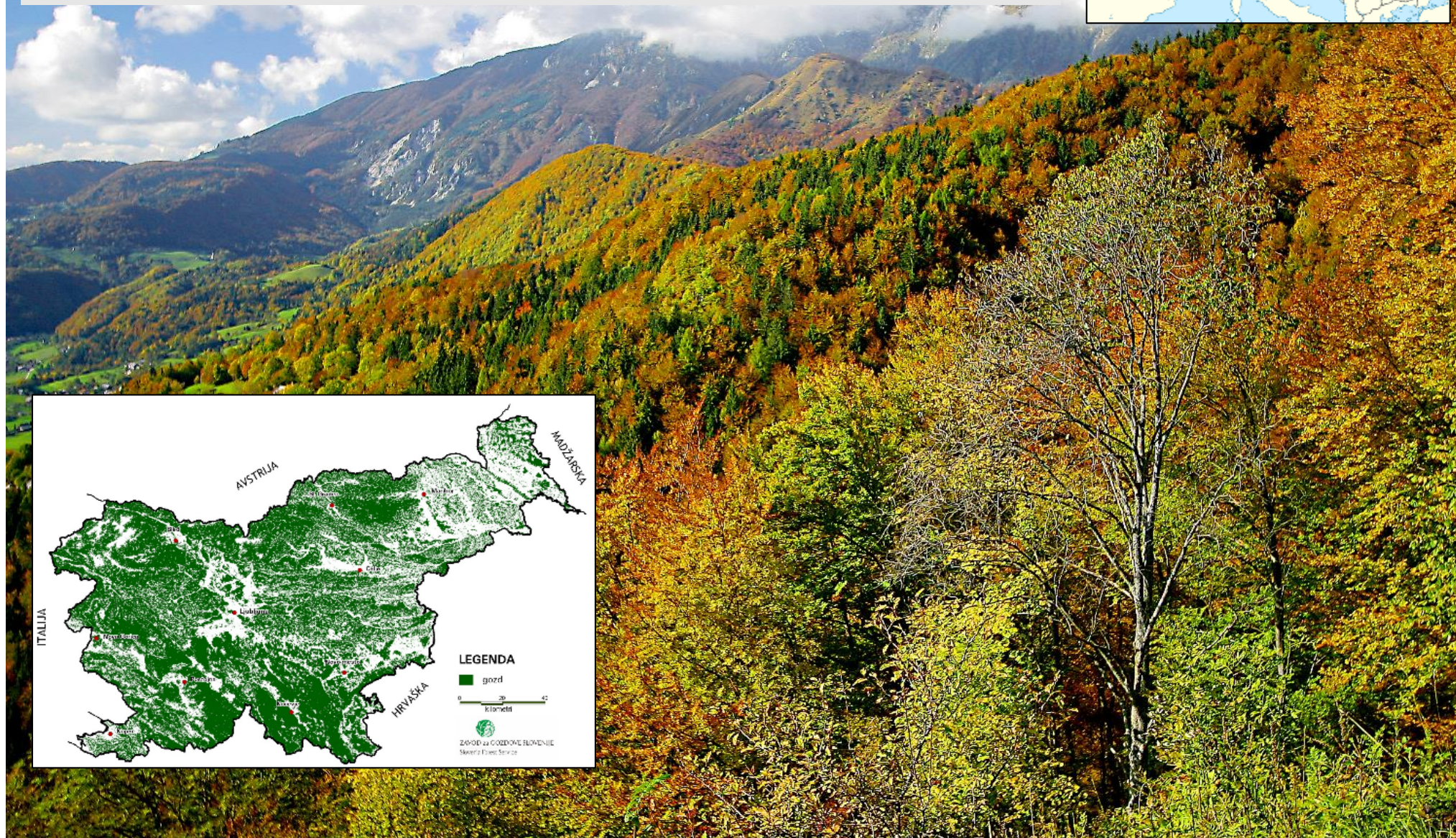
INVASIVE PLANT SPECIES

- **Invasive alien species (IAS)** are animals and plants that are **introduced** accidentally or deliberately into a **natural environment where they are not normally found**, with serious **negative consequences** for their new environment.
- They are a **major threat to native plants and animals** in Europe and are one of the five **major causes of biodiversity loss**.
- They can also cause significant adverse **impacts on the economy** (their economic impact in the EU was estimated at around EUR 12 billion per year) as well as **human health**, such as severe allergies and burns.
- **Regulation (EU) No 1143/2014** of the European Parliament and of the Council of 22 October 2014 on the **prevention and management of the introduction and spread of invasive alien species**



FORESTS IN SLOVENIA

- Forest area increases: 36 % in y. 1875, 43 % in y. 1947, 53 % in y. 1990
- Forests cover 58 % (1.177.165 ha) (SFS, 2025)



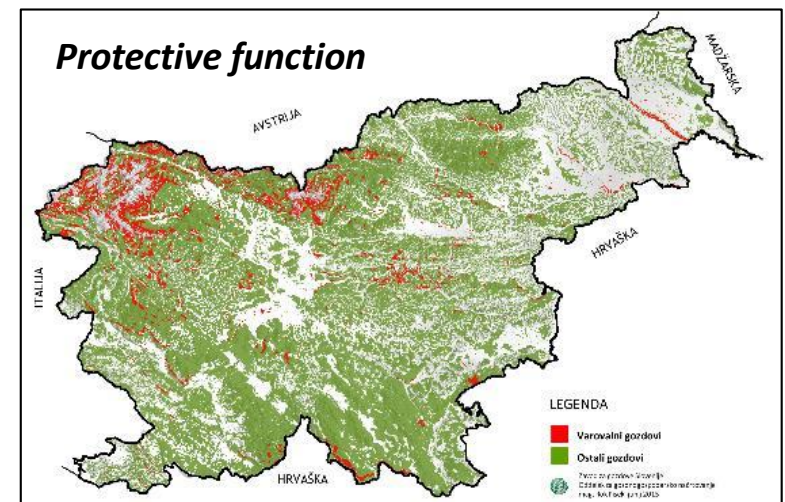
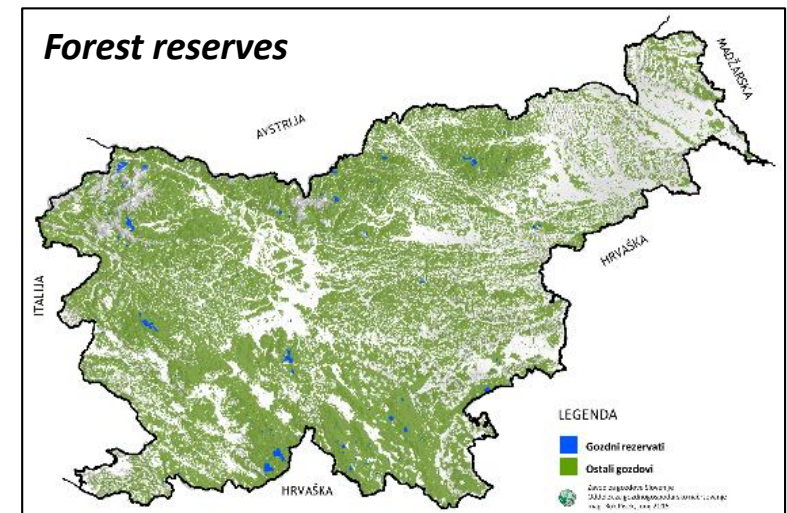
TREE SPECIES – share of total growing stock (SFS, 2025)

- European beech (*Fagus sylvatica*): 32.9%
- Norway spruce (*Picea abies*): 30.1%
- European silver fir (*Abies alba*): 7.4%
- Oak species (*Quercus* sp.): 7.1%
- Pine species (*Pinus* sp.): 5.4%
- etc.



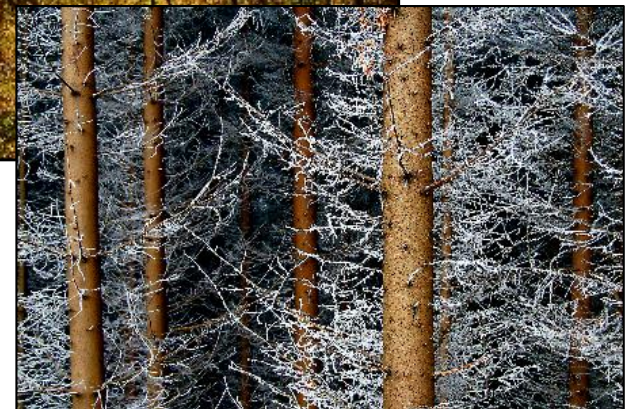
FORESTS WITHOUT SIGNIFICANT IMPACTS

- The network of 171 **forest reserves** - almost **without direct human impacts** - covers nearly 0.8% of forest area (9,426 ha; SFS, 2025).
- **Protection forests** cover 8,4 % of forest area (98,828 ha; SFS, 2025).



FORESTS WITHOUT SIGNIFICANT IMPACTS

- Forests in Slovenia, especially those in **higher elevations** are **relatively well preserved**
- There are **almost no alien species**, except some **planted alien tree species**



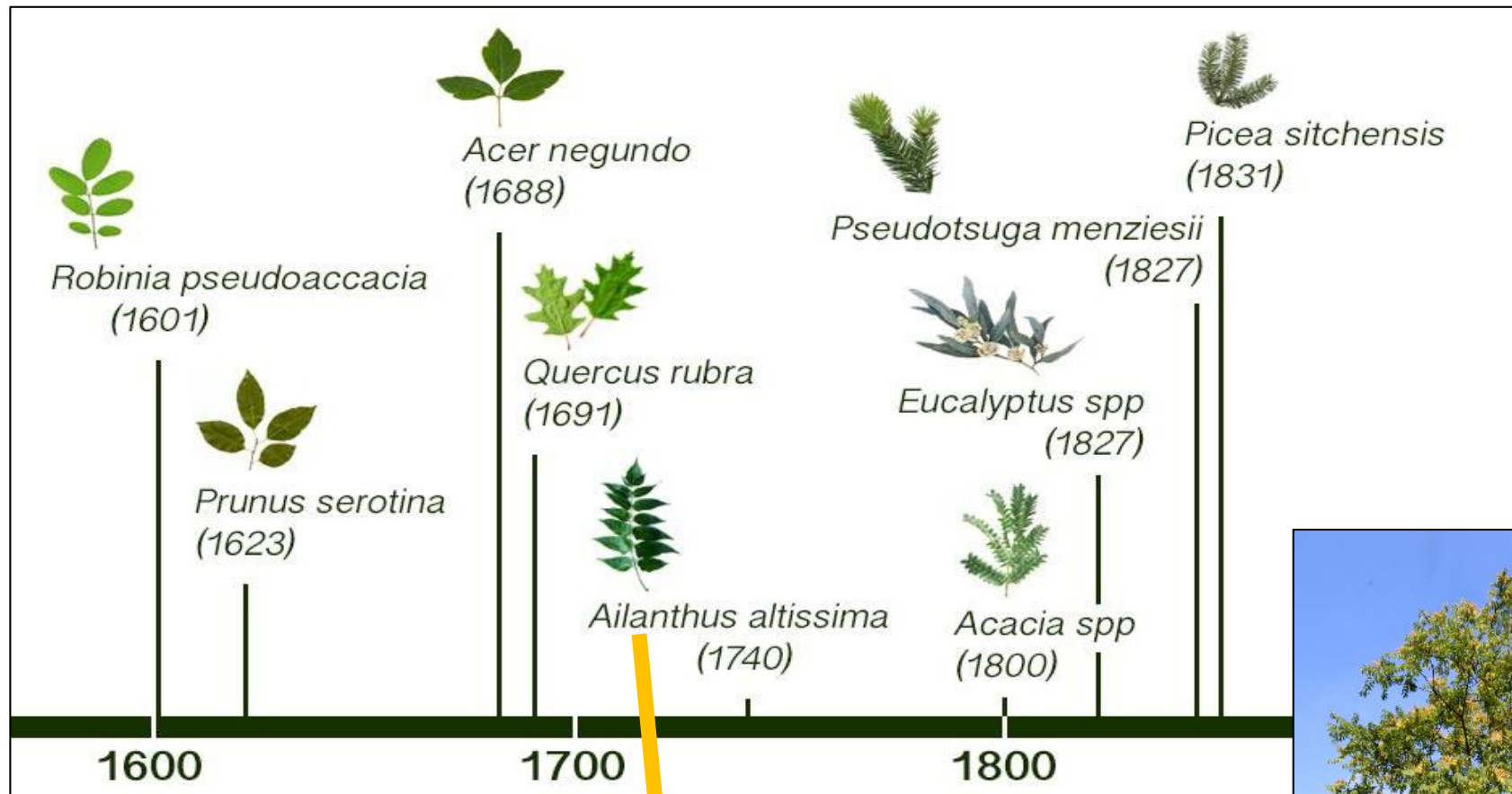
ALIEN SPECIES THREAT TO SLOVENIAN FOREST

- In Slovenia, **problems caused by alien species were overlooked threat** for many years and only a few studies paid attention to this topic.
- With the **start of awareness raising** activities in 2008, it became evident that the **problem of alien species in Slovenia is much larger** that was estimated before.
- Between 2000 and 2011 the number of recorded **alien plant species** has **increased for 11 %**.
- Several alien species also **invaded forests** and **alter ecosystems** by dense cover.



ALIEN TREE SPECIES IN EUROPE

www.in-tree.org/



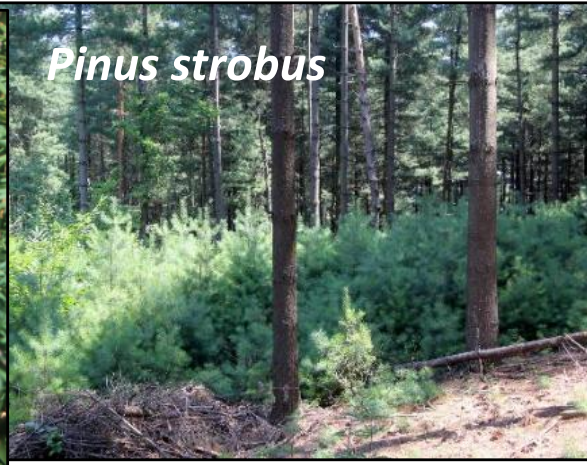
First record of ***Ailanthus altissima*** in park near Ljubljana in 1795



ALIEN TREE SPECIES (ATS) IN SLOVENIAN FORESTS

- Alien tree species were more widely introduced between two **World Wars**, and partly **after the Second World War**
- **Slovenian Forest Servis database**: ATS portion in Slovenian forests growing stock was ca. **1 %**
- Most common alien tree species (share in GS of ATS):
 - **Black locust (*Robinia pseudoacacia*): 60 %**
 - Eastern white pine (*Pinus strobus*): 18 %
 - Douglas fir (*Pseudotsuga menziesii*): 5 %
 - Red oak (*Quercus rubra*): 3 %

Source: Kutnar & Pisek, 2013, Professional Journal of Forestry



ALIEN TREE SPECIES IN NATIONAL FOREST INVENTORY (NFI) PLOTS

- Systematic 2 × 2 km unaligned sampling grid
- **3,027 plots** measured → 2020–2024
- Annually, one panel (4 × 4 km) was measured → about 750 sample plots
- **10 non-native tree** species recorded in **138 plots**
- **2 different** non-native tree species recorded in **5 plots**
- Average growing stock of measured non-native tree species: **1.1% of total growing stock** (3.6 m³/ha ± 28%)

ALIEN TREE SPECIES	SHARE (%)
<i>Robinia pseudoacacia</i>	61
<i>Pinus strobus</i>	25
<i>Quercus rubra</i>	6
<i>Pseudotsuga menziesii</i>	5
<i>Abies nordmanniana</i>	0.6
<i>Aesculus hippocastanum</i>	0.5
<i>Ailanthus altissima</i>	0.4
<i>Acer negundo</i>	0.4
<i>Pinus pinaster</i>	0.4
<i>Pinus halepensis</i>	0.3

Acta Silvae et Ligni 134 (2024), 11–26

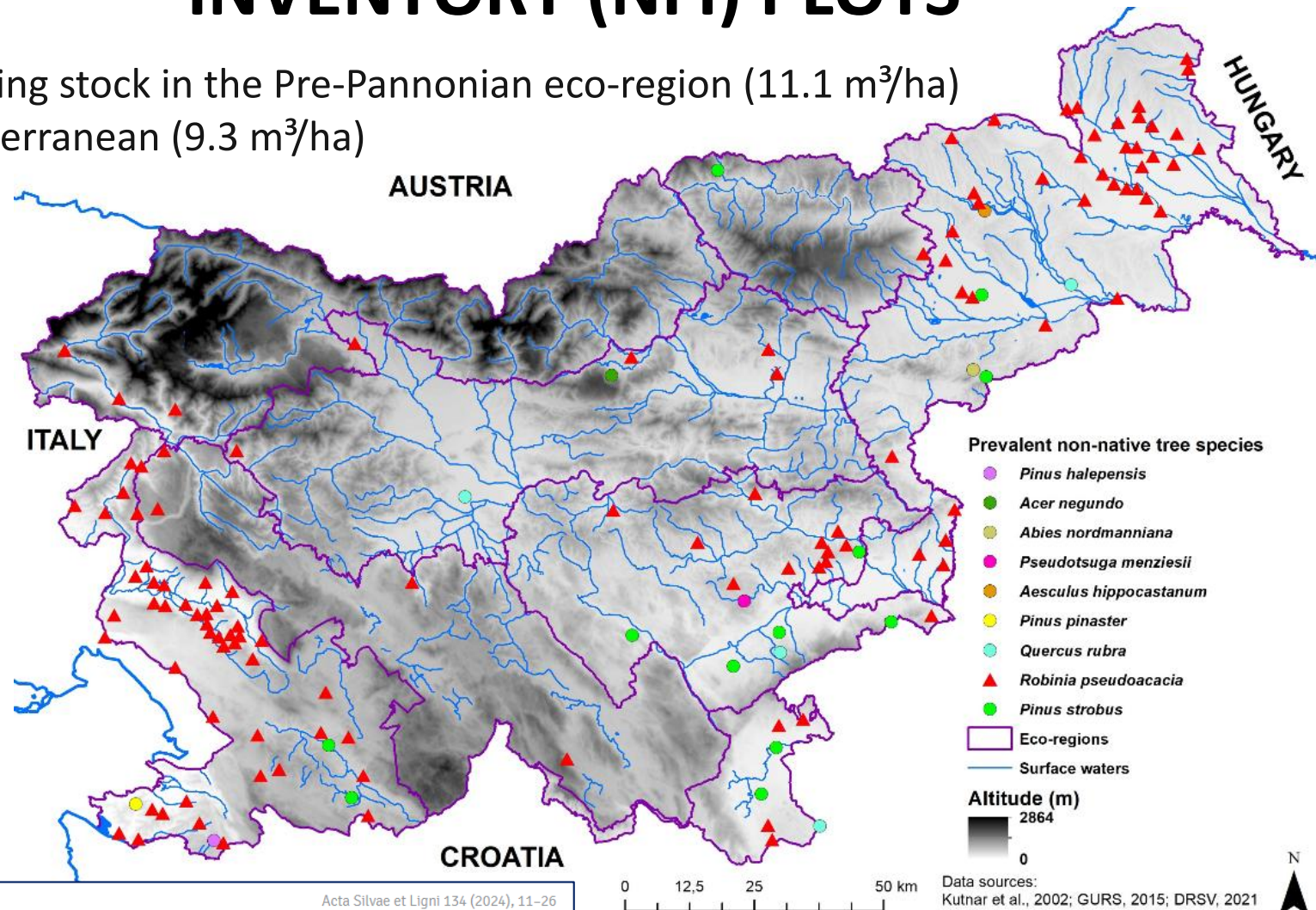
Izvirni znanstveni članek / Original scientific article

PESTROST IN POJAVLJANJE DOMAČIH IN TUJERODNIH DREVESNIH IN GRMOVNIH VRST NA PLOSKVAH NACIONALNE GOZDNE INVENTURE V SLOVENIJI
DIVERSITY AND OCCURRENCE OF NATIVE AND NON-NATIVE TREE AND SHRUB SPECIES IN NATIONAL FOREST INVENTORY PLOTS IN SLOVENIA

Anže Martin PINTAR¹, Andreja FERREIRA², Luka KRAJNC³, Gal KUŠAR⁴, Mitja SKUDNIK^{5,6*}

ALIEN TREE SPECIES IN NATIONAL FOREST INVENTORY (NFI) PLOTS

- Highest growing stock in the Pre-Pannonian eco-region (11.1 m³/ha) and Sub-Mediterranean (9.3 m³/ha)



Acta Silvae et Ligni 134 (2024), 11–26

Izvirni znanstveni članek / Original scientific article

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PRESENCE OF ALIEN PLANT SPECIES IN FOREST TYPES

- In **vegetation database** (phytosociological relevés) of Biological Institute (ZRC SAZU), **93 alien plant species** were recorded in Slovenian forests
- Most of them are native to **eastern Asia and North America**
- Alien species occurred within **72 % of forest types** (in 53 from 74 forest types)
- Forest type with the highest number of alien species in alluvial forest (**willow-poplar community-type; 44 species**)

*Source: Dakskobler et al., 2016,
XXXIII. Forestry Study Days,
Ljubljana*



ALIEN PLANT SPECIES IN LOWLAND FORESTS

PERIODICUM BIOLOGORUM
VOL. 119, No 4, 251–260, 2017
DOI: 10.18054/pbx.v119i4.4933

UDC 57:61
CODEN PDBIAD
ISSN 0031-5362



original research article

Occurrence of invasive alien plant species in the floodplain forests along the Mura River in Slovenia

Solidago sp.



Impatiens glandulifera



Ambrosia artemisiifolia



Echinocystis lobata



Fallopia sp.



Erigeron annuus



Helianthus tuberosus



Parthenocissus quinquefolia



Conyza canadensis



Duchesnea indica



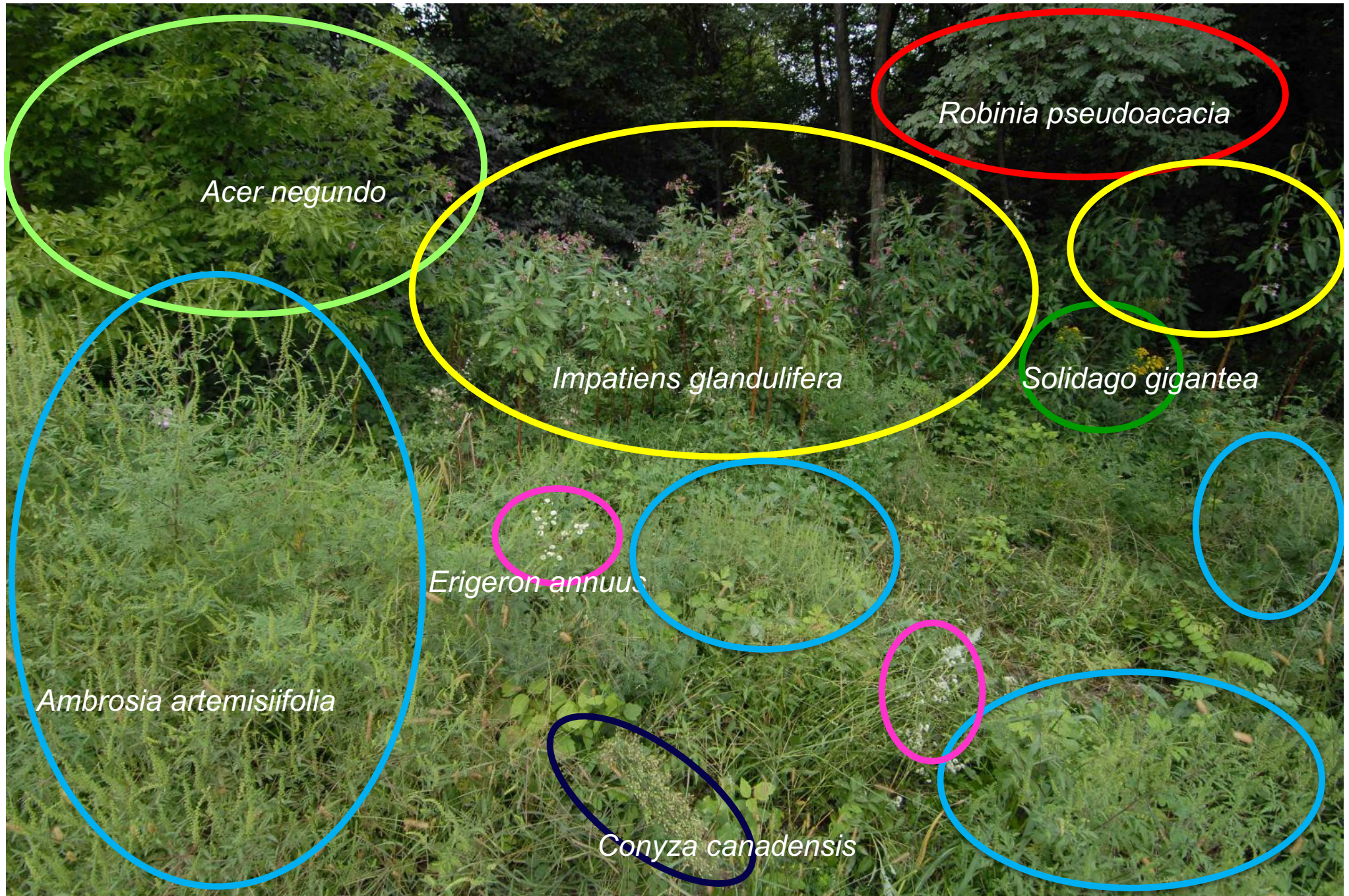
Acer negundo



Rudbeckia laciniata



ALIEN PLANT SPECIES IN LOWLAND FOREST

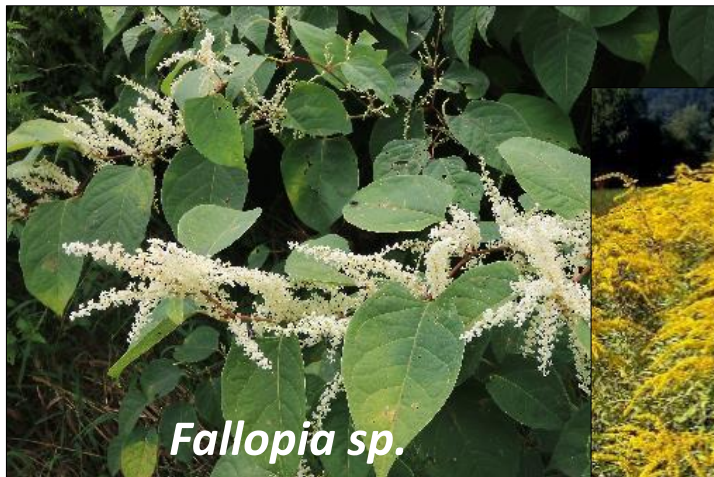


INVASIVE ALIEN PLANT SPECIES IN FORESTS

Composition and structure of natural communities are the **most significantly shaped** by:

- Black locust (*Robinia pseudoacacia*)
- Boxelder maple (*Acer negundo*)
- Tree of heaven (*Ailanthus altissima*)
- Knotweeds (*Fallopia japonica* and *F. x bohemica*)
- Giant goldenrod (*Solidago gigantea*)

Source: Dakschobler et al., 2016,
XXXIII. Forestry Study Days,
Ljubljana



LIST OF INVASIVE ALIEN PLANT SPECIES IN Invazivke.SI APPLICATION



- Invazivke web application is system for the collection of data on invasive alien species (IAS) – developed within Life Artemis project
- Including list of 86 alien plant species associated with Slovenian forests
- 64 species on alert list
- 14 species on observation list
- 18 species from EU Regulation list

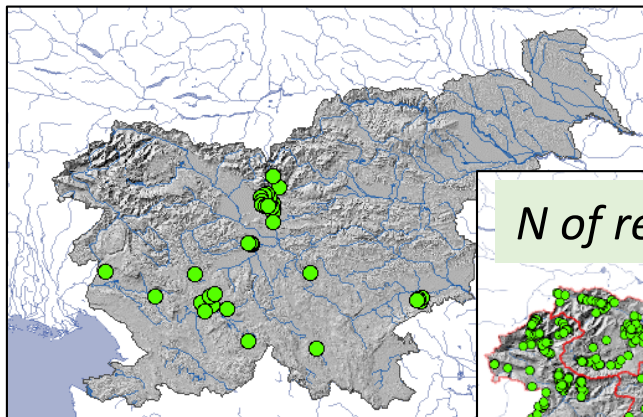
Slovensko ime	Znanstveno ime	Opozorilni seznam	Opazovalni seznam	EU seznam E	EU seznam Q
akacija	<i>Acacia saligna</i>				0
azor. čr.	<i>Acer negundo</i>				
esen	<i>Ailanthus altissima</i>				0
lakebija	<i>Akebia quinata</i>	▲			
a žvrbija	<i>Ambrosia artemisiifolia</i>		▲		
rušica	<i>Amelanchier spicata</i>	▲			
morfa	<i>Amorpha fruticosa</i>		▲		
	<i>Araujia sericifera</i>	▲			
nica	<i>Asclepias syriaca</i>	▲			0
karis	<i>Baccharis halimifolia</i>				0
v češmin	<i>Berberis thunbergii</i>		▲		
apirjevka	<i>Broussonetia papyrifera</i>	▲			
budleja	<i>Buddleja davidii</i>	▲			
	<i>Catalpa bignonoides</i>		▲		0
avilec	<i>Celastrus orbiculatus</i>	▲			
oprivovec	<i>Celtis occidentalis</i>	▲			
osat	<i>Cirsium candelabrum</i>	▲			
a	<i>Conyza canadensis</i>		▲		
udoletnica	<i>Conyza sumatrensis</i>	▲			
svilnati	<i>Cornus sericea</i>	▲			
mpaška	<i>Cortaderia jubata</i>				0
nešplja	<i>Cotoneaster horizontalis</i>	▲			
bršljan	<i>Delawarea odorata</i>	▲			
navadna dojca	<i>Deutzia scabra</i>	▲			
vodna hijacinta	<i>Eichornia crassipes</i>				0
ozkolistna ohčica	<i>Elaeagnus angustifolia</i>	▲			
bodeča ohčica	<i>Elaeagnus pungens</i>	▲			
vodna kuga ali račja zel	<i>Elodea canadensis</i>				
zahodna račja zel	<i>Elodea nuttallii</i>				0



IAS LOCATIONS IN INFORMATION SYSTEM

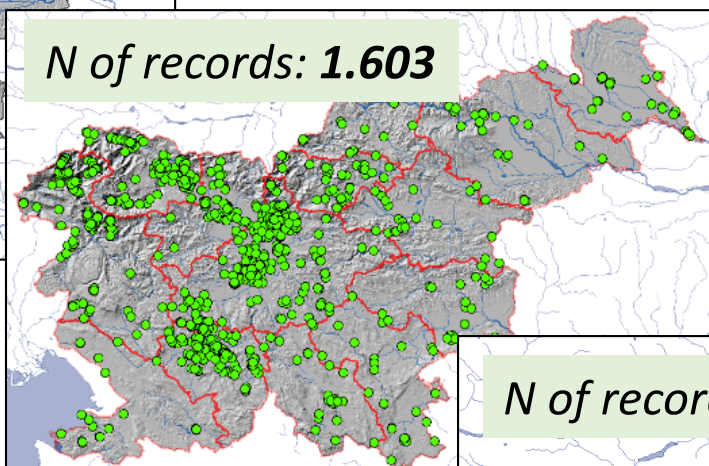


June 2017



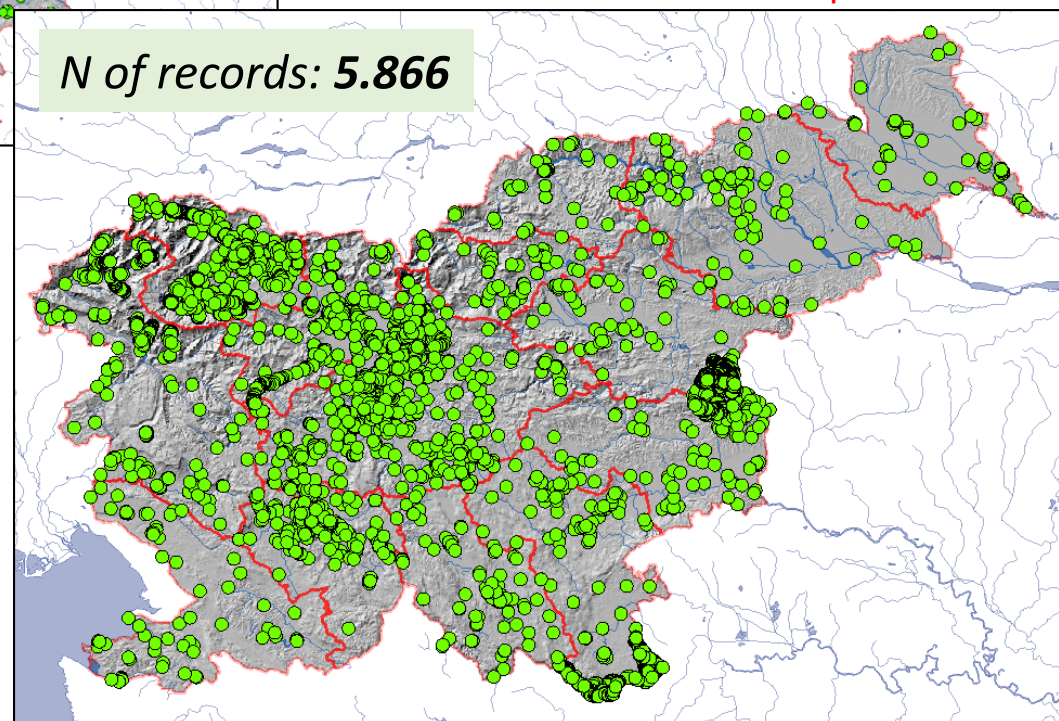
Erigeron annuus

November 2018



<https://www.invazivke.si/>

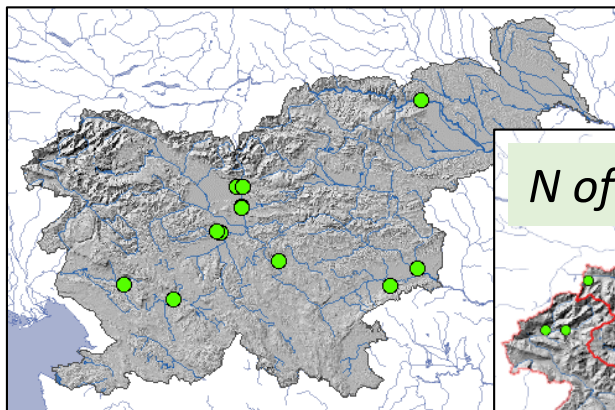
September 2025



IAS LOCATIONS IN INFORMATION SYSTEM

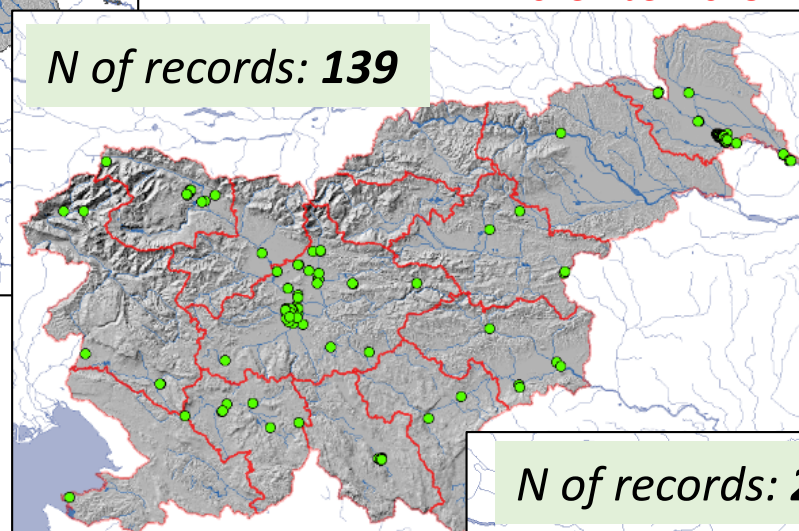


June 2017



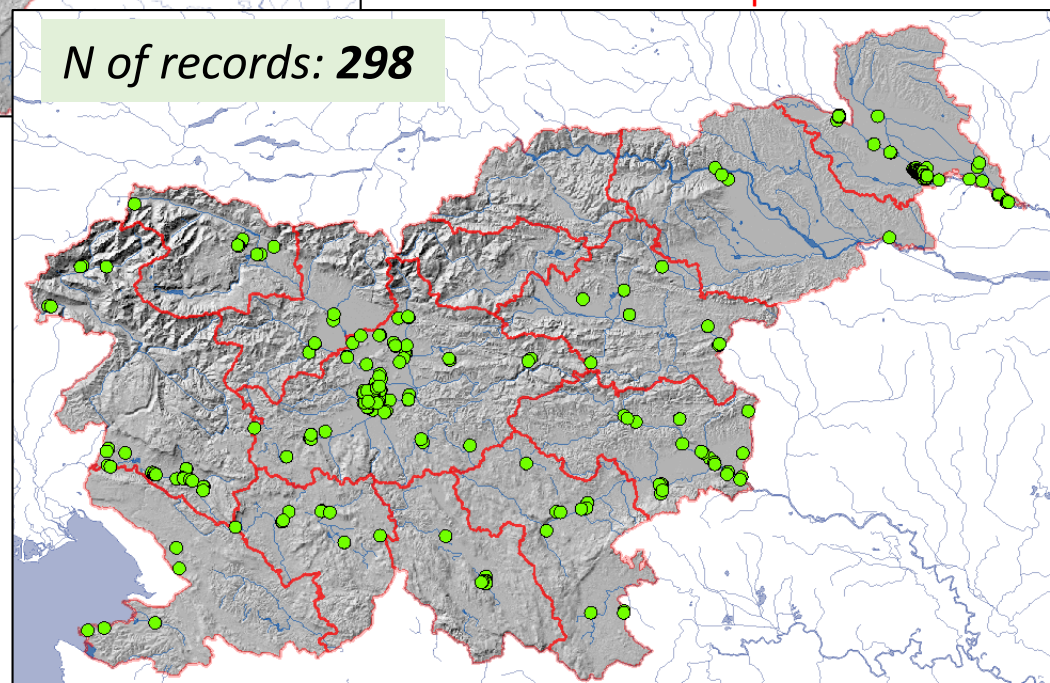
Acer negundo

November 2018



<https://www.invazivke.si/>

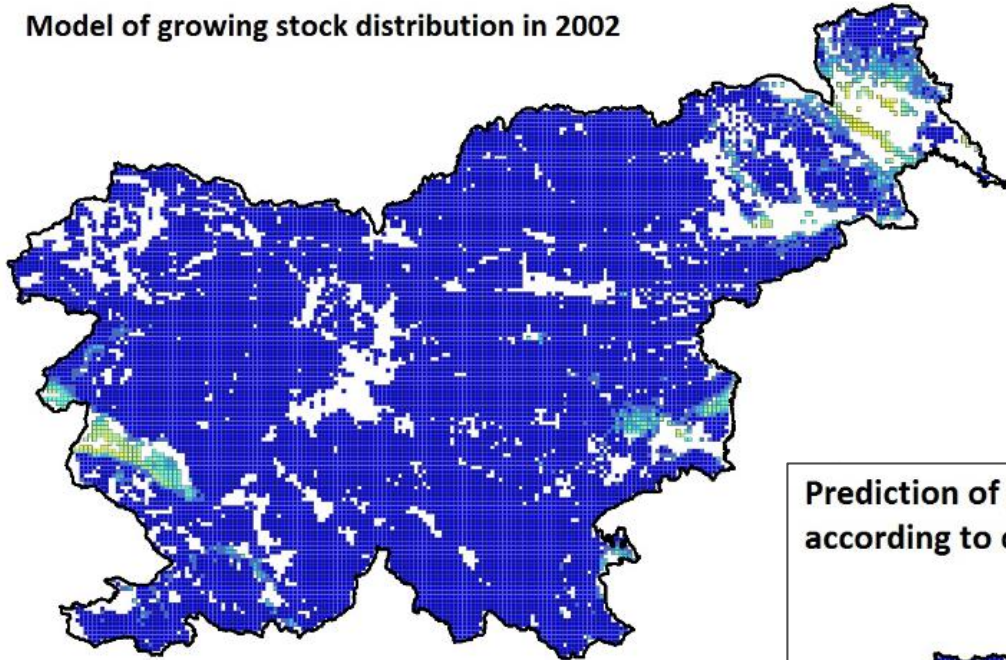
September 2025



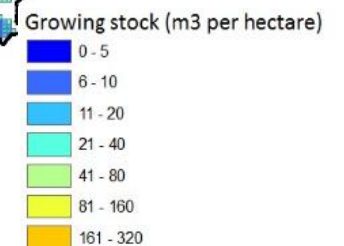
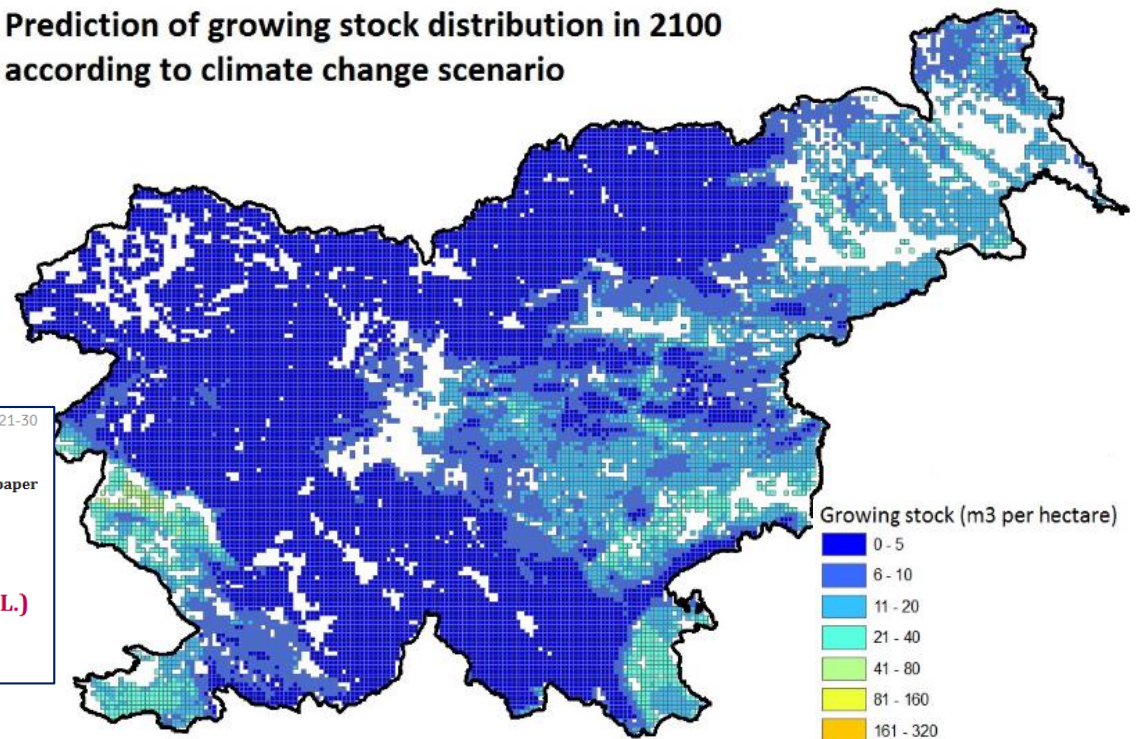
PREDICTION OF *Robinia pseudoacacia* FUTURE DISTRIBUTION IN SLOVENIA



Model of growing stock distribution in 2002



Prediction of growing stock distribution in 2100
according to climate change scenario



Acta Silvae et Ligni 102 (2013), 21-30

Izvirni znanstveni članek / Original scientific paper

SEDANJE STANJE RAZŠIRJENOSTI ROBINIJE (*Robinia pseudoacacia* L.) V
SLOVENIJI IN NAPOVEDI ZA PRIHODNOST
**THE CURRENT DISTRIBUTION OF BLACK LOCUST (*Robinia pseudoacacia* L.)
IN SLOVENIA AND PREDICTIONS FOR THE FUTURE**

Lado KUTNAR¹, Andrej KOBLER²

PREDICTION OF FUTURE DISTRIBUTION NON-NATIVE TREES IN THE ALPINE SPACE

Within ALPTREES project, potential distribution maps were prepared for:

- 15 non-native tree species
- for two climate change scenarios RCP 4.5 and 8.5

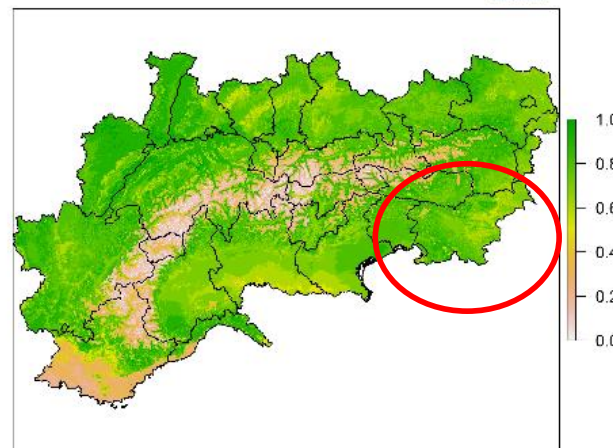


Robinia pseudoacacia
RCP 8.5
2041 - 2060

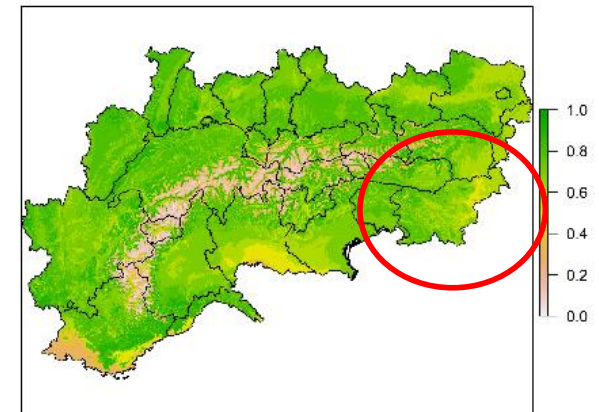


Black locust (*Robinia pseudoacacia*):
RCP 8.5 – for 2041-2060, 2061-2080, 2081-2100

Robinia pseudoacacia
RCP 8.5
2061 - 2080



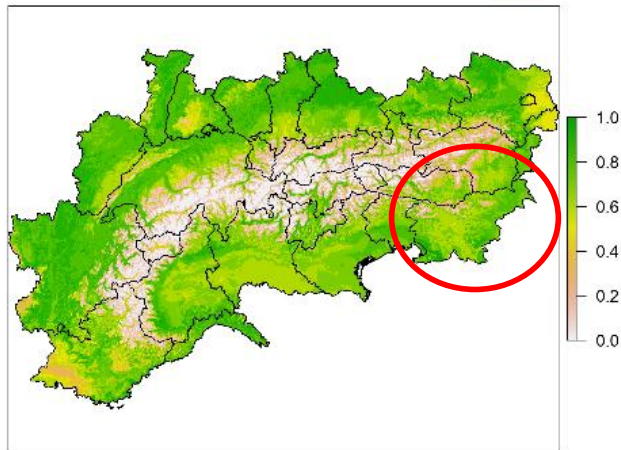
Robinia pseudoacacia
RCP 8.5
2081 - 2100



Adjusted after:
Debojyoti Chakraborty, Silvio Schueler, Joana Raquel Silva Vicente
"Maps of the potential distribution of non-native tree species in Europe".
Unpublished. These maps were produced under the EU-Cost ACTION NNEXT.

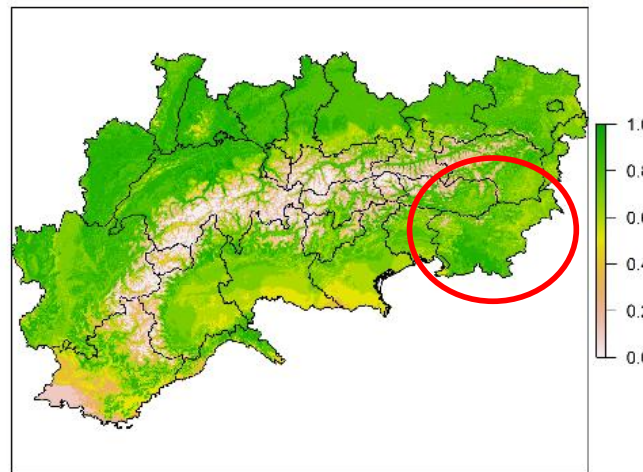
PREDICTION OF FUTURE DISTRIBUTION NON-NATIVE TREES IN THE ALPINE SPACE

Acer negundo
RCP 8.5
2041 - 2060

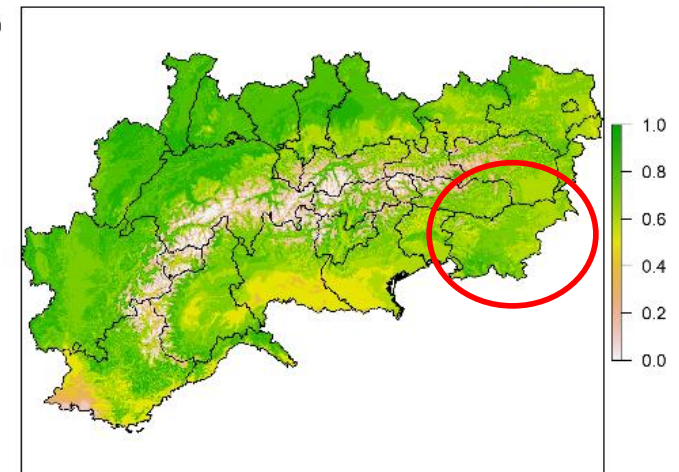


Box elder (*Acer negundo*):
RCP 8.5 – for 2041-2060 & 2081-2100

Acer negundo
RCP 8.5
2061 - 2080



Acer negundo
RCP 8.5
2081 - 2100



Acer negundo

Adjusted after:
Debojyoti Chakraborty, Silvio Schueler, Joana Raquel Silva Vicente
"Maps of the potential distribution of non-native tree species in Europe".
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PREDICTION OF FUTURE DISTRIBUTION OF ALIEN PLANTS

American pokeweed (*Phytolacca americana*)

- In forested areas, its occurrence is influenced by **disturbances** caused by extreme weather events or by the **prevalence of Norway spruce monocultures**.
- The risk map highlights numerous **vulnerable areas**, especially **forest edges**, which are highly susceptible to invasion.



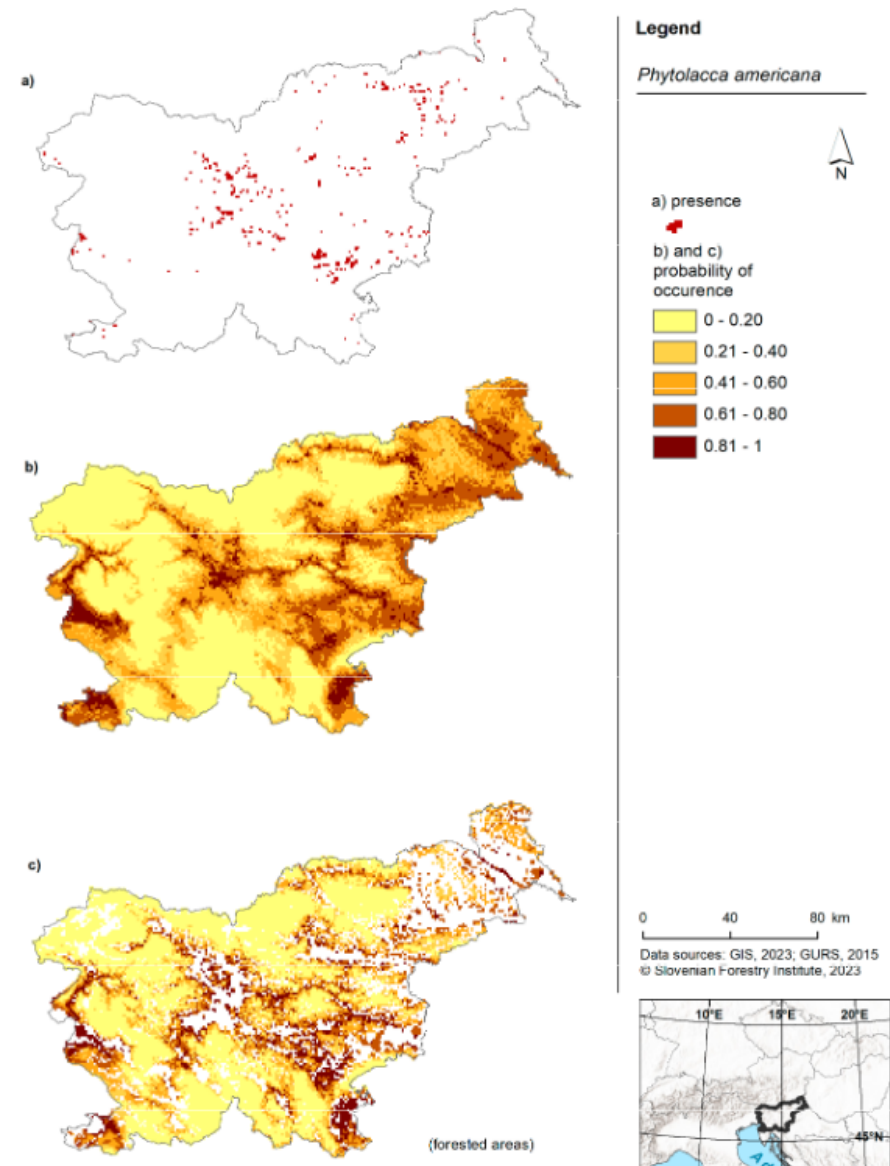
 plants



Article

Importance of Habitat Context in Modelling Risk Maps for Two Established Invasive Alien Plant Species: The Case of *Ailanthus altissima* and *Phytolacca americana* in Slovenia (Europe)

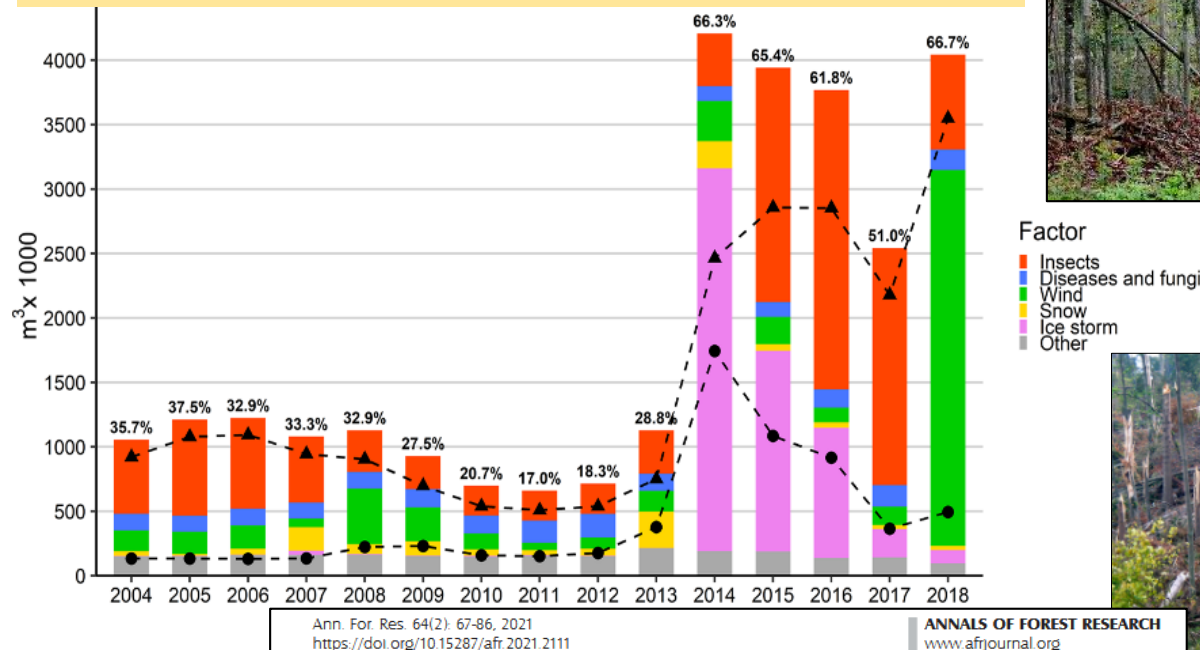
Maarten de Groot ^{1,*}, Erika Kozamernik ¹, Janez Kermavnar ¹, Marija Kolšek ², Aleksander Marinšek ¹, Andreja Nève Repe ² and Lado Kutnar ¹



LARGE-SCALE DISTURBANCES IN LAST YEARS

Slovenian forests significantly changed by **massive ice storm in 2014** and subsequent **bark beetle attacks** (2015, 2016, 2017 and later) and **windthrows** (2017, 2018 and later).

Sanitary felling (removal of damaged and diseased trees) in the total annual felling



Climate change and disturbances will shape future temperate forests in the transition zone between Central and SE Europe

Lado Kutnar¹, Janez Kermavnar¹, Anže Martin Pintar²



Ice storm 2014



Bark beetles attack (photo: R. Brus)

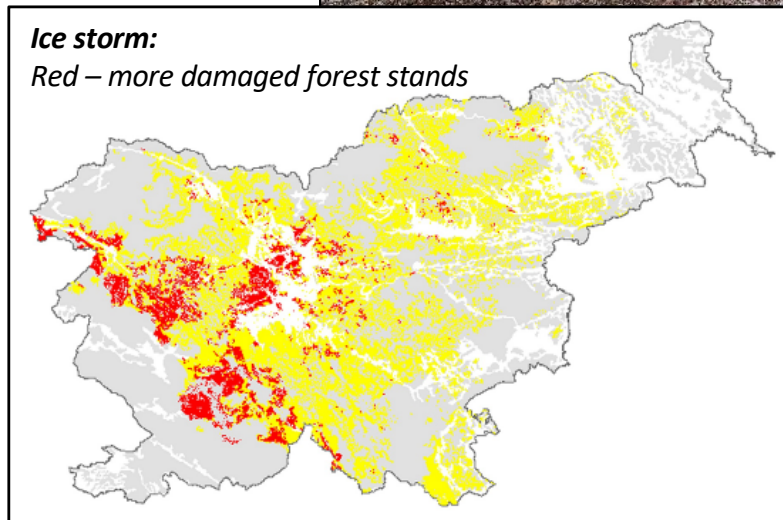


Windthrow



LARGE-SCALE DISTURBANCES IN LAST YEARS

- Forests are **more open** and under **threat of invasive alien species**.
- Removal of damaged trees - **disturbances by machinery and transport of wood** means increasing chances for arrival of new invasive alien species



DISTURBANCES AND CANOPY MORTALITY OF OAK TREES

- Study of pedunculate oak (*Quercus robur*) and sessile oak (*Quercus petraea*) forests
- Mature trees of pedunculate oak (*Quercus robur*) exhibited **crown defoliation or complete dieback**, which altered the ecological conditions at the forest floor



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DOI: 10.1111/jvs.13317

RESEARCH ARTICLE

Journal of Vegetation Science

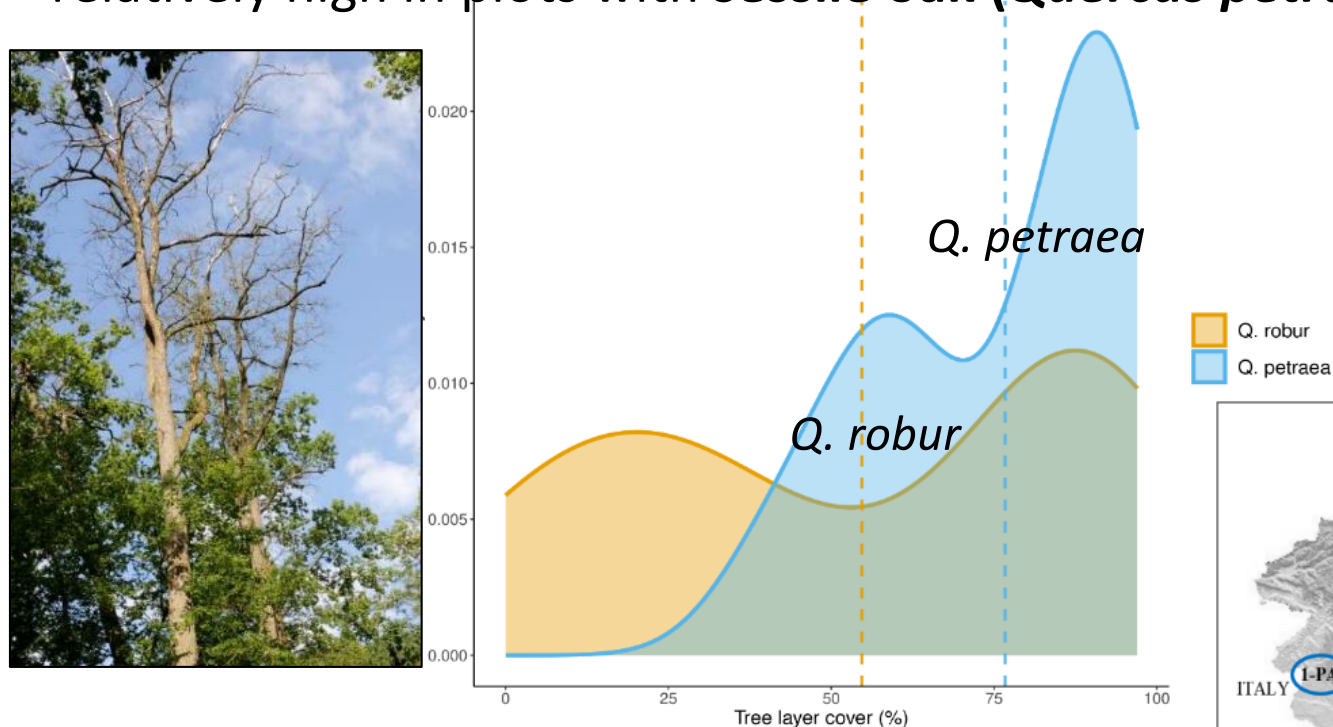


Three decades of understorey vegetation change in *Quercus*-dominated forests as a result of increasing canopy mortality and global change symptoms

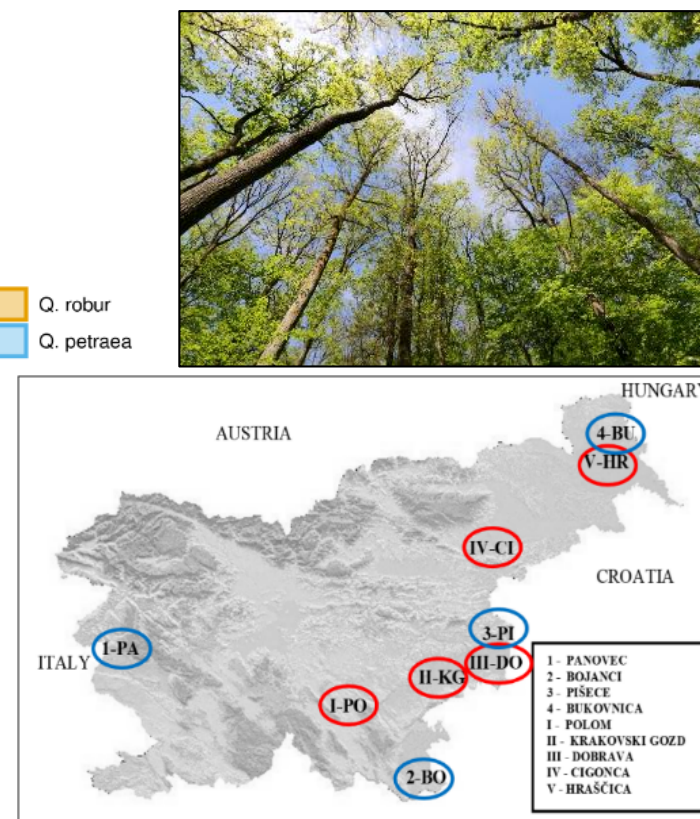
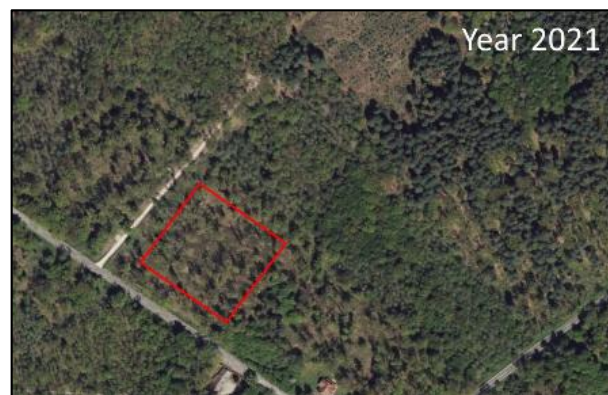
Janez Kermavnar  | Lado Kutnar 

TREE LAYER COVER DECREASE

- **Tree layer cover** decreased from **95%** in early 1990s to an average of **55%** in plots with **pedunculate oak (*Quercus robur*)**, whereas it remained relatively high in plots with **sessile oak (*Quercus petraea*; 77%)**



Source: Atlas okolja (ARSO)

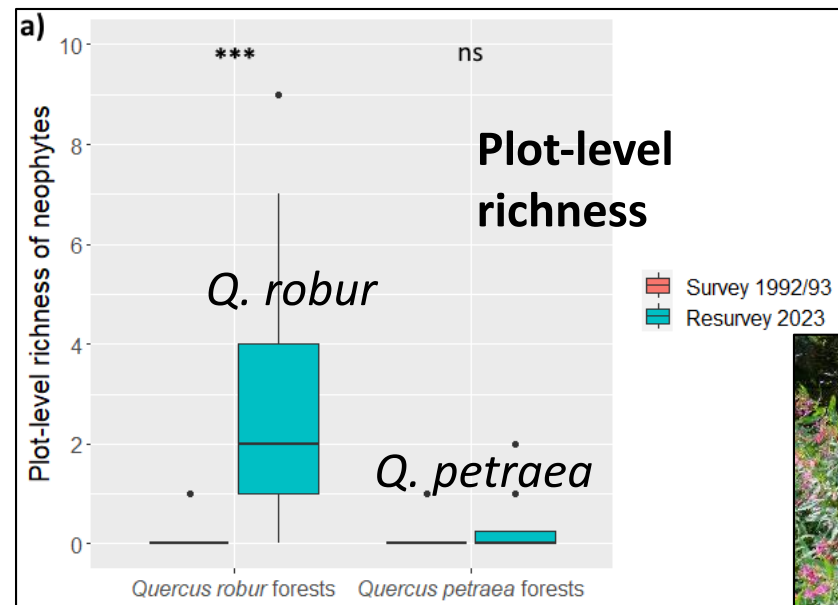
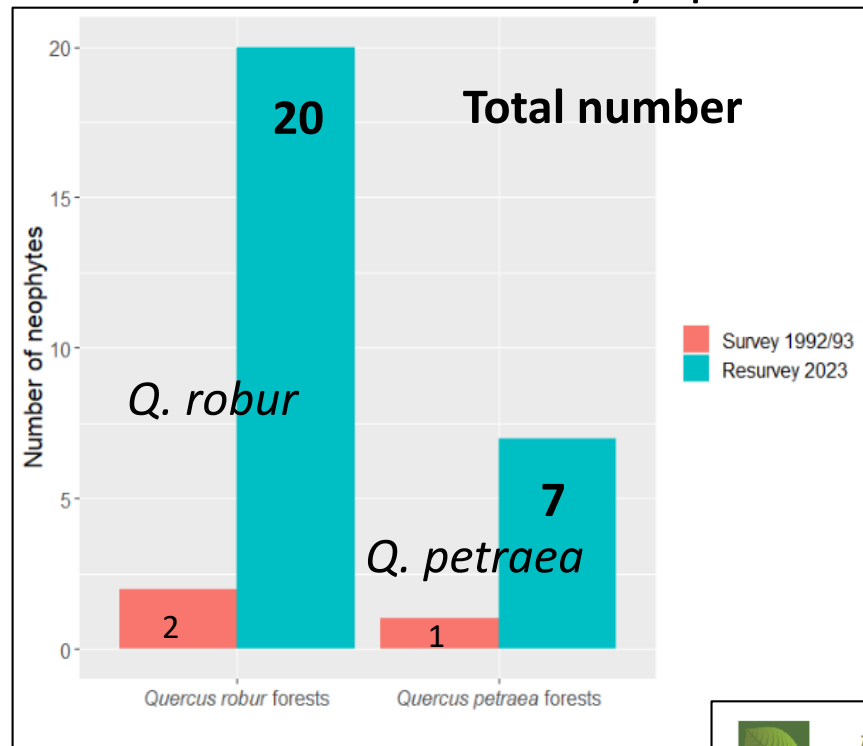


Dobrava site (III-DO) near Brežice (*Q. robur*):

- Satellite images from **2006 (left)** and **2021 (right)** reveals significant **changes in stand conditions** and **habitat degradation** (i.e., more open and fragmented forests).
- The red rectangle denotes a 100 x 100 m permanent research area established in 1993.

INCREASE IN ABUNDANCE OF ALIEN PLANT SPECIES

- In the early **1990s** in 45 plots (20x20 m), only **3 non-native plant species** were recorded **with low abundance**, representing less than 2% of the total species pool in the understory layer
- In **2023**, the **total number of non-native plants** increased to **22 species**, 15 herbaceous and 7 woody species



Plants 2024, 13, 962. <https://doi.org/10.3390/plants13070962>

Article

**Habitat Degradation Facilitates the Invasion of Neophytes:
A Resurvey Study Based on Permanent Vegetation Plots in Oak
Forests in Slovenia (Europe)**

Janez Kermavnar * and Lado Kutnar



Lists of alien plant species in oak forests

Forest type	Species	Frequency 1992/1993	Frequency 2023
<i>Quercus robur</i>	<i>Impatiens parviflora</i>	0	14
	<i>Solidago gigantea</i>	0	13
	<i>Erechtites hieraciifolius</i>	0	7
	<i>Erigeron annuus</i>	0	6
	<i>Impatiens glandulifera</i>	0	4
	<i>Epilobium ciliatum</i>	0	4
	<i>Conyza canadensis</i>	0	3
	<i>Phytolacca americana</i>	0	2
	<i>Robinia pseudoacacia</i>	0	2
	<i>Solidago canadensis</i>	0	1
	<i>Bidens frondosa</i>	0	1
	<i>Quercus rubra</i>	0	1
	<i>Juglans nigra</i>	0	1
	<i>Matricaria discoidea</i>	0	1
	<i>Oxalis fontana</i>	0	1
	<i>Parthenocissus quinquefolia</i>	0	1
	<i>Populus x canadensis</i>	0	1
	<i>Pinus strobus</i>	1	1
	<i>Duschesnea indica</i>	0	1
	<i>Veronica persica</i>	2	1
<i>Quercus petraea</i>	<i>Conyza canadensis</i>	1	1
	<i>Galinsoga parviflora</i>	0	1
	<i>Solidago canadensis</i>	0	1
	<i>Solidago gigantea</i>	0	1
	<i>Erigeron annuus</i>	0	1
	<i>Robinia pseudoacacia</i>	0	1
	<i>Spiraea japonica</i>	0	1

Impatiens parviflora



Solidago gigantea



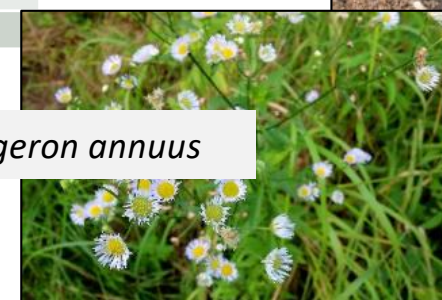
Erechtites hieraciifolius
(photo: V. Babij)



Impatiens glandulifera

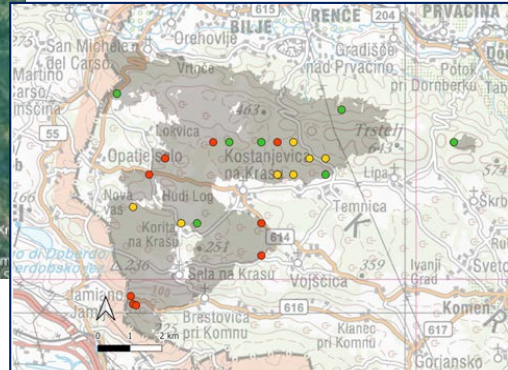


Erigeron annuus



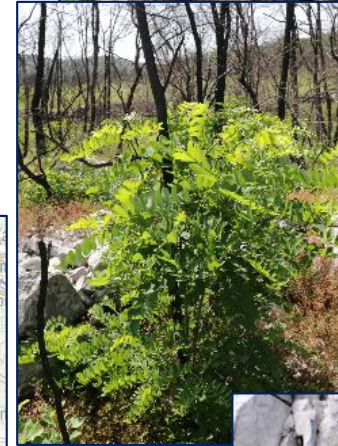
FOREST FIRES

Forest fires between 15 and 29 July 2022 –
damaged **3.707 ha** in SW Slovenia (at the
border with Italy)



Year after (2023) in **23 plots**:

- identified **260 ferns and vascular plants**
- **9 invasive or potentially invasive non-native plant species**: *Robinia pseudacacia*, *Ailanthus altissima*, *Conyza sumatrensis*, *C. canadensis*, *Senecio inaequidens*, *Erigeron annuus*, *Phytolacca americana*, *Erechtites hieraciifolius*, *Amaranthus hybridus* (and **additional 3 species** on the burnt area **outside of the plots**)



CONTROL OF INVASIVE ALIEN SPECIES (IAS) IN SLOVENIA

Invasive Alien Species reporting - 2019-2024, Slovenia (Ministry of Natural Resources and Spatial Planning - MNVP):

- For the **implementation of EU Regulation No 1143/2014** in Slovenia, **more than 5.5 million EUR** was spent on activities linked to the **IAS management** during the **period 2019-2024**: this included **national funds** for activities of public bodies (Ministry, 10 protected areas and 2 scientific public bodies), as well as funds provided for **several EU projects** (LIFE, Cohesion Funds and the European Maritime and Fisheries Fund).
- The resources provided to **public bodies for IAS management** activities from the national budget per year were as follows (in EUR): 375.000 (2019), 39.500 (2020), 623.000 (2021), 735.000 (2022), 675.500 (2023) and **917.000 (2024)**.

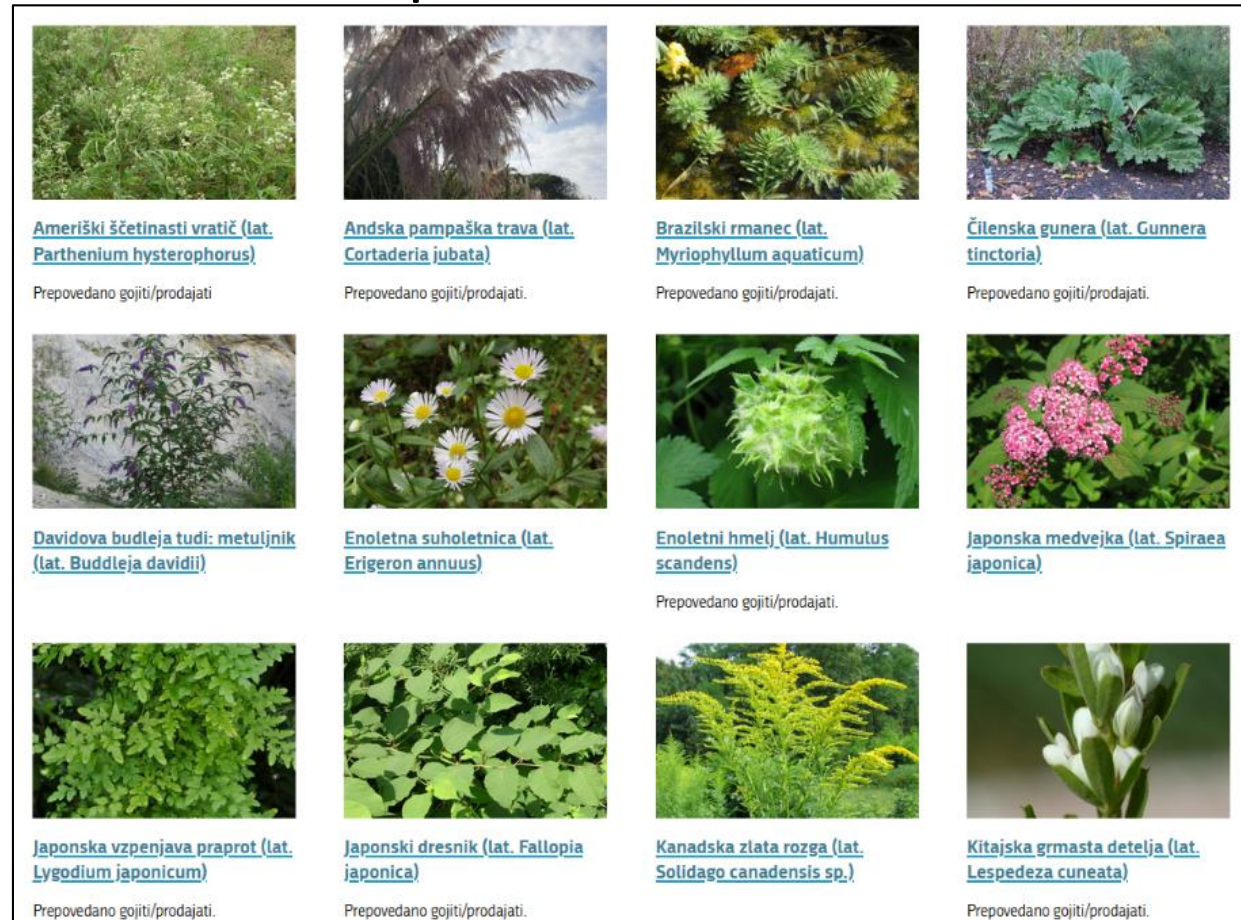


Source: MNVP - Invasive Alien Species reporting - 2019-2024, Slovenia

INVASIVE PLANT SPECIES IN SLOVENIA

Ministry of Natural Resources and Spatial Planning (Republic of Slovenia) website:

- **53 invasive plant species** are presented on its website
- **Basic species description, distribution, and habitats**
- **Control and eradication of species**



ERADICATION OF INVASIVE PLANT SPECIES

The Institute for Nature Conservation, founded by the public and project funds, **coordinated most of the activities to eradicate the following IAS:**

- *Heracleum mantegazzianum*
 - *Pueraria montana* var. *lobata*
 - *Ailanthus altissima*
 - *Phytolacca americana*
 - *Impatiens glandulifera*
 - *Helianthus tuberosus*
 - *Asclepias syriaca*
 - *Amorpha fruticosa*
 - *Paulownia tomentosa*
 - *Prunus serotina*
 - *Celastrus orbiculatus*
 - *Akebia quinata*
 - *Phyllostachys* sp.
 - *Solidago gigantea*, *S. canadensis*
- etc.



In the eradication of invasive alien plants, different **public institutions** (such as protected areas, including landscape parks) and **private institutions** (e.g. Zavod Symbiosis, Zavod Jazon, 4T, REtrava) were also involved.

MEASURES TO CONTROL THE SPREAD OF INVASIVE ALIEN PLANTS

Institute for Nature Conservation prepared a manual for controlling the spread of invasive alien plant species on the agricultural land

(includes species common also in forests).

The manual comprises the following species:

- *Rudbeckia laciniata*
- *Solidago canadensis*
- *Solidago gigantea*
- *Erigeron annuus*
- *Ambrosia artemisiifolia*
- *Asclepias syriaca*
- *Impatiens glandulifera*
- *Phytolacca americana*
- *Ailanthus altissima*
- *Fallopia japonica*
- *Fallopia x bohemica*
- *Fallopia sachalinensis*



Manual pulling and digging of *Phytolacca americana* in the spruce stand (Photo: Andrej Štemberger Zupan)



Girdling of *Ailanthus altissima* trees in the Karst (Photo: Zavod Jazon)

CONCLUSIONS

- In Slovenian forests, **frequency and cover** of alien plant species is **increasing**.
- **New alien plant** species are **invading** forests in Slovenia.
- Observed increase of alien species is triggered by progressive **tree canopy mortality**, increasing frequency of **natural and man-induced disturbances**, including forest interventions.
- Due to **climate change** and increasing frequency of forest **disturbances**, the spread of **alien plant species** is expected to **intensify** in the future in forests.
- Additional **forest management activities** will be required **to control the spread** of alien plant species in Slovenian forests.



GOZDARSKI INŠTITUT SLOVENIJE
SLOVENIAN FORESTRY INSTITUTE

Thank you for attention



LIFE integrirani projekt za okrepljeno upravljanje Nature 2000 v Sloveniji

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MINISTRSTVO ZA NARAVNE VIRE IN PROSTOR