



**BOOK OF ABSTRACTS**  
**Detection and control of forest invasive alien species  
in a dynamic world**

International conference of the LIFE ARTEMIS project  
25–28 September, Ljubljana, Slovenia

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**ZBORNIK POVZETKOV**  
**Zaznavanje in nadzor tujerodnih vrst v gozdovih  
v spreminjajočem se svetu**

Mednarodna konferenca projekta LIFE ARTEMIS  
25.–28. september, Ljubljana, Slovenija



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# **Zaznavanje in nadzor tujerodnih vrst v gozdovih v spreminjajočem se svetu**

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**The *Silva Slovenica* Publishing Centre,  
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# Kolofon

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## Foreword / Predgovor

When you walk through the forests in Europe more and more alien species can be observed which were not there only a few decades ago. Many of them have not such a large impact on the forests, but there is a small number of species which have a huge impact, in this sense that even native species can be put on the red list of endangered species. In the case of ash dieback (*Hymenoscyphus fraxineus*), the fungal pathogen swooped through Europe in no time and now we see in many countries a large decrease of ash.

It is of course the question what we should do against these invasive alien species. In many cases when the species is already established eradication becomes often impossible or if nothing else the costs are much higher than the benefits. It is therefore key that the potential invasive alien species will be detected as soon as possible and therefore an early warning and rapid response system should be set up. The development of an efficient early warning and rapid response system for harmful organisms for forests is foreseen both in the new European Plant Health legislation and in Regulation on Invasive Alien Species. Both documents include lists of priority species that pose the highest risk to the EU, among which there are many organisms potentially harmful for forests. However, in many cases the early warning and rapid response system is not yet prepared or could be improve.

In the project LIFE ARTEMIS Awareness, training and measures on invasive alien species in forests (LIFE15 GIE/SI/000770) the main goal is to contribute to the reduction of the harmful impacts of invasive alien species on biodiversity by increasing public awareness and by setting up an effective early warning and rapid response framework for invasive alien species in forests. The international conference "Detection and control of forest invasive alien species in a dynamic world" is organized. During this conference we will exchange new experience with presentations and workshops on alien species in forests, detection and their management.

I wish all a great time with this very exciting program in the coming four days.

dr. Maarten de Groot,  
project leader LIFE ARTEMIS

Dandanes med sprehodom po gozdu lahko opazimo veliko tujerodnih vrst, ki jih še pred nekaj desetletji tam niti ni bilo. Kljub temu, da mnoge med njimi nimajo izrazitega vpliva na gozdove, je vse več takih, ki v gozdni prostor vnašajo velike spremembe. Vpliv invazivnih tujerodnih vrst lahko povzroči celo uvrstitev domorodnih vrst na rdeče sezname ogroženih vrst. Kot primer lahko navedemo jesenov ožig (*Hymenoscyphus fraxineus*), glivnega patogena, ki se je izjemno hitro razširil po Evropi in povzročil opazen upad številčnosti jesena v mnogih evropskih državah.

Pojavi se vprašanje, kaj bi proti tem invazivnim tujerodnim vrstam moral storiti. V mnogih primerih, ko so vrste že vzpostavljene, je izkoreninjenje nemogoče ali pa stroški presežejo koristi takega ukrepa. Zaradi tega je ključno, da se potencialne invazivne tujerodne vrste na novem območju čim prej odkrijejo, za kar je ključna vzpostavitev sistema zgodnjega obveščanja in hitrega odzivanja. Razvoj učinkovitega sistema zgodnjega obveščanja in hitrega odzivanja za škodljive organizme v gozdovih je predviden tako v novi evropski zakonodaji o zdravstvenem varstvu rastlin kot v Uredbi o invazivnih tujerodnih vrstah. Oba dokumenta vključujeta sezname prednostnih vrst, ki predstavljajo največjo nevarnost za Evropsko unijo, med katerimi pa je tudi veliko organizmov, ki so lahko škodljivi za gozdove. Kljub vsemu pa sistemi zgodnjega obveščanja in hitrega odzivanja v večini primerov še niso pripravljene ali bi jih bilo možno izboljšati.

Glavni namen projekta LIFE ARTEMIS - Osveščanje, usposabljanje in ukrepanje za invazivne tujerodne vrste v gozdovih (LIFE15 GIE/SI/000770) je prispevati k zmanjšanju negativnih vplivov invazivnih tujerodnih vrst na biodiverziteti s povečanjem osveščenosti javnosti in z vzpostavitvijo učinkovitega okvira sistema za zgodnje odkrivanje in hitro odzivanje na invazivne tujerodne vrste v gozdovih. V sklopu projekta organiziramo tudi mednarodno konferenco "Zaznavanje in nadzor invazivnih tujerodnih vrst v gozdovih v spreminjajočem se svetu". Tu bomo preko predstavitev in delavnic izmenjali najnovejše izkušnje s tujerodnimi vrstami v gozdovih, z njihovim odkrivanjem in upravljanjem.

Vsem želim produktivno srečanje z zelo zanimivim programom tekom prihodnjih štirih dni.

dr. Maarten de Groot,  
vodja projekta LIFE ARTEMIS

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The conference is organised in the framework of the project LIFE ARTEMIS (LIFE15 GIE/SI/000770). Aim of the project is to contribute to the reduction of the harmful impacts of invasive alien species on biodiversity by increasing public awareness and by setting up an effective early warning and rapid response framework for invasive alien species in forests.

More information on the LIFE ARTEMIS project can be found on [www.tujerodne-vrste.info](http://www.tujerodne-vrste.info).

Information system for IAS: [www.invazivke.si](http://www.invazivke.si)

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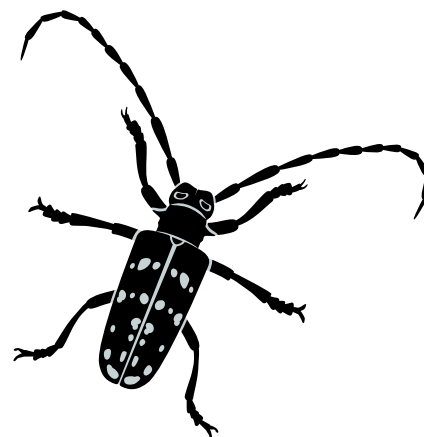
# Conference programme / Program konference

25<sup>th</sup> September 2019 / 25. september 2019

9:00 – 10:00	Registration	
10:00 – 10:45	Welcome speeches and official opening	
<b>Section 1:</b>	<b>Invasive alien species (IAS) and forests: an introduction</b>	
	<b>Invazivne tujerodne vrste in gozdovi: uvod</b>	
10:45 – 11:30	<b>Keynote speaker:</b> Helen E. Roy Global perspectives on the ecology of invasive alien species: people, policy and nature <i>Globalni vidiki ekologije invazivnih tujerodnih vrst: ljudje, politika in narava</i>	
11:30 – 12:00	Coffee break	
12:00 – 12:15	D. Oražem, A. Poljanec, A. Breznikar	Forest and forestry in Slovenia <i>Gozd in gozdarstvo v Sloveniji</i>
12:15 – 12:30	M. de Groot, Š. Jagodic, D. Jurc, A. Kavčič, M. Kolšek, J. Kus Veenvliet, L. Kutnar, J. Malovrh, A. Marinšek, N. Ogris, B. Piškur, B. Rantaša, D. Fon, A. Verlič, S. Zidar	Forest IAS and people: how LIFE ARTEMIS project raised awareness and increased the participation of early detection of alien species <i>Gozd in ljudje: kako je projekt LIFE ARTEMIS osveščal javnost in povečal njeno vključenost v zgodnje zaznavanje tujerodnih vrst</i>
12:30 – 12:45	B. Tavzes	Preparation of renewed legislative and institutional framework for prevention and management of invasive alien species in Slovenia <i>Priprava prenovljenega zakonodajnega in institucionalnega okvira za preprečevanje vnosa in širjenja ter obvladovanja invazivnih tujerodnih vrst v Sloveniji</i>
12:45 – 13:45	Lunch	
<b>Section 2:</b>	<b>Citizen science and invasive alien species</b>	
	<b>Ljubiteljska znanost in invazivne tujerodne vrste</b>	
13:45 – 14:30	<b>Keynote speaker:</b> Peter Crow Can citizen scientists help to record invasive forest pests or diseases? – lessons learned from the UK's OBSERVATREE tree health project <i>Ali lahko ljubiteljski znanstveniki pomagajo pri popisovanju invazivnih, gozdu škodljivih organizmov ali boleznih? Nova spoznanja, pridobljena pri projektu Združenega kraljestva za zdravje dreves OBSERVATREE</i>	
14:30 – 14:45	N. Jogan, A. Marinšek, L. Kutnar, J. Kus Veenvliet, K. Eler, J. Kermavnar, N. Ogris, M. de Groot	Effectiveness of citizens' science projects in early detection of invasive alien species <i>Učinkovitost projektov ljudske znanosti za zgodnje zaznavanje invazivnih tujerodnih vrst</i>
14:45 – 15:00	Z. Strojini Božič, B. Trčak	Project APPLAUSE – from harmful to useful with citizens' led activities <i>Projekt APPLAUSE – od škodljivih do uporabnih tujerodnih rastlin z aktivnim vključevanjem prebivalcev</i>
15:00 – 15:15	B. Rantaša, Z. Grecs, M. Kolšek	Turning theory into practice – IAS workshops for field professionals and forest owners <i>Iz teorije v prakso: usposabljanja o invazivnih tujerodnih vrstah v gozdovih za strokovnjake in lastnike gozdov v okviru projekta LIFE ARTEMIS</i>
15:15 – 15:45	Coffee break	
15:45 – 17:45	<b>Workshop 1:</b> The ethics of citizen science for IAS early detection <i>Etika ljubiteljske znanosti pri zgodnjem zaznavanju invazivnih tujerodnih vrst</i>	
	<b>Workshop 2:</b> Challenges and solutions in early warning systems of potential IAS in forests <i>Izzivi in rešitve pri sistemih zgodnjega obveščanja o potencialnih invazivnih tujerodnih vrstah v gozdu</i>	
19:30 – 22:30	Social event with dinner	

<b>Section 3: Early detection of forest invasive alien species</b>	
<b>(part 1) Zgodnje zaznavanje invazivnih tujerodnih vrst v gozdu</b>	
9:00 – 9:45	<b>Keynote speaker:</b> René Eschen Detection of potential pests and diseases of woody plants before their arrival in importing countries <i>Odkrivanje potencialnih škodljivih organizmov in bolezni lesnatih rastlin pred prihodom v države uvoznice</i>
9:45 – 10:00	C. Aglietti, P. Capretti, L. Ghelardini, G. Marchi, I. Barnes, C. Villari New multiplex Loop mediated isothermal amplification (LAMP) based assays to early detect <i>Dothistroma pini</i> , <i>Dothistroma septosporum</i> and <i>Lecanosticta acicola</i> on pine needles <i>Nov multipleksni test na podlagi z zanko posredovanega izotermalnega pomnoževanja (LAMP) za zgodnje odkrivanje gliv Dothistroma pini, Dothistroma septosporum in Lecanosticta acicola na borovih iglicah</i>
10:00 – 10:15	J. Bonte, W. Vanreusel, I. Delcour, J. Audenaert, B. Gobin, J. Witters Development of a system for awareness, early detection and notification of organisms harmful to plants in Belgium and beyond <i>Razvoj sistema za ozaveščanje, zgodnje odkrivanje in obveščanje o organizmih, škodljivih za rastline v Belgiji in drugje</i>
10:15 – 10:30	E. Bullas-Appleton Canada's forest pest surveillance program <i>Kanadski program nadzora gozdu škodljivih organizmov</i>
10:30 – 11:00 Coffee break/Odmor za kavo	
11:00 – 11:15	G. Hoch, J. Connell, A. Roques Using a multi-lure approach for trapping Cerambycidae in high risk areas for the introduction of bark and wood boring pests in Austria <i>Uporaba pristopa z več vabami za lov kozličkov s pastmi na območjih z visokim tveganjem za vnos lesnih škodljivcev v Avstriji</i>
11:15 – 11:30	U. Hoyer-Tomiczek, G. Sauseng, G. Hoch Detection dogs for the surveillance of invasive bark and wood boring insects <i>Psi za odkrivanje in nadzorovanje invazivnih ksilofagnih žuželk</i>
11:30 – 11:45	P. Pajk, A. Zupančič Examination of the presence and distribution of pest in the context of the survey programme <i>Preučevanje navzočnosti in razširjenosti škodljivih organizmov z vidika programov preiskav</i>
11:45 – 12:45	<b>Poster session/Predstavitve posterjev</b>
12:45 – 13:45 Lunch/Kosilo	
<b>Section 3: Early detection of forest invasive alien species</b>	
<b>(part 2) Zgodnje zaznavanje invazivnih tujerodnih vrst v gozdu</b>	
13:45 – 14:30	<b>Keynote speaker:</b> Massimo Faccoli Plant health survey in Europe: background, current situation and next challenges <i>Sistematične raziskave na področju zdravstvenega varstva rastlin v Evropi: ozadje, trenutni položaj in prihodnji izzivi</i>
14:30 – 14:45	J. Sweeney, P. Silk, P. Mayo, K. Ryall, D. Miller, C. Hughes, K. Van Rooyen, J. M. Gutowski, Q. Meng, Y. Li, J. Francese, D. Rassati, T. Kimoto, J. Allison Methods for improving early detection of exotic wood boring beetles <i>Metode za izboljšanje zgodnjega odkrivanja tujerodnih ksilofagnih hroščev</i>
14:45 – 15:00	T. Urvois, A. Roques, J. P. Rossi, C. Kerdelhue, M. A. Auger-Rozenberg Species distribution modelling and expansion monitoring of two invasive ambrosia beetles, <i>Xylosandrus compactus</i> and <i>X. crassiusculus</i> <i>Modeliranje razširjenosti vrst in spremljanje širjenja dveh invazivnih vrst ambrozijskih podlubnikov – Xylosandrus compactus in X. crassiusculus</i>
15:00 – 15:15	N. I. Kirichenko, E. Akulov, D. Lees, C. Lopez-Vaamonde Examination of the presence and distribution of pest in the context of the survey programme <i>Preučevanje navzočnosti in razširjenosti škodljivih organizmov z vidika programov preiskav</i>
15:15 – 15:45 Coffee break/Odmor za kavo	

<b>Section 4: Information systems for recording invasive alien species</b> <b>Informacijski sistemi za zbiranje podatkov o invazivnih tujerodnih vrstah</b>		
15:45 – 16:00	N. Ogris, M. de Groot	Information system Invazivke: role in early warning of IAS, statistics, problems and challenges <i>Informacijski sistem Invazivke: vloga v zgodnjem obveščanju ITV, statistika, problemi in izzivi</i>
16:00 – 16:15	E. Per	Information systems and information management to record alien parakeet species in Turkey <i>Informacijski sistemi in informacijsko upravljanje za evidentiranje tujerodnih vrst skobčevk v Turčiji</i>
<b>Section 5: Awareness raising and attitudes towards invasive alien species</b> <b>Osveščanje javnosti in njen odnos do invazivnih tujerodnih vrst</b>		
16:15 – 16:30	E. Tricarico	LIFE ASAP: "Alien Species Awareness Program" in Italy <i>LIFE ASAP: program ozaveščanja o tujerodnih vrstah v Italiji</i>
16:30 – 16:45	A. Japelj, M. de Groot	Successive polling of Slovenes about invasive alien forest species <i>Intervalno anketiranje Slovencev o invazivnih tujerodnih vrstah</i>
16:45 – 17:00	M. Šipek, N. Šajna	Public knowledge and perceptions of suburban plant invasions: the role of residential gardens and garden waste deposits in forest fragments <i>Poznavanje in dožemanje invazij tujerodnih rastlin med širšo javnostjo: pomen domačih vrtov in odlagališč vrtnih odpadkov v periurbanih gozdnih fragmentih</i>





Section 6: Monitoring and control of forest invasive alien species Spremljanje in nadzor invazivnih tujerodnih vrst v gozdu		
9:00 – 9:45	<b>Keynote speakers:</b> A. Csóka, P. Kézdy, M. Korda, A. Csiszár Practical experiences in invasive alien plant control in protected areas of Hungary <i>Praktične izkušnje pri nadzoru nad invazivnimi tujerodnimi rastlinami na zavarovanih območjih Madžarske</i>	
9:45 – 10:00	K. Černý, L. Havrdová, V. Zýka, V. Strnadová, Z. Haňáčková, D. Zahradník, M. Hrabětová, D. Romportl, M. Mrázková, E. Chumanová	Alien invasive pathogens in the Czech Republic, their list, the most important recent findings and possible mitigation and adaptation strategies <i>Invazivni tujerodni patogeni na Češkem, seznam teh patogenov, najpomembnejše najnovejše ugotovitve ter mogoče strategije za ublažitev in prilagajanje</i>
10:00 – 10:15	J. Galko, C. Nikolov, J. Vakula, S. Rell, M. Zúbrik, A. Kunca	National monitoring of two non-native species in Slovakia: <i>Ips duplicatus</i> and <i>Xylosandrus germanus</i> (Curculionidae: Scolytinae) <i>Nacionalno spremljanje dveh tujerodnih vrst na Slovaškem: Ips duplicatus in Xylosandrus germanus (Curculionidae: Scolytinae)</i>
10:15 – 10:30	R. O'Hanlon, C. Fleming	Recent experience with dealing with Invasive alien species threatening plant health in Northern Ireland <i>Najnovejše izkušnje z obravnavo invazivnih tujerodnih vrst, ki ogrožajo zdravstveno varstvo rastlin na Severnem Irskem</i>
10:30 – 11:00	Coffee break/Odmor za kavo	
11:00 – 11:15	U. Kanjir, M. Kavčič, A. Smerdu, Ž. Kokalj	APPLAUSE: Combining satellite and ground survey data for effective IAPS data collection <i>APPLAUSE: Združevanje satelitskih in terenskih podatkov za učinkovito zbiranje informacij o invazivnih tujerodnih rastlinah</i>
11:15 – 11:30	B. Piškur, A. Kavčič, M. Triplat	Outbreak of a quarantine organism in Slovenian forests: actions and challenges <i>Izbruh karantenskega škodljivega organizma v slovenskih gozdovih: ukrepi in izzivi</i>
11:30 – 11:45	C. M. Shuttleworth, N. Robinson, E. C. Halliwell, H. Peek, R. Clews-Roberts, C. McKinney, D. J. Everest, K. W. Larsen	Evolving grey squirrel management techniques in Europe <i>Razvoj tehnik upravljanja sive veeverice v Evropi</i>
11:45 – 12:00	D. Williams, G. Csóka, B. Hrašovec, G. Hoch, M. de Groot, K. Hradil, C. Chireceanu, B. Castagneyrol	Evaluating the pest status in Europe of the oak lace bug, <i>Corythucha arcuata</i> (Heteroptera, Tingidae), and developing survey, control and management strategies <i>Ocenjevanje statusa škodljivega organizma v Evropi za hrastovo čipkarko, Corythucha arcuata (Heteroptera, Tingidae), in razvoj strategij stalnega raziskovanja, nadzora in upravljanja</i>
12:00 – 12:15	S. Rozman, J. Malovrh	Action plan for invasive alien species (IAS) management in the Landscape park Tivoli, Rožnik and Šišenski hrib (LPTRŠ) near Ljubljana, Slovenia – stakeholders' involvement <i>Akcijski načrt za obvladovanje invazivnih tujerodnih vrst (ITV) v Krajskem parku Tivoli, Rožnik in Šišenski hrib (KP TRŠ) pri Ljubljani, Slovenija – vključevanje deležnikov</i>
12:15 – 13:15	Lunch/Kosilo	
Section 7: Ecology and invasive alien species Ekologija in invazivne tujerodne vrste		
13:15 – 13:30	T. Campagnaro, S. Iacopino, F. G. Simonelli, G. Trentanovi, T. Sitzia	Effects of <i>Robinia pseudoacacia</i> in Natura 2000 sites in Italy: a comparison with <i>Castanea sativa</i> woods <i>Vplivi drevesa Robinia pseudoacacia na območjih Natura 2000 v Italiji: primerjava z gozdovi Castanea sativa</i>
13:30 – 13:45	A. Csiszár, M. Korda, G. Zagyvai, V. Tiborc, E. Zaxné Simon, D. Bartha	Occurrence of invasive alien plants in canopy gaps of different forest communities <i>Prisotnost invazivnih tujerodnih rastlin v vrzelih v različnih gozdnih združbah</i>

13:45 – 14:00	M. Pepe, L. Gratani, L. Varone, G. Fabrini	Thermal requirements for seed germination of three Invasive alien species (IAS) <i>Toplotne zahteve za klitje semen treh invazivnih tujerodnih vrst</i>
14:00 – 14:15	A. Vannini, C. Morales Rodriguez	Analysis of fungal community associated to the alien invasive ambrosia beetle <i>Xylosandrus compactus</i> : a specific contribute to the project LIFE17 NAT/IT/000609 SAMFIX: SAving Mediterranean Forests from Invasions of <i>Xylosandrus</i> beetles and associated pathogenic fungi <i>Analiza glivne združbe, povezane z invazivnim tujerodnim hroščem Xylosandrus compactus: posebni prispevek k projektu LIFE17 NAT/IT/000609 SAMFIX: Reševanje sredozemskih gozdov pred vnosi hroščev Xylosandrus in povezanih patogenih gliv</i>
14:15 – 14:30	G. Csóka, M. Paulin, Á. Mikó, C. Eötvös, C. Gáspár, A. Hirka	The oak lace bug ( <i>Corythucha arcuata</i> ) – a multiple threat on oak ecosystems <i>Hrastova čipkarka (Corythucha arcuata) – večkratna nevarnost za hrastove ekosisteme</i>
14:30 – 15:00	Coffee break/Odmor za kavo	
15:00 – 16:30	<b>Workshop 3:</b> Communicating on invasive alien species: exchange of tips and tricks for successful outreach <i>Komuniciranje o invazivnih tujerodnih vrstah: izmenjava izkušenj in pristopov, ki delujejo</i>	
	<b>Workshop 4:</b> Rapid response and invasive alien species <i>Hitro odzivanje in invazivne tujerodne vrste</i>	
16:30 – 17:00	Conslusions/Zaključki	

## 28<sup>th</sup> September 2019 / 28. september 2019

8:30 – 17:30 **Field excursion**  
Terenska ekskurzija

**SECTION 1**  
**INVASIVE ALIEN SPECIES AND FORESTS:**  
**AN INTRODUCTION**

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# Global perspectives on the ecology of invasive alien species: people, policy and nature

## Globalni vidiki ekologije invazivnih tujerodnih vrst: ljudje, politika in narava

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Biological invasions can threaten biodiversity and ecosystems, particularly through their interactions with other drivers of change. Species inventories are recognised as critical for the management of biological invasions, informing horizon scanning and surveillance, and underpinning prevention, control and elimination of invasive alien species. There have been major developments in the availability of high quality data on invasive alien species. Ensuring knowledge on invasive alien species shared between countries, is essential to advance understanding and enable successful implementation of strategies to manage invasive alien species. Here we provide an overview of the ways in which this information can be used to inform science, policy and ultimately conservation. We include insights into invasion ecology from broad patterns and processes to approaches in surveillance and monitoring, particularly involving citizens and highlighting the importance of collaborations. Networks established through these collaborative initiatives have benefits for people, science and nature.

**Keywords:** non-native species, impacts, pathways, predictions

Vnosi tujerodnih organizmov lahko ogrozijo biotsko raznovrstnost in ekosisteme, zlasti v interakciji z drugimi dejavniki sprememb. Sezname vrst so potrjeno ključni za upravljanje vnosov tujerodnih organizmov, dajejo informacije pri pregledu perspektiv in nadzoru ter pomagajo pri preprečevanju, nadzoru in izkoreninjenju invazivnih tujerodnih vrst. Glede razpoložljivosti visokokakovostnih podatkov o invazivnih tujerodnih vrstah so bili ustvarjeni pomembni razvojni dosežki. Zagotavljanje znanja o invazivnih tujerodnih vrstah, ki se izmenjuje med državami, je ključno za boljše razumevanje in omogočanje uspešnega izvajanja strategij za upravljanje invazivnih tujerodnih vrst. Podajamo pregled načinov možne uporabe teh informacij za obveščanje na področju znanosti, politike in ohranjanja narave. Vključujemo spoznanja o ekologiji vnosov od splošnih vzorcev in procesov do pristopov pri nadzoru in spremljanju, zlasti vključevanja državljanov in poudarjanja pomena sodelovanja. Omrežja, vzpostavljena pri teh pobudah za sodelovanje, koristijo ljudem, znanosti in naravi.

**Ključne besede:** tujerodne vrste, vplivi, poti vnosa, napovedi



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# Forest and forestry in Slovenia

## Gozd in gozdarstvo v Sloveniji

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Slovenia is among the most forested countries in Europe. In 2018, the forest area covered 1.177.244 ha of land (58%). Most Slovenian forests are located within the area of beech, fir-beech and beech-oak sites (70%), which have a relatively high production capacity. 77% of forests in Slovenia are privately owned, 23% of forests are public (owned by the state or local communes). The growing stock of Slovenian forests amounts 302 m<sup>3</sup>/ha. The annual increment is 7.5 m<sup>3</sup>/ha. Damages to forests are mostly caused by weather (wind, sleet, snow) and by insects (mainly by bark beetles). Spruce bark beetles are the most common reason for sanitary felling.

Slovenian forests are well preserved both in terms of vegetation and fauna. Forests covers a large share (over 70%) of the Slovenian territory included in the European ecological network Natura 2000.

Forest management and forest use in Slovenia are directed by The Ministry of Agriculture, Forestry and Food as the supreme state institution in the field of forestry and by the Slovenia Forest Service (SFS) as a public forestry service in all Slovenian forests. The most important tasks of SFS are: management planning, silviculture and forest protection, forestry technique, forest wildlife and hunting, public relations and education of forest owners. SFS on daily basis cooperates with other professional institutions in Slovenian forestry (Slovenian Forestry Institute, Forestry Inspection, Slovenian State Forests and other forest management companies, Chamber of Agriculture and Forestry of Slovenia and others), with forest owners, local communities and other national related institutions.

**Keywords:** forest, forestry, Slovenia Forest Service

Slovenija je med najbolj gozdnatimi državami v Evropi. V letu 2018 je površina gozdov znašala 1.177.244 ha (58 % celotne površine države). Večina slovenskih gozdov se nahaja na bukovih, jelovo-bukovih in bukovo-hrastovih rastiščih (70 %), ki imajo relativno visoko produkcijsko sposobnost. 77 % slovenskih gozdov je v zasebni lasti, 23 % pa v lasti države in lokalnih skupnosti. Povprečna lesna zaloga znaša 302 m<sup>3</sup>/ha, povprečni letni prirastek pa 7,5 m<sup>3</sup>/ha. Škode v gozdovih povzročajo predvsem vremenske ujme (žled, veter, sneg) in napadi žuželk, predvsem smrekovih podlubnikov. Smrekovi podlubniki so tudi najpogostejši vzrok za sanitarni posek. Slovenski gozdovi so relativno dobro ohranjeni – predstavljajo preko 70 % ozemlja Slovenije, ki je vključeno v Naturo 2000.

Krovna institucija za usmerjanje gospodarjenja z gozdovi in rabe gozdov v Sloveniji je Ministrstvo za kmetijstvo, gozdarstvo in prehrano Republike Slovenije, za izvajanje ukrepov gozdarske politike pa je zadolžen Zavod za gozdove Slovenije (ZGS), ki opravlja javno gozdarsko službo v vseh slovenskih gozdovih ne glede na lastništvo. Najpomembnejše naloge ZGS so: gozdarsko načrtovanje na vseh nivojih, usmerjanje ukrepov gojenja in varstva gozdov, usmerjanje rabe gozdarskih tehnologij pri gospodarjenju z gozdovi, upravljanje s prostoživečimi živalmi, odnosi z javnostmi, razvoj podeželja in izobraževanje lastnikov gozdov. ZGS pri izvajanju svojih nalog sodeluje z ostalimi strokovnimi institucijami, ki delujejo na področju gozdarstva (Gozdarski inštitut Slovenije, gozdarska inšpekcija, Slovenski državni gozdovi in ostala izvajalska podjetja, Kmetijska gozdarska zbornica Slovenije idr.), z lastniki gozdov, lokalnimi skupnostmi in ostalimi povezanimi institucijami.

**Ključne besede:** gozd, gozdarstvo, Zavod za gozdove Slovenije

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## Forest and people: how LIFE ARTEMIS project raised awareness and increased the participation of early detection of alien species

### Gozd in ljudje: kako je projekt LIFE ARTEMIS osveščal javnost in povečal njeno vključenost v zgodnje zaznavanje tujerodnih vrst

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Invasive alien species have been shown to be a large problem in the last decades in forests. The best way of dealing with invasive alien species is by early detection or prevention. However, there are only a few experts working with the detection of invasive alien species, therefore help from the general public and forest professionals is needed. The project LIFE ARTEMIS - Awareness, training and measures on invasive alien species in forests (LIFE15 GIE/SI/000770) started in July 2016 as a communication project. The goal of the project LIFE ARTEMIS is to contribute to the reduction of the harmful impacts of invasive alien species on biodiversity by increasing public awareness and by setting up an effective early warning and rapid response framework for invasive alien species in forests. Project objectives to be achieved by the project were 1) Increase awareness of the general public, in particular of private forest owners, of threats caused by invasive alien species to forests, 2) Establish an efficient national institutional framework for early detection and rapid response for alien species in forests and 3) Improve the national capacity for early detection of alien species in forests by mobilizing and training professionals and volunteers. During this presentation we will present how people can help with the management of invasive alien species, what were the successes and the learning points during this project.

**Keywords:** invasive alien species, forests, citizen science, early warning and rapid response, LIFE

Invazivne tujerodne vrste so se v zadnjih desetletjih pokazale kot velik problem v gozdovih. Najustreznejši način upravljanja z invazivnimi tujimi vrstami je njihovo zgodnje odkrivanje ali preprečevanje njihove naselitve. Vendar se z zaznavanjem invazivnih tujerodnih vrst v okolju ukvarja le malo strokovnjakov, zato je potrebna pomoč širše javnosti in gozdarskih strokovnjakov. Projekt LIFE ARTEMIS - Osveščanje, usposabljanje in ukrepanje za invazivne tujerodne vrste v gozdovih (LIFE15 GIE/SI/000770) se je začel julija 2016 kot komunikacijski projekt. Cilj projekta je prispevati k zmanjšanju negativnih vplivov invazivnih tujerodnih vrst na biotsko raznovrstnost s povečanjem osveščenosti javnosti in z vzpostavitvijo učinkovitega okvira za zgodnje odkrivanje in hitro odzivanje na invazivne tujerodne vrste v gozdovih. Konkretni cilji projekta so bili: 1) povečati osveščenost javnosti, še posebej zasebnih lastnikov gozdov, glede nevarnosti, ki jo predstavljajo invazivne tujerodne vrste za gozdove, 2) vzpostaviti učinkovit institucionalni okvir za zgodnje odkrivanje in hitro odzivanje (ZOHO) za tujerodne vrste v gozdnem prostoru in 3) izboljšati zmogljivost za zgodnje zaznavanje tujerodnih vrst v gozdovih z aktivacijo in usposabljanjem zaposlenih na področju upravljanja z gozdovi in prostovoljcev. Tekom predstavitve bomo predstavili, kako lahko javnost sodeluje pri upravljanju z invazivnimi tujerodnimi vrstami in kakšni so bili uspehi in izzivi projekta.

**Ključne besede:** invazivne tujerodne vrste, gozdovi, ljubiteljska znanost, zgodnje obveščanje in hitro odzivanje, LIFE

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## Preparation of renewed legislative and institutional framework for prevention and management of invasive alien species in Slovenia

### Priprava prenovljenega zakonodajnega in institucionalnega okvira za preprečevanje vnosa in širjenja ter obvladovanja invazivnih tujerodnih vrst v Sloveniji

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Slovenia had a legal framework for addressing only a certain aspects of dealing with invasive alien species (IAS) before the adoption of the EU Regulation No 1143/2014 on the prevention and management of the introduction and spread of invasive alien species in 2014. The EU regulation provided a framework on which more comprehensive legal and organisational measures are being developed. In the last decade in parallel with the development of legislative measures, more effort was given to building awareness on IAS and to collecting information on alien species. Different projects for raising public awareness, for eradication and management of IAS, for the development and testing new techniques took place. These projects and other forms of collaboration helped with creation of network for cooperation among governmental organisations, NGOs and individuals in the field of IAS. Some experience was gained on management and on early detection and rapid eradication. This helped in the process of drawing a proposal for improved legislative and organisational framework with the aim to establish a comprehensive system. It is foreseen that on the national level existing public bodies, mostly from the field of nature protection and the ones dealing with the use of natural resources will serve as a foundation of the system. Additional support is foreseen by other organisational solutions in order to address specific needs in combating IAS, such as need for early detection and rapid response. Information system will have to be established and adequate staffing and financial resources will also be needed.

**Keywords:** invasive alien species, legal framework, management of IAS, Slovenia

V Sloveniji je pred letom 2014, ko je bila sprejeta Uredba EU št. 1143/2014 o preprečevanju in upravljanju vnosa in širjenja invazivnih tujih vrst, pravni okvir opredeljeval le določena ravnanja z invazivnimi tujerodnimi vrstami (ITV). Uredba EU je uvedla pravni okvir na podlagi katerega razvijamo celovitejše pravne in upravljalvske ukrepe. V zadnjem desetletju smo, vzporedno z razvojem pravnih podlag, veliko vlagali tudi v izboljševanje zavedanja o ITV in v zbiranje podatkov o tujerodnih vrstah. Izvajali smo različne projekte za izboljšanje osveščenosti, za odstranjevanje in za obvladovanje ITV, vključno z razvojem in testiranjem novih tehnik. Ti projekti in druge oblike sodelovanja so pripomogli k vzpostavitvi neformalne mreže sodelovanja med vladnimi in nevladnimi organizacijami ter posamezniki s področja ITV. V tem času smo pridobili tudi določene izkušnje pri obvladovanju, zgodnjem odkrivanju in hitri odstranitvi ITV. Te izkušnje smo uporabili pri pripravi predloga za dopolnitev zakonodajnega in upravljalvskega okvirja z namenom oblikovanja celovitega sistema. Sistem ravnanja z ITV naj bi temeljil na obstoječih javnih organih predvsem s področja varstva narave ter področja rabe naravnih virov. Dodatno podporo, predvsem v primerih, kjer so pri zgodnjem odkrivanju in hitrem odzivu potrebni specifični načini ukrepanja za ITV, naj bi zagotavljale tudi druge organizacije. Treba bo zagotoviti tudi informacijski sistem ter ustrezne kadrovske in finančne vire.

**Ključne besede:** invazivne tujerodne vrste, pravni okvir, upravljanje z ITV, Slovenija

# **SECTION 2**

## **CITIZEN SCIENCE AND INVASIVE ALIEN SPECIES**



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## Can Citizen Scientists help to record invasive forest pests or diseases? – Lessons learned from the UK's Observatree tree health project

### Ali lahko ljubiteljski znanstveniki pomagajo pri popisovanju invazivnih, gozdu škodljivih organizmov ali boleznih? Nova spoznanja, pridobljena pri projektu Združenega kraljestva za zdravje dreves Observatree

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Observatree is a multi-partner project designed to give Citizen Scientists the tools, knowledge and skills to monitor tree health within the UK. This allows them to report signs of ill-health and the presence of invasive pests or diseases. Unlike many Citizen Science projects, Observatree invests heavily in training and maintaining a network of volunteers to recognise selected tree pests and diseases. We work closely with tree health professionals to focus on the invasive alien species that are of greatest concern. Equipping our volunteers with the skills to report new sightings of these pests or diseases allows them to potentially act as an early warning system. If an outbreak of a new pest or disease is identified early enough, there is a better chance to manage it, perhaps by reducing rates of spread or potentially removing it all together.

Within the project, we have created a wide range of educational materials for our volunteers. These are produced by tree health experts and contain the latest scientific knowledge. Many of these materials are used by professional plant health inspectors and are also available to those working in forestry, tree and woodland management.

Originating as a 4-year LIFE co-funded project, Observatree is now entering its 7<sup>th</sup> year. During this time, we have learned a lot about Citizen Science data; what keeps volunteers motivated and engaged. This presentation will highlight some of the successes to date, the challenges we have found and how Observatree has evolved accordingly.

**Keywords:** citizen science, tree health, invasive alien species, early warning system, education

Observatree je večpartnerski projekt, katerega namen je ljubiteljske znanstvenike opremiti z orodji, znanjem in veščinami za spremljanje zdravja dreves v Združenem kraljestvu. To jim omogoča poročanje o slabem zdravju in prisotnosti invazivnih škodljivih organizmov ali boleznih. V nasprotju s številnimi drugimi projekti na področju ljubiteljske znanosti projekt Observatree veliko vlaga v usposabljanje in vzdrževanje mreže prostovoljcev za prepoznavanje izbranih škodljivih organizmov in boleznih na drevesih. Osredotočamo se na invazivne tujerodne vrste, ki najbolj vzbujajo skrb, in pri tem tesno sodelujemo s strokovnjaki za zdravje dreves. Prostovoljce opremljamo z veščinami za poročanje o novih opažanjih teh škodljivih organizmov ali boleznih in tako omogočamo, da lahko potencialno sodelujejo v sistemu zgodnjega opozarjanja. Če dovolj zgodaj prepoznamo izbruh novega škodljivega organizma ali boleznih, je možnost obvladanja večja, morda z znižanjem stopnje razširjenosti ali s popolnim izkoreninjenjem.

V okviru projekta smo za prostovoljce pripravili zelo raznovrstno izobraževalno gradivo. Izdelujejo ga strokovnjaki za zdravje dreves in vsebuje najnovejša znanstvena dognanja. To gradivo pogosto uporabljajo strokovnjaki inšpekcijske službe za zdravstveno varstvo rastlin in je na voljo tudi delavcem v gozdarstvu ter na področju gospodarjenja z drevesi in gozdnimi zemljišči.

Projekt Observatree, ki je bil prvotno štiriletni projekt, sofinanciran s sredstvi programa LIFE, se zdaj izvaja že sedmo leto. V tem času smo se veliko naučili o podatkih v ljubiteljski znanosti ter o tem, kaj ohranja motiviranost in angažiranost prostovoljcev. V tej predstavitvi bodo orisani nekateri dosedanja uspehi, izzivi, s katerimi smo se srečevali, in kako se je skladno s tem razvijal projekt Observatree.

**Ključne besede:** ljubiteljska znanost, zdravje dreves, invazivne tujerodne vrste, sistem zgodnjega opozarjanja, izobraževanje

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# Effectiveness of citizens' science projects in early detection of invasive alien species in Slovenia

## Učinkovitost projektov ljudske znanosti za zgodnje zaznavanje invazivnih tujerodnih vrst v Sloveniji

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An early detection of potential invasive alien species (IAS) with rapid response activities is of crucial importance for their efficient suppression. On one hand we are all aware of that fact, but there are several fold more »candidate IAS« than already established invaders in the country and there are several different pathways and different areas of origin all with rich fauna and flora where such "candidates" are native. It is definitely not an easy task to spot the first population of any newcomer species and to recognize it as a potentially harmful.

Five different citizens' science projects conducted in Slovenia in last decade have been compared with the aim to check their efficiency in early detection of IAS. Their goals were quite diverse but the main focus of all were invasive alien species. Target public of collaborators were from complete laymen without any special training in IAS recognition to technical staff with some level of previous training in some related fields (e.g. students of biology, foresters). Although only one of the projects (LIFE ARTEMIS) has been (among other tasks) specifically focused on the creation of alert lists and early detection of potentially invasive alien species, also all other projects resulted in at least some recorded populations of taxa previously not known in Slovenia or its certain parts.

We tried to evaluate the approaches of various studied projects in respect of early IAS detection efficiency to achieve a better understanding of advantages and disadvantages of such citizens' science projects' potential for the future.

**Keywords:** citizen science initiative, assessment, forest invasive alien species, cost-benefit analysis

Zgodnje zaznavanje potencialnih invazivnih tujerodnih vrst (dalje: ITV) s takojšnjim ukrepanjem proti njim je za učinkovito zatiranje širjenja ITV ključnega pomena. Tega dejstva se vsi zavedamo, a število "kandidatov" za ITV je nekajkrat večje od števila že ustaljenih ITV, poti vnosa so zelo različne in nepredvidljive, prav tako območja, iz katerih te potencialne invazivke prihajajo, hkrati pa so prav predeli Sveta z izredno bogato favno in floro tisti, iz katerih prihaja največje število potencialnih invazivk. Tako je zaznava prvih populacij neke tujerodne vrste in prepoznavanje njihove potencialne invazivnosti izredno zahtevna naloga.

Primerjali smo pet različnih "citizens' science" projektov, ki so bili izpeljani v Sloveniji v zadnjem desetletju, pozorni smo bili predvsem na njihovo učinkovitost za zgodnje zaznavanje potencialnih ITV. Glavni cilji teh petih projektiv so bili precej različni, a vsi so se ukvarjali s problematiko ITV. Tudi ciljne skupine javnosti so bile pri projektih različne od popolnoma laičnih posameznikov, ki se s tematiko ITV niso nikoli ukvarjali, do strokovnjakov, ki so se v preteklosti vsaj delno posvečali tudi ITV (npr. študenti biologije, gozdarji ...). Čeprav je imel le eden od primerjanih projektov (LIFE ARTEMIS) zgodnje zaznavanje ITV med svojimi glavnimi temami, so bili tudi med rezultati ostalih projektov vsaj posamezni, ki so predstavljali prve zaznave pojavljanja neke potencialno invazivne tujerodne vrste v Sloveniji ali vsaj njenem delu.

Primerjali in ovrednotili smo pristope teh projektov glede zgodnje zaznave potencialnih ITV, da bi na podlagi prepoznanih prednosti in slabosti pristopov v bodoče lažje usmerjali podobne projekte ter dosegli njihovo večjo učinkovitost.

**Ključne besede:** ljubiteljska znanost, zgodnja zaznava ITV, gozdne invazivne tujerodne vrste, ocena učinkovitosti

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## Project APPLAUSE – from harmful to useful with citizens' led activities

### Projekt APPLAUSE – od škodljivih do uporabnih tujerodnih rastlin z aktivnim vključevanjem prebivalcev

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The project APPLAUSE addresses unsolved questions with regard to invasive alien plant species (IAPS) in terms of the zero-waste approach and circular economy. Ljubljana, as a »zero waste city«, recognizes the potential of setting up a systematic participatory model which uses IAPS biomass to develop new sustainable products. A new perspective is being introduced, presenting IAPS as a locally accessible and abundant resource and opportunity for a new business model. Instead of incinerating, new useful products are designed and produced, enabling new green jobs and cross-sectoral cooperation. We are introducing new green technologies in all aspects of IAPS treatment (e.g. pilot enzymatic processing of IAPS fibres instead of chemical) and circular economy principles in development of new products (e.g. re-use). Information and communication technology is used to address target groups and to produce open data, new knowledge and develop new services like IAPS monitoring with data from Sentinel-2 satellites. The waste of biomass pre-processing is used for transformation into useful chemicals for industry (e.g. vanilla, which is an intermediate in the production of pharmaceuticals, cosmetics and other fine chemicals) and various 3D composites (e.g. plates, cutlery ...). The citizens are strongly supporting the activities, linking the results with the higher quality of the living environment. New products are strong ambassadors, drawing peoples' attention to the IAPS issues and solutions. New ideas are arising, which makes the project an on-going process.

The APPLAUSE project is co-financed by the European Regional Development Fund through the Urban Innovative Actions (UIA) initiative.

**Keywords:** invasive alien plants, citizens, circular economy, processing biomass

S projektom APPLAUSE obravnavamo nerešena vprašanja v zvezi z invazivnimi tujerodnimi rastlinskimi vrstami (ITRV) z vidika pristopa nič odpadkov in krožnega gospodarstva. Ljubljana je kot "mesto brez odpadkov" prepoznala potencial vzpostavitve sistematičnega participativnega modela, ki uporablja biomaso ITRV za razvoj novih trajnostnih izdelkov. ITRV so bogat, lokalno dostopen vir, ki ponuja priložnost za vzpostavitev novega poslovnega modela. Namesto sežiga biomase predelamo v nove uporabne izdelke, kar odpira nova zelena delovna mesta in omogoča medsektorsko sodelovanje. V projektu uvajamo tudi nove zelene tehnologije (npr. pilotna encimska obdelava vlaken ITRV namesto kemične obdelave) in načela krožnega gospodarstva pri razvoju novih izdelkov (npr. ponovna uporaba). Za vključevanje ciljnih skupin, pripravo odprtih podatkov, novega znanja in razvoja novih storitev, v projektu uporabljamo sodobno komunikacijsko in informacijsko tehnologijo, kot je spremljanje razširjenosti ITRV z analizo podatkov satelitov Sentinel-2. Odpadke v procesu predobdelave biomase uporabljamo za preoblikovanje v uporabne kemikalije za industrijo (npr. vanilin, ki je vmesni izdelek pri proizvodnji zdravil, kozmetike in drugih drobnih kemikalij) in različne 3D kompozite (npr. krožnike, jedilni pribor ...). V projekt so močno vpeti tudi meščanke in meščani, ki rezultate projekta povezujejo z višjo kakovostjo svojega bivalnega okolja. Novi trajnostni izdelki učinkovito opozarjajo na problematiko ITRV. Tekom izvajanja projekta se porajajo nove ideje, ki so dober popotnik za izvajanje dejavnosti tudi po zaključku projekta.

Projekt APPLAUSE sofinancira Evropski sklad za regionalni razvoj preko pobude Urban Innovative Actions (UIA).

**Ključne besede:** invazivne tujerodne rastlinske vrste, meščani, krožno gospodarstvo, predelava biomase

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## Turning theory into practice – invasive alien species themed workshops for field professionals and forest owners within the LIFE ARTEMIS project

### Iz teorije v prakso: usposabljanja o invazivnih tujerodnih vrstah v gozdovih za strokovnjake in lastnike gozdov v okviru projekta LIFE ARTEMIS

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The discoveries of the scientific community often face difficulties when attempting to implement them in practice. Therefore, the communication and dissemination of the project's results to forestry professionals and forest owners is an activity, crucial to the successful recognition and implementation of outputs of the LIFE ARTEMIS project.

The awareness, activation and participation of professional institutions in Slovenian forestry and forest owners are an indispensable step to addressing the issue of invasive alien species (IAS) in Slovenian forests.

Within the LIFE ARTEMIS project, 33 early warning and rapid response workshops have been organised in order to reach communication goals – raise awareness, answer the question: "How to respond if I spot an IAS?" and create an operational base for addressing the problem of IAS in the future. The "train the trainers" method was used – draft presentations, prepared by the LIFE ARTEMIS project team, were then adapted and presented by the heads of silviculture and forest protection of 14 regional units of the Slovenia Forest Service in cooperation with project experts from the Slovenian Forestry Institute. The combination of the scientific and practical knowledge ensured that the presentations were relevant and understandable to stakeholders.

In total, over 1000 participants took part in 33 events of the LIFE ARTEMIS Action B.2, exceeding the project targets. Today, the issue of alien invasive species in forests is part of the professional and the societal debate in Slovenia. Furthermore, most forestry experts are trained to respond in the case of recognising an IAS.

**Keywords:** invasive alien species, communication, dissemination

Prenos znanstvenih izsledkov iz teorije v prakso je pogosto eden izmed najzahtevnejših korakov izvedbe projekta. Ozaveščanje, aktivacija in participacija lastnikov gozdov in strokovnjakov, ki delujejo v slovenskem gozdnem prostoru, so ključni koraki pri reševanju problematike invazivnih tujerodnih vrst (ITV) v slovenskih gozdovih, zato so bile komunikacijske in diseminacijske aktivnosti projektnih rezultatov pomemben del projekta LIFE ARTEMIS.

V okviru projekta LIFE ARTEMIS je bilo organiziranih 33 usposabljanj za zgodnje odkrivanje in hitro odzivanje (ZOHO) ITV. Cilji usposabljanj so bili: ozaveščanje o problematiki ITV, izobraževanje o ravnanju v primeru odkritja ITV v gozdu in gradnja kapacitet za soočanje s problematiko ITV v gozdovih. Usposabljanja so bila izvedena z metodo "usposobi izvajalce usposabljanj". Osnutke predstavitev, ki so jih pripravili člani ožje projektne skupine LIFE ARTEMIS, so v sodelovanju s strokovnjaki Gozdarskega inštituta Slovenije prilagodili Vodje odsekov za gojenje in varstvo ZGS in izvedli usposabljanja v 14 Območnih enotah Zavoda za gozdove Slovenije (ZGS). Kombinacija znanstvenih in praktičnih znanj je zagotovila relevantnost in razumljivost za udeležence.

Skupno se je usposabljanj v okviru akcije LIFE ARTEMIS B.2 udeležilo preko 1000 udeležencev na 33 dogodkih, projektni cilji so bili preseženi. Večina strokovnjakov, ki delujejo v slovenskem gozdnem prostoru, je usposobljenih za odziv na odkritje ITV v gozdu. Danes je problematika ITV v gozdovih del strokovnih in javnih razprav v Sloveniji, za kar gre zasluga tudi projektnim aktivnostim.

**Ključne besede:** invazivne tujerodne vrste, komunikacije, diseminacija

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## WORKSHOP 1

### **The ethics of citizen science for IAS early detection**

#### **Etika ljubiteljske znanosti pri zgodnji zaznavi ITV**

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Citizen science is a really useful approach for IAS early detection, because it means that we can call upon a large crowd of 'detectors' right across a region to be on the look out for IAS. Of course, this requires that we should think about equipping people with the right training and tools (e.g. smartphone apps), but what is rarely considered is the ethical dimension of citizen science for IAS. As an ecologist, I haven't been trained in ethics, but I'm increasingly thinking that it is important. Especially for forestry and tree IAS, there could be substantial negative impacts from action following the citizen's report. This could include negative consequences of precautionary management actions on people's recreation, livelihoods and income. In this workshop we will explore some of the ethical challenges of citizen science, whether we should be concerned, who has responsibility and how we can take this into account in our citizen science projects.

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## WORKSHOP 2

### Challenges and solutions in early warning systems of potential invasive alien species in forests

#### Izzivi in rešitve pri sistemih zgodnjega obveščanja o potencialnih invazivnih tujerodnih vrstah v gozdu

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Invasive alien species have strong impacts on forests and other ecosystems. Early warning systems are the most effective management tool in dealing with IAS, because alien populations in the early stages of arrival are confined and small enough to eradicate. In Europe early warning systems are set and operational for some of the invasive alien species. However, practice showed that they could be made more effective. Moreover, such systems should still be developed for many harmful organisms. In this workshop we will 1) identify the main problems regarding the early detection and the early warning system as a whole for different forest organisms and 2) discuss about possible solutions for the identified problems.



**SECTION 3**  
**EARLY DETECTION OF FOREST**  
**INVASIVE ALIEN SPECIES**

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## Detection of potential pests and diseases of woody plants before their arrival in importing countries

### Odkrivanje potencialnih škodljivih organizmov in bolezni lesnatih rastlin pred prihodom v države uvoznice

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Prevention of alien pest introductions is more cost-effective than eradication or control of established alien species. Knowledge of the identity and potential impacts caused by alien pests and diseases is essential for the development and international acceptance of pre-border pest management measures and regulation. However, the organisms associated with trees in exporting countries and the damage such organisms may do to trees in importing countries are insufficiently known. Identification of pests and diseases before they arrive and establish is therefore urgently needed. This presentation will mainly be about sentinel plants as an early warning system for detection of pests. I will illustrate the effectiveness of sentinel plants for identifying pest-host associations in exporting countries and the potential for damage to plants in importing countries. Factors influencing the diversity of pests associated with a single tree species will be reviewed and I will discuss where sentinel plants should be located and when samples should be taken.

**Keywords:** sentinel plants, early warning, international trade, risk analysis, pests and pathogens

Preprečevanje vnosa tujerodnih škodljivih organizmov je stroškovno učinkovitejše kot izkoreninjenje ali nadziranje naseljenih tujerodnih vrst. Prepoznavanje tujerodnih škodljivih organizmov in njihovih potencialnih vplivov in bolezni, ki jih povzročajo, je ključno za razvoj in mednarodno sprejetje ukrepov in predpisov na področju zatiranja škodljivcev še pred mejo. Vendar organizmi, povezani z drevesi v državah izvoznih, in škoda, ki jo lahko taki organizmi povzročijo na drevesih v državah uvoznih, niso dovolj znani. Zato je nujno prepoznavanje škodljivih organizmov in bolezni, preden prispejo na neko območje in se naselijo. Ta predstavitev se osredotoča na privabljalne rastline kot sistem zgodnjega opozarjanja za odkrivanje škodljivih organizmov. Ponazoril bom učinkovitost privabljalnih rastlin za prepoznavanje povezav škodljivih organizmov in gostiteljev v državah izvoznih in potencialne škode za rastline v državah uvoznih. Pregledal bom dejavnike, ki vplivajo na raznolikost škodljivih organizmov, povezanih s samo eno drevesno vrsto, in obravnaval priporočeno lokacijo privabljalnih rastlin in priporočeni čas odvzema vzorcev.

**Ključne besede:** privabljalne rastline, zgodnje zaznavanje, mednarodna trgovina, analiza tveganj, škodljivi organizmi in patogeni

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## New multiplex Loop mediated isothermal amplification (LAMP) based assays to early detect *Dothistroma pini*, *Dothistroma septosporum* and *Lecanosticta acicola* on pine needles

### Nov multipleksni test na podlagi z zanko posredovanega izotermalnega pomnoževanja (LAMP) za zgodnje odkrivanje gliv *Dothistroma pini*, *Dothistroma septosporum* in *Lecanosticta acicola* na borovih iglicah

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Needle blights are among the most serious needle fungal diseases affecting pine species. Among the different causal agents, *Dothistroma pini*, *D. septosporum* and *Lecanosticta acicola* have been reported in many countries and are of particular concern, especially where they have been introduced. Because management strategies might vary depending on the specific pathogen, a fast and accurate diagnosis is crucial. Due to the similarity of their morphology and symptoms they are hard to distinguish one from the other. Hence DNA-based detection is preferred. Current PCR-based assays available for their DNA detection and quantification require well-equipped laboratories and are time consuming. The possibility to screen for such pathogens directly in the field represents an advancement in technology that could significantly expedite a rapid response to the threat. The objective of this study was, therefore, to develop and validate a real-time monitoring loop mediated isothermal amplification (LAMP) assay for targeting in multiplex any combinations of two of the three pathogens at the same time using a portable LAMP device. LAMP primers and fluorescent assimilating probes were designed to target the beta tubulin ( $\beta$ -tub2) and elongation factor (EF-1 $\alpha$ ) regions for the two *Dothistroma* species, and *L. acicola*, respectively. Each reaction was able to recognize each pathogen with high specificity and sensitivity when tested directly on infected pine needles. The simplicity, sensitivity, specificity, and minimum required equipment make this LAMP assay ideal for in field routine plant tissue testing, and could have great implications for the management of *D. septosporum*, *D. pini* and *L. acicola*.

**Keywords:** alien species, early detection, fungi, point-of-care diagnosis, pine diseases

Rdeča pegavost in rjavenje borovih iglic sta med najresnejšimi glivičnimi boleznimi iglic, ki prizadenejo vrste bora. Med različnimi povzročitelji so v številnih državah poročali o glivah *Dothistroma pini*, *D. septosporum* in *Lecanosticta acicola*, ki vzbujajo posebno skrb, zlasti tam, kjer so bile vnesene. Ker so lahko strategije ravnanja odvisne od specifičnega patogena, je ključna hitra in točna diagnoza. Zaradi podobne morfologije in simptomov jih je težko razločevati med seboj. Zato ima prednost odkrivanje patogenov na podlagi DNA. Sedanji testi na podlagi PCR, ki so na voljo za odkrivanje in kvantifikacijo njihove DNA, so zamudne in zanje so potrebni dobro opremljeni laboratoriji. Možnost presejanja za te patogene neposredno na terenu je napredek v tehnologiji, ki bi lahko pomembno pospešil odziv na grožnjo. Cilj te študije je bil zato razviti in potrditi test z zanko posredovanega izotermalnega pomnoževanja (LAMP) v realnem času, usmerjen na multipleks katerih koli sočasnih kombinacij dveh od treh patogenov z uporabo prenosnega pripomočka LAMP. Začetniki in fluorescentna veriga prilagojevalne sonde LAMP so pri obeh vrstah *Dothistroma* usmerjeni na beta-tubulin ( $\beta$ -tub2), pri vrsti *L. acicola* pa na elongacijski faktor (EF-1 $\alpha$ ). Pri vsaki reakciji je bilo mogoče pri testiranju neposredno na okuženih borovih iglicah z veliko specifičnostjo in občutljivostjo prepoznati posamezni patogen. Zaradi preprostosti, občutljivosti, specifičnosti in minimalne potrebne opreme je ta test LAMP idealen za rutinsko testiranje rastlinskega tkiva na terenu in bi lahko pomembno vplival na ukrepanje v primeru prisotnosti gliv *D. septosporum*, *D. pini* in *L. acicola*.

**Ključne besede:** tujerodne vrste, zgodnje odkrivanje, glive, diagnoza na mestu oskrbe, bolezni na borih

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# Development of a system for awareness, early detection and notification of organisms harmful to plants in Belgium and beyond

## Razvoj sistema za ozaveščanje, zgodnje odkrivanje in obveščanje o organizmih, škodljivih za rastline v Belgiji in drugje

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From 14/12/2019, Regulation (EU) 2031/2016 will enter into force, which will fundamentally reform the plant health policy. This Regulation introduces a proactive approach to prevent the introduction and spread of harmful organisms. The emphasis is more than ever on prevention, which means rapid detection before establishment. When a harmful organism is introduced, control is a lengthy and costly process, especially when more time elapses between the introduction and establishment of a new harmful organism and the moment of its detection. By investing in preventive measures, high control costs and yield losses can be avoided. Rapid detection before the organism establishes can only be achieved by a continuous "surveillance" of the territory.

During this Belgian government-funded project, we aim to create a well-developed, user-friendly and widely known web platform for awareness-raising, rapid detection and reporting of a number of organisms harmful to plants that currently pose a major threat, due to their high risk of introduction and establishment in a number of important crops, forests and public green spaces in Belgium and other EU-countries. This web platform should not only be there for professional purposes (government, researchers, growers, foresters, ...), but also targets to inform nature lovers and all people who may come into contact with invasive exotic species in their region, of the chances and risks of the occurrence of these organisms, without scaremongering. Moreover, it is necessary to ensure a smooth and clear reporting of findings, supported by a system of validation by experts in the event that a potential quarantine organism is reported.

**Keywords:** quarantine pests, awareness and monitoring platform, early detection, citizen science

14. decembra 2019 bo začela veljati Uredba (EU) 2031/2016, ki bo temeljito reformirala politiko zdravstvenega varstva rastlin. Ta uredba uvaja proaktiven pristop za preprečevanje vnosa in širjenja škodljivih organizmov. Bolj kot kdaj koli prej je poudarek na preprečevanju, kar pomeni hitro odkritje, preden se organizem naseli. Po tem ko je škodljivi organizem vnesen, je postopek nadzora dolgotrajen in zelo drag, zlasti če med vnosom in naselitvijo novega škodljivega organizma ter trenutkom njegovega odkritja mine več časa. Z vlaganjem v preventivne ukrepe je mogoče preprečiti visoke stroške nadzora in izgube pridelka. Hitro odkritje pred naselitvijo organizma je mogoče samo s stalnim nadzorovanjem ozemlja.

V okviru tega projekta, ki ga financira belgijska vlaga, želimo vzpostaviti dobro razvito, uporabniku prijazno in splošno znano spletno platformo za ozaveščanje, hitro odkrivanje in poročanje o več organizmih, škodljivih za rastline, ki so trenutno najbolj nevarni zaradi velike možnosti vnosa in naselitve na več pomembnih kulturah, v gozdovih in na javnih zelenih površinah v Belgiji in drugih državah EU. Spletna platforma ne bo namenjena samo strokovnjakom (vladi, raziskovalcem, gojiteljem, gozdarjem ...), temveč tudi obveščanju ljubiteljev narave in vseh drugih, ki bi lahko v svoji regiji prišli v stik z invazivnimi tujerodnimi vrstami, o možnostih in tveganjih navzočnosti teh organizmov, ne da bi za to vzbujali paniko. Poleg tega je treba zagotoviti nemoteno in jasno poročanje o ugotovitvah, ki bo v primeru poročanja o potencialnem karantenskem škodljivem organizmu podprto s sistemom potrjevanja, ki ga bodo izvajali strokovnjaki.

**Ključne besede:** karantenski škodljivi organizmi, platforma za ozaveščanje in spremljanje, zgodnje odkrivanje, ljubiteljska znanost

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## Canada's forest pest surveillance program

### Kanadski program nadzora gozdu škodljivih organizmov

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The Canadian Food Inspection Agency's (CFIA) national plant health survey program provides information in support of import, export, and domestic regulatory programs and is the basis for sound regulatory decisions.

Pest surveys are required to maintain claims of "pest-free" status of an area, to detect new populations of quarantine pests, and to delimit populations of quarantine pests with limited distributions in Canada. Pest surveys are also an integral part of control and eradication programs. The CFIA uses various survey methods to detect priority invasive forest pests including emerald ash borer, Asian longhorned beetle, oak wilt, and hemlock woolly adelgid in addition to broad-spectrum pathway based surveys designed to target other wood boring pests. Collaborative research, public outreach and education are key elements of the CFIA's annual regulatory survey program.

**Keywords:** forest pests, early detection, research, public education and outreach

Nacionalni program sistematičnih raziskav na področju zdravstvenega varstva rastlin Kanadske agencije za nadzor hrane (CFIA) zagotavlja informacije v podporo uvozu, izvozu in domačim regulativnim programom in je temelj za dobre regulativne odločitve.

Sistematične raziskave škodljivih organizmov so potrebne, da se izpolnijo zahteve glede odsotnosti škodljivcev na nekem območju, odkrijejo nove populacije karantenskih škodljivih organizmov in razmejijo populacije karantenskih škodljivih organizmov, ki so v Kanadi že delno razširjeni. Sistematične raziskave škodljivih organizmov so tudi sestavni del programov nadzora in izkoreninjenja. Kanadska agencija za nadzor hrane uporablja različne metode sistematičnih raziskav za odkrivanje prednostnih invazivnih in gozdu škodljivih organizmov, vključno z jesenovim krasnikom, azijskim kozličkom, hrastovo uvelostjo in čugovo volnato ušjo, ter sistematične raziskave širokega spektra na podlagi poti vnosa škodljivih organizmov, usmerjene v druge lesne škodljivce. Skupne raziskave ter obveščanje in izobraževanje javnosti so ključni elementi letnega regulativnega programa sistematičnih raziskav Kanadske agencije za nadzor hrane.

**Ključne besede:** gozdu škodljivi organizmi, zgodnje odkrivanje, raziskave, izobraževanje in obveščanje javnosti

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## Using a multi-lure approach for trapping Cerambycidae in high risk areas for the introduction of bark and wood boring pests in Austria

### Uporaba pristopa z več vabami za lov kozličkov s pastmi na območjih z visokim tveganjem za vnos lesnih škodljivcev v Avstriji

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A multi lure approach for trapping a wide variety of Cerambycidae was tested at the Port of Vienna in 2017 and 2018, a high risk area for the introduction of invasive tree pests transported in wood packaging material (part of the EUPHRESCO research project "Multi-lure and multi-trap surveillance for invasive tree pests"). Traps were deployed on the site of the port and in an adjacent broadleaved forest. A second experiment was set up in a pine forest in eastern Austria not influenced by wood imports. Blends of cerambycid pheromone compounds were tested: Blend 1 with attractants for various Lamiinae, Blend 2 with attractants for various Cerambycinae and Prioninae, Blend 3 combined all volatiles. Additionally, ethanol and alpha pinene were added as general attractants.

A total of 31 cerambycid species was detected with the traps in 2017; 36 species were detected in 2018. Species composition differed between sites depending on the habitat. Subfamilies showed preferences according to the composition of the lures: Lamiinae and Spondylidinae preferred Blend 1, Cerambycinae and *Prionus coriarius* Blend 2. The complete mix in Blend 3 was attractive for all groups; the number of species was slightly increased. The addition of ethanol and alpha pinene increased the number of caught specimens but not the number of species. Overall, we caught 28 cerymbicid species at the Port of Vienna. This figure represents more than 50 % of the cerambycid fauna of this part of Vienna. No non-native cerambycid was detected in the two years.

**Keywords:** trapping, generic lures, Cerambycidae, surveillance, ports of entry

Pristop z več vabami za lov raznovrstnih kozličkov s pastmi je bil v letih 2017 in 2018 preizkušen v dunajskem pristanišču, ki je območje z visokim tveganjem za vnos invazivnih škodljivih organizmov za drevesa, ki se prevažajo v lesenem pakirnem materialu (del raziskovalnega projekta EUPHRESCO z naslovom Nadzorovanje invazivnih škodljivih organizmov za drevesa z več vabami in več pastmi). Pasti so bile nameščene v pristanišču in bližnjem listnatem gozdu. Drugi poskus je bil izveden v borovem gozdu v vzhodni Avstriji, ki ni pod vplivom uvoza lesa. Preizkušene so bile mešanice feromonov za privabljanje kozličkov: prva mešanica z atraktantom za različne predstavnike poddružine Lamiinae, druga mešanica z atraktanti za različne predstavnike poddružin Cerambycinae in Prioninae in tretja mešanica, ki je vsebovala vse hlapne snovi. Poleg tega sta bila kot splošna atraktanta dodana etanol in alfa pinen.

Leta 2017 je bilo s pastmi ulovljenih skupno 31 vrst kozličkov, leta 2018 pa 36 vrst. Vrstna sestava se je med lokacijami razlikovala glede na habitat. Pri poddružinah se je pokazala naslednja naklonjenost do sestave vab: za poddružini Lamiinae in Spondylidinae je bila privlačnejša prva mešanica, za poddružino Cerambycinae in vrsto *Prionus coriarius* pa druga mešanica. Mešanica vseh hlapnih snovi v tretji mešanici je bila privlačna za vse skupine, število vrst je bilo nekoliko večje. Z dodatkom etanola in alfa pinena se je povečalo število ujetih osebkov, število vrst pa se ni povečalo. V dunajskem pristanišču smo skupno ujeli 28 vrst kozličkov. To število pomeni več kot 50 % favne kozličkov v tem predelu Dunaja. V teh dveh letih tujerodni kozlički niso bili ulovljeni.

**Ključne besede:** lov s pastmi, generične vabe, Cerambycidae, nadzorovanje, vstopna pristanišča



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# Detection dogs for the surveillance of invasive bark and wood boring insects

## Psi za odkrivanje in nadzorovanje invazivnih ksilofagnih žuželk

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Surveillance is a key element in management of invasive alien pests, especially of wood boring insects like the Asian longhorn beetle (ALB) *Anoplophora glabripennis* and the citrus longhorn beetle (CLB) *Anoplophora chinensis* or Buprestidae like the emerald ash borer (EAB) *Agrilus planipennis*. Visual detection of infestation of wood boring insects is particularly challenging because external symptoms can be extremely slight, may be hidden or removed due to environmental influences.

Dogs have been trained at the Austrian Research Centre for Forests (BFW) and employed for the detection of both Asian longhorn beetles since 2009 in several European countries at import controls and in outbreak areas. The method was evaluated in two test series with a median sensitivity and specificity of 80–100 %. It is included as supplementing detection method in the German guidelines for *A. glabripennis* control as well as in the EPPO standards PM9/15 and PM9/16 of procedures for official control of *A. glabripennis* respectively *A. chinensis*.

Initial training of dogs on *Agrilus planipennis* started in November 2017 at the BFW. Scent material consists of living larvae, bark and wood pieces with galleries, saw dust and frass of EAB. Training the dogs involved inspection of firewood and wood logs as typical pathways for introduction of EAB as well as young ash trees in forestry nurseries and old ash trees in urban areas. The sensitivity of the method towards EAB was tentatively quantified reaching promising results with a sensitivity of 83–100 % and a specificity of 89–100 %.

**Keywords:** *Anoplophora* species, *Agrilus planipennis*, detection dogs, sensitivity, specificity

Nadzorovanje je ključni element upravljanja invazivnih tujerodnih škodljivih organizmov, zlasti ksilofagnih žuželk, kot sta azijski kozliček (*Anoplophora glabripennis*) in kitajski kozliček (*Anoplophora chinensis*), in krasnikov, kot je jesenov krasnik (*Agrilus planipennis*). Vizualno odkrivanje napadenosti s ksilofagnimi žuželkami je še posebej zahtevno, ker so lahko zunanji simptomi komaj vidni, skriti ali se lahko odstranijo zaradi okoljskih vplivov.

Psi, ki jih dresirajo v Avstrijskem raziskovalnem centru za gozdove (BFW), se od leta 2009 uporabljajo za odkrivanje azijskih kozličkov v več evropskih državah pri uvoznem nadzoru in na območjih izbruha. Metoda je bila ocenjena v dveh poskusnih serijah s srednjo občutljivostjo in specifičnostjo 80–100 %. Kot dopolnilna metoda odkrivanja je vključena v nemške smernice za nadzor nad vrsto *A. glabripennis* in standarda EPPO PM9/15 in PM9/16 za postopke uradnega nadzora nad vrstama *A. glabripennis* oziroma *A. chinensis*.

Prva dresura psov za odkrivanje vrste *Agrilus planipennis* se je začela novembra 2017 v centru BFW. Material za prepoznavanje vonja vsebuje žive ličinke, dele skorje in lesa z rovi in črvino jesenovega krasnika. Dresura psov je vključevala pregled drv in hlodov kot značilnih poti vnosa jesenovega krasnika, mladih jesenov v gozdnih drevesnicah in starih jesenov na urbanih območjih. Občutljivost metode pri jesenovem krasniku je bila okvirno kvantificirana in je dosegla obetavne rezultate z občutljivostjo 83–100 % in specifičnostjo 89–100 %.

**Ključne besede:** vrste *Anoplophora*, *Agrilus planipennis*, psi za odkrivanje, občutljivost, specifičnost

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## Examination of the presence and distribution of pest in the context of the survey programme

### Preučevanje navzočnosti in razširjenosti škodljivih organizmov z vidika programov preiskav

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Prevention and early detection of the presence of pests, determined in the new EU plant health regulating, is extremely important for timely and effective eradication. Member States shall, from December 2019, carry out risk-based surveys over specific periods for more than 400 quarantine pest and some other regulated pest, which represent a risk to the EU territory. Early detection of pest is of key importance for effective eradication and shall reduce the number and extent of outbreaks constituting a significant risk to plant health. The results of pest surveillance also provide the basis for pest categorization/pest listing, pest status determination, and the data obtained by survey are used in Pest Risk Analyses (PRA). Dissemination of information of findings and outbreaks of pests to the public is new and very important approach, combined with supported EUROPHYT application, also used for awareness raising. Slovenia has implemented the survey programs for more than 16 years. The data obtained from multiannual survey programmes can also be used in the case of emergency measures, because the stage of invasion could be followed. Archive data within the survey are available by the geographical informational system "Fitosanitarni prostorski portal Slovenije" to the public. In this presentation, the results of surveys in Slovenia for the last 5 years are presented.

**Keywords:** plant health, survey, early detection, GIS, awareness raising

Preprečevanje in zgodnje odkrivanje navzočnosti škodljivih organizmov, ki so določeni v novi evropski uredbi o zdravju rastlin, je izrednega pomena za njihovo pravočasno in učinkovito izkoreninjanje. Države članice EU morajo od decembra 2019 v določenih časovnih obdobjih izvajati preglede, ki temeljijo na osnovi tveganja, za več kot 400 karantenskih škodljivih organizmov in drugih reguliranih škodljivih organizmov. Zgodnje odkritje škodljivih organizmov so ključnega pomena za učinkovito izkoreninjenje in za zmanjšanje števila in obsega izbruhov, ki predstavljajo veliko tveganje za zdravje rastlin. Rezultati pregledov so osnova za kategorizacijo/ uvrščanje na sezname, določanje statusa škodljivcev, pridobljeni podatki pa se uporabijo tudi pri pripravi analiz tveganja za škodljive organizme (PRA). Podajanje informacij o najdbah in izbruhih škodljivih organizmov javnosti v kombinaciji z EUROPHYT aplikacijo je nov in pomemben pristop za ozaveščanje javnosti. Slovenija izvaja programe preiskav že 16 let. Podatki, pridobljeni iz večletnih programov preiskav se lahko uporabijo v primeru nujnih ukrepov, ker z njimi lahko določimo stopnjo škodljivosti. Podatki o preiskavah so javnosti dostopni na Fitosanitarnem prostorskem portalu Slovenije. V tej predstavitvi so prikazani podatki o preiskavah za zadnjih 5 let za Slovenijo.

**Ključne besede:** zdravje rastlin, preiskava, zgodnje odkrivanje, GIS, ozaveščanje javnosti

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## Plant health survey in Europe: background, current situation and next challenges

### Sistematične raziskave na področju zdravstvenega varstva rastlin v Evropi: ozadje, trenutni položaj in prihodnji izzivi

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In the last decades several alien species of insects, especially bark- and wood-boring beetles (Coleoptera), have largely expanded the range of their native biogeographic regions invading new continents and countries. The introduction of non-native wood-boring beetles can cause severe damage in forest ecosystems and understanding the long-range pathways of arrival and the environmental drivers affecting their invasion at the local scale is of utmost importance to enhancing management strategies. In this paper we explore background, current situation and next challenges associated to plant health survey in Europe to contrast biological invasions. Richness and abundance of alien species found in new countries were most strongly associated with the amount of commodities arriving annually in the international ports and airports, and with surface and composition of the forests growing in the landscape surrounding the point-of entry. The simultaneous use of traps in ports with large volume of imported commodities and in their surrounding broadleaf forests can strongly increase the probability of alien wood-boring beetle interceptions. The prompt identification of sites where the arrival and establishment of alien species is more probable, combined with an efficient trapping protocol, can substantially improve the efficacy of early detection. Similar approaches may be used in many countries as early-warning systems to implement timely measures to eradicate or contain alien invasions at the European scale. Possible protocols and tools allowing more efficient and cheap monitoring systems are also suggested to reduce the risk of new biological invasions.

**Keywords:** biological invasions, alien species, monitoring, interceptions

V zadnjih desetletjih se je več tujerodnih vrst žuželk, zlasti podlubnikov in drugih ksilofagnih hroščev (Coleoptera), razširilo na precej večjem območju svoje biogeografske regije, kjer so avtohtone, in prehajajo na nove celine in v nove države. Vnos tujerodnih ksilofagnih hroščev lahko povzroči veliko škodo v gozdnih ekosistemih, zato je razumevanje dolgih poti vnosa, po katerih prispejo, in okoljskih dejavnikov, ki vplivajo na njihov vnos na lokalni ravni, izjemno pomembno za izboljševanje strategij upravljanja. V tem članku raziskujemo ozadje, trenutni položaj in prihodnje izzive, povezane s sistematičnimi raziskavami na področju zdravstvenega varstva rastlin v Evropi, s katerimi se odzivamo na vnose tujerodnih organizmov. Raznovrstnost in številčnost tujerodnih vrst, najdenih v novih državah, sta bili zelo močno povezani s količino blaga, ki je letno prispelo v mednarodna pristanišča in na mednarodna letališča, ter s površino in sestavo gozdov v pokrajini, ki obdaja točko vstopa. Sočasna uporaba pasti v pristaniščih z velikimi količinami uvoženega blaga in okoliških listnatih gozdovih lahko močno poveča verjetnost prestrežb tujerodnih ksilofagnih hroščev. Takojšnja opredelitev lokacij, na katerih sta prihod in naselitev tujerodnih vrst verjetnejša, v kombinaciji z učinkovitim protokolom za lov s pastmi lahko precej izboljša učinkovitost zgodnjega odkrivanja. Podobne pristope je mogoče v številnih državah uporabiti kot sistem zgodnjega opozarjanja za izvajanje pravočasnih ukrepov za izkoreninjenje ali omejevanje vnosov tujerodnih vrst na evropski ravni. Predlagajo se tudi morebitni protokoli in orodja, ki omogočajo učinkovitejše in cenejše sisteme spremljanja, da se zmanjša tveganje novih vnosov tujerodnih organizmov.

**Ključne besede:** vnosi tujerodnih organizmov, tujerodne vrste, spremljanje, prestrežbe

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## Methods for improving early detection of exotic wood boring beetles

### Metode za izboljšanje zgodnjega odkrivanja tujerodnih ksilofagnih hroščev

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Traps baited with pheromones and host volatiles are commonly used to monitor urban forests near ports and industrial parks for early detection of non-native bark- and wood boring insects inadvertently introduced from wood used to pack goods traded globally. To date, most surveys have used black (intercept-panel or multi-funnel) traps placed about 1.5 m above the ground. We present data from trapping experiments performed in North America, Europe, and China that consistently demonstrate that the efficacy of detecting both native and exotic species of bark- and wood boring beetles (Cerambycidae, Buprestidae, Scolytinae) is increased by using more than one trap colour, placing traps in the upper tree canopy as well as the understory, and using more than one type of pheromone/host volatile lure combination. Species richness and abundance of both buprestids and cerambycids were generally greater in canopy traps than understory traps while the opposite was true for Scolytines. Moreover, species composition differed between canopy and understory traps, indicating both strata must be sampled to increase the chances of detecting exotic species that may be present. Setting traps in the canopy is relatively inexpensive and easy to do with a little experience. Placing traps on the edge of forest stands also increases the number of species of target taxa detected and may be especially useful at sites where placing traps in the upper canopy is not feasible. Trap color also significantly affects detection of buprestids and cerambycids in traps. Commercially available "EAB green" funnel traps

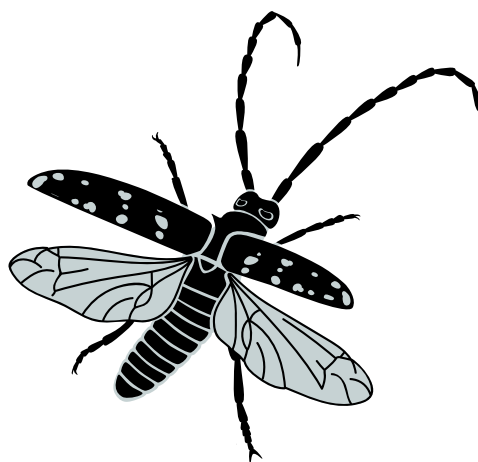
Za zgodnje odkrivanje tujerodnih podlubnikov in drugih ksilofagnih žuželk, ki so bili nenamerno vneseni z lesom, ki se uporablja za pakiranje blaga v svetovni trgovini, se na splošno uporabljajo pasti s feromonskimi vabami in hlapnimi snovmi gostiteljskih rastlin, s katerimi se spremljajo urbani gozdovi v bližini pristanišč in industrijskih con. Do zdaj so se v večini sistematičnih raziskav uporabljale črne (prestrezne ali večlijakaste) pasti, nameščene približno 1,5 m nad tlemi. Predstavljamo podatke iz poskusov z lovom s pastmi v Severni Ameriki, Evropi in na Kitajskem, ki dosledno dokazujejo, da se učinkovitost odkrivanja domorodnih in tujerodnih vrst podlubnikov in drugih ksilofagnih hroščev (Cerambycidae, Buprestidae, Scolytinae) poveča z uporabo pasti več kot ene barve, nameščanjem pasti v zgornji del drevesne krošnje in podrast ter uporabo več kot ene vrste kombinacije feromonov in hlapnih snovi gostiteljskih rastlin za vabo. Vrstna raznovrstnost in številčnost krasnikov in kozličkov sta bili na splošno večji v pasteh v krošnjah kot v pasteh v podrasti, za podlubnike pa je veljalo prav nasprotno. Poleg tega se je med pastmi v krošnjah in pastmi v podrasti razlikovala vrstna sestava, kar kaže, da je treba vzorce jemati v obeh slojih, da se povečajo možnosti za odkrivanje morebitnih tujerodnih vrst. Nameščanje pasti v krošnjo je z nekaj izkušnjami razmeroma poceni in preprosto. Tudi nameščanje pasti na rob gozdnih sestojev poveča število vrst opaženega ciljnega taksona in je lahko posebno koristno na lokacijah, kjer nameščanje pasti v zgornji del krošnje ni izvedljivo. Na odrivanje krasnikov in kozličkov

placed in the upper tree canopy catch far more species and specimens of buprestids, especially *Agrilus* spp., than do black or purple traps in the canopy, or green, black or purple traps in the understory. Multiple component "super lures" generally attract more target taxa than binary or ternary lure combinations but semiochemicals attractive to certain species sometimes interfere with attraction of other species. We show that some multi-lures perform better in traps placed in conifers while others perform better when placed in broadleaf trees. Our take-home message to regulatory agencies is this: to increase the chances of detecting exotic bark- and wood boring beetles, place green traps in the canopy and either black or purple traps in the understory, place some traps on the edge of urban forest stands, and use more than one type of multi-component semiochemical lure.

**Keywords:** exotic wood boring beetles, early detection, trap height, trap colour

s pastmi pomembno vpliva tudi barva pasti. V lijakastih pasteh za jesenove krasnike zelene barve, ki so na voljo na trgu in so nameščene v zgornjem delu drevesne krošnje, se ulovi veliko več vrst in osebkov kozličkov, zlasti *Agrilus* spp., kot v črnih ali vijoličastih pasteh v krošnjah ali zelenih, črnih ali vijoličastih pasteh v podrasti. Večkomponentne super vabe na splošno privlačijo več ciljnih taksonov kot kombinacije z dvema ali tremi vabami, vendar semiokemikalije, privlačne za nekatere vrste, včasih vplivajo na privlačnost za druge vrste. Pojasnjujemo, da so nekatere večkomponentne vabe učinkovitejše v pasteh, nameščenih na iglavcih, druge pa so učinkovitejše, če so nameščene na listavcih. Naše glavno sporočilo regulativnim agencijam je: za povečanje možnosti odkritja tujerodnih podlubnikov in drugih ksilofagnih hroščev namestite v krošnjah zelene pasti, v podrasti pa črne ali vijoličaste pasti, nekaj pasti namestite na rob sestojev urbanega gozda in uporabite več kot eno vrsto večkomponentnih vab s semiokemikalijami.

**Ključne besede:** tujerodni ksilofagni hrošči, zgodnje odkrivanje, višina pasti, barva pasti





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## Species distribution modelling and expansion monitoring of two invasive ambrosia beetles, *Xylosandrus compactus* and *X. crassiusculus*

### Modeliranje razširjenosti vrst in spremljanje širjenja dveh invazivnih ambrozijskih podlubnikov – *Xylosandrus compactus* in *X. crassiusculus*

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Biological invasions, which are constantly increasing worldwide, constitute one of the main threats on biodiversity. In addition, climate change would help species – notably ectotherms – broaden their distribution range. Getting a better understanding of invasive species' biology and invasion history could help us reacting in a more appropriate way to future invasions, if not preventing them. Species distribution modelling (SDM) can be used to predict the suitable areas for invasive species and thus help choosing in which area focus the detection and conservation efforts. As part of the Life Project SAMFIX (2018-2022), we applied SDM to *Xylosandrus crassiusculus* and *X. compactus*, two ambrosia beetles newly arrived in Europe. We performed MaxEnt and Biomod models, and projected these models using both present climate data and future climate scenarios. At the same time, traps equipped to lure those two species have been set in South of France between the Italian border and Toulon in order to monitor their expansion in the Mediterranean basin, and acquire data on their phenology and dynamics. This will allow us to update their distribution and make prediction maps about the suitable areas for both species throughout Europe and thus to know where to reinforce our trapping efforts next years. This should allow us noticing further invasions at earlier stages and help mitigating the effects of their invasion in areas of interest such as National Parks and other protected areas. We will here present our first results.

**Keywords:** invasive species, ambrosia beetle, species distribution modelling, detection, expansion monitoring

Vnosi tujerodnih organizmov, ki so čedalje pogostejši po vsem svetu, so ena od glavnih groženj biotski raznovrstnosti. Poleg tega podnebne spremembe vrstam – zlasti ektotermnim organizmom – pomagajo povečati območje razširjenosti. Boljše razumevanje biologije invazivnih vrst in zgodovine vnosa nam lahko pomaga, da se bomo na prihodnje vnose odzivali ustrezneje, če nam jih že ne bo uspelo preprečiti. Modeliranje razširjenosti vrst je mogoče uporabiti za napovedovanje primernih območij, na katera bi se lahko širile invazivne vrste, in nam zato lahko pomaga pri odločitvi, na katero območje naj se osredotočimo pri odkrivanju invazivnih vrst in prizadevanjih za ohranjanje narave. Kot del projekta Life SAMFIX (2018–2022) smo modeliranje razširjenosti vrst uporabili za vrsti *Xylosandrus crassiusculus* in *X. compactus*, dveh vrst tujerodnih hroščev, ki sta nedavno prispeli v Evropo. Izvedli smo modela MaxEnt in Biomod ter ju projektirali z uporabo sedanjih podatkov o podnebju in prihodnjih podnebnih scenarijev. Hkrati smo pasti z vabami za navedeni vrsti namestili na jugu Francije na območju med italijansko mejo in Toulonom, da bi spremljali njuno širjenje v sredozemskem bazenu ter pridobili podatke o njuni fenologiji in dinamiki. To nam bo omogočalo posodobitev podatkov o njuni razširjenosti in izdelavo napovednih zemljevidov s primernimi območji po vsej Evropi, na katera bi se lahko širili obe vrsti, in nam dalo informacije, kje je treba v naslednjih letih okrepiti lov s pastmi. Tako bomo lahko prej opazili nadaljnje vnose in ublažili njihove vplive na interesnih območjih, kot so narodni parki in druga zavarovana območja. Predstavili bomo prve rezultate.

**Ključne besede:** invazivne vrste, ambrozijski podlubnik, modeliranje razširjenosti vrst, odkrivanje, spremljanje širjenja



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## Detecting primary ranges of invasive forest pests using historical herbaria

### Odkrivanje primarnih območij razširjenosti invazivnih gozdu škodljivih organizmov z uporabo zgodovinskih herbarijev

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Historic herbarium collections represent invaluable sources of data for studying invasions in herbivorous pests. Larvae of endophagous insects can be found on the leaves pressed centuries ago. Investigating herbarium specimens potentially helps define past distributions, makes feasible detection of the region of origin of invasive species and helps constrain the timing of their appearance in new locations. Advanced DNA barcoding techniques, i.e. next generation sequencing, open up new perspectives to recover degraded DNA of archival specimens.

Here we focus on the invasive lime leafminer, *Phyllonorycter issikii* Kumata (Lepidoptera: Gracillariidae) that expanded its range in the late 20th century, presumably from East Asia, and colonized most of Europe, where it was first documented in 1980s. We have used historical herbarium collections of limes sampled across the Palearctic to specify the lime leafminer's primary range and to elucidate its arrival time to Europe. Considering that the horticultural industry is recognized as one of the major pathways for introduction of pests, preservation of herbarium specimens from the cultivated species growing in the botanical gardens and parks as well as historical records about plant introductions found on the labels on herbarium sheets may represent important additional resources to track pest expansion.

Some of the World's biggest herbarium collections of horticultural limes are stored in the UK – in the Royal Botanical Gardens in Kew and Edinburgh, and in the Natural History Museum (London). Surveying the herbaria of these depositaries in general supports the recent invasion of the lime leafminer in Europe and its long-term occurrence

Zgodovinski herbariji so dragocen vir podatkov za proučevanje vnosov rastlinojedih škodljivih organizmov. Ličinke fitofagnih žuželk je mogoče najti na listih, stisnjenih pred več stoletji. Raziskovanje herbarijskih osebkov lahko pomaga določiti razširjenost v preteklosti, omogoča ugotavljanje regij izvora invazivnih vrst in pomaga omejiti čas njihovega pojava na novih lokacijah. Napredne tehnike določanja črtnih kod DNA, tj. sekvenciranje naslednje generacije, omogočajo nove perspektive za obnovitev razgrajene DNA arhiviranih osebkov.

Osredotočamo se na invazivnega lipovega listnega zavrtača, *Phyllonorycter issikii* Kumata (Lepidoptera: Gracillariidae), ki je območje razširjenosti povečal v poznem 20. stoletju, domnevno iz vzhodne Azije, in se je naselil v večjem delu Evrope, kjer je bil prvič dokumentiran v osemdesetih letih prejšnjega stoletja. Za določanje primarnega območja razširjenosti lipovega listnega zavrtača in pojasnitev časa njegovega prihoda v Evropo smo uporabili zgodovinske herbarije z vzorci lipe iz Palearktike. Glede na to, da je hortikultura priznana ena od glavnih poti vnosa škodljivih organizmov, so lahko ohranjeni herbarijski osebki vrst, gojenih v botaničnih vrtovih in parkih, ter zgodovinski zapisi o vnosih rastlin na nalepkah na listih herbarijev pomembni dodatni viri pri spremljanju širjenja pojavljanja škodljivih organizmov.

Nekaj največjih herbarijskih zbirk hortikulturnih vrst lipe na svetu je shranjenih v Združenem kraljestvu – v Kraljevem botaničnem vrtu Kew in Kraljevem botaničnem vrtu v Edinburgu ter v Prirodoslovnem muzeju (London). Sistematično raziskovanje herbarijev iz teh zbirk na splošno potrjuje nedaven vnos lipovega listnega zavrtača

in East Asia. According to herbarium specimens, the lime leafminer was widely distributed in China going back to 19th century, a country where it has not been known so far and yet it may potentially be a source region for *Ph. issikii*. Interestingly though, a few *Phyllonorycter* mines were found on limes in Italy and France in the herbarium of Erich Martin Hering (a German entomologist who specialized in leafmining insects), dating back to 1927 and 1942, and in few locations in the UK back to 1915 and 1987. The identity of the sampled archival insects is being investigated to clarify the question about the earliest occurrence of this pest in Europe.

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**Keywords:** herbarium, past distribution, invasive pest

v Evropo in njegovo dolgotrajno pojavljanje v vzhodni Aziji. Glede na herbarijske osebke je bil lipov listni zavrtač v 19. stoletju močno razširjen na Kitajskem, kjer do zdaj ni bil znan in morda *Ph. issikii* izvira od tam. Zanimivo je, da je bilo nekaj zavrtačev iz rodu *Phyllonorycter* najdenih v letih 1927 in 1942 na lipi iz Italije in Francije v herbariju Ericha Martina Heringa (nemškega entomologa, ki se je specializiral za listne zavrtače) ter v letih 1915 in 1987 na nekaj lokacijah v Združenem kraljestvu. Raziskuje se identiteta vzorčenih arhiviranih žuželk, da bi se pojasnilo vprašanje prvega pojava tega škodljivega organizma v Evropi.

Študijo je podprla Ruska ustanova za osnovne raziskave (št. 19-04-01029 A).

**Ključne besede:** herbarij, razširjenost v preteklosti, invazivni škodljivi organizmi

**SECTION 4**  
**INFORMATION SYSTEMS FOR RECORDING**  
**INVASIVE ALIEN SPECIES**

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## Information system Invazivke: role in early warning of IAS, statistics, problems and challenges

### Informacijski sistem Invazivke: vloga v zgodnjem obveščanju ITV, statistika, problemi in izzivi

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Early warning systems along with citizen science play a crucial role in early detection of invasive alien species (IAS). We developed the information system "Invazivke" in the project LIFE ARTEMIS as support tool for early detection of IAS in Slovenia. The system is publicly and freely available for both web and mobile users. At the end of 2018, Invazivke had 907 registered users. However, there were 427 active installs on android devices, only 224 users actually contributed at least one record, and only 105 users contributed more than five observations. Challenge remains how to reach and motivate the unused potential of registered users. Altogether, we have 63,650 observations of IAS reported in the system at the beginning of May 2019. However, only 12.5% of the records were reported through Web and mobile application. The system promotes merging of IAS data from various data sources and most of the data was provided by other information systems. The data of the citizen scientists is validated by five experts of various taxonomic groups and only validated and correct observations are shown publicly. 93.7% of the reported data was evaluated as correctly determined and only 2.7% of data was incorrect. The users mainly report IAS observations using mobile application (90.8% of observations). The mobile application provides simpler and quicker use where only selection of IAS and a photo is needed to report an observation other data as GPS coordinates and date of observation are added automatically. Finally, the system is quite a success and is now adapted and translated into six languages in Danube region (project REFOCuS).

**Keywords:** information system, database, invasive alien species, development, citizen science

Sistem zgodnjega obveščanja skupaj z ljubiteljsko znanostjo igra odločilno vlogo pri zgodnjem odkrivanju invazivnih tujerodnih vrst (ITV). V okviru projekta LIFE ARTEMIS smo razvili informacijski sistem »Invazivke« kot orodje za zgodnje obveščanja ITV v Sloveniji. Sistem je javno in brezplačno dostopen tako spletnim kot tudi mobilnim uporabnikom. Ob koncu leta 2018 je sistem Invazivke imel 907 registriranih uporabnikov. Aktivnih namestitev na Android napravah je bilo samo 427, samo 224 uporabnikov je prispevalo vsaj en zapis in samo 105 uporabnikov je prispevalo več kot 5 najdb. Kako motivirati neuporabljen potencial registriranih uporabnikov ostaja izziv. V sistemu je bilo v začetku maja 2019 zabeleženo skupaj 63.650 najdb ITV. Vendar samo 12,5 % zapisov je prišlo iz naslova spletne in mobilne aplikacije Invazivke. Sistem promovira združevanje podatkovnih zbirk o ITV iz različnih virov. Večino podatkov tako prihaja iz drugih informacijskih sistemov. V informacijskem sistemu podatke ljubiteljskih znanstvenikov preverja pet strokovnjakov za različne taksonomske skupine. Samo preverjeni in pravilni podatki so prikazani javno. 93,7 % najdb je bilo ocenjenih kot pravilno določenih in samo 2,7 % zapisov je bilo nepravilnih. Uporabniki sporočajo najdbe ITV večinoma z mobilno aplikacijo Invazivke (90,8 % zapisov). Mobilna aplikacija omogoča lažji in hitrejši vnos, saj se GPS koordinate in datum najdbe dodajo avtomatsko, uporabnik mora izbrati samo ITV in dodati vsaj eno fotografijo. Sistem je dokaj uspešen in smo ga prilagodili in prevedli v šest jezikov v Podonavju (projekt REFOCuS, sistem DanubeForestHealth).

**Ključne besede:** informacijski sistem, podatkovna zbirka, invazivna tujerodna vrsta, razvoj, ljubiteljska znanost

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## Information Systems and Information Management to Record Alien Parakeet Species in Turkey

### Informacijski sistemi in informacijsko upravljanje za evidentiranje tujerodnih vrst skobčevk v Turčiji

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Biological invasion is an important problem for the provision of ecosystem services. In recent years, non-native species have been expanding their distribution areas in different ways. These species need to be managed. Correct, detailed and up-to-date information about the species is required for an accurate management approach. Parakeet Census of Turkey, which is based on citizen science, began in 2016 in order to determine the status of the exotic parrots. A national database was established with this research. This database is updated with observations sent by citizen scientists and information in international databases. The distribution of exotic parrots, and its ecological, economic and social effects are determined by using the database. A watch and an alarm list about species were created but there is no effective legal tools prohibiting import of these species in Turkey. This database will be a useful resource for the scientists and the decision makers in the management and risk assessment of alien bird species. The development of new approaches is important for an accurate and effective management of alien species.

**Keywords:** exotic, invasion, species, management, database

Vnosi tujerodnih organizmov so pomembno vprašanje pri zagotavljanju ekosistemskih storitev. V zadnjih letih se je območje razširjenosti tujerodnih vrst širil na različne načine. Zato je treba te vrste upravljati. Za ustrezen upravljavski pristop so potrebne pravilne, podrobne in najnovejše informacije o vrstah. Da bi se ugotovilo število tujerodnih papig, se je leta 2016 v Turčiji začel izvajati popis skobčevk, ki temelji na ljubiteljskih poznavalcih. Pri tej raziskavi je bila vzpostavljena nacionalna zbirka podatkov. Zbirka podatkov se posodablja na podlagi opažanj ljubiteljskih poznavalcev in informacij iz mednarodnih zbirk podatkov. Razširjenost tujerodnih papig ter ekološki, gospodarski in družbeni vplivi te razširjenosti se določajo z uporabo te zbirke podatkov. Izdelana sta bila nadzorni in opozorilni seznam vrst, vendar ni učinkovitih pravnih orodij, s katerimi bi uvoz teh vrst v Turčijo prepovedali. Ta zbirka podatkov bo koristen vir za znanstvenike in nosilce odločanja pri upravljanju tujerodnih vrst ptic in oceni tveganja, ki ga te pomenijo. Za natančno in učinkovito upravljanje tujerodnih vrst je pomemben razvoj novih pristopov.

**Ključne besede:** tujeroden, vnos, vrsta, upravljanje, zbirka podatkov

**SECTION 5**  
**AWARENESS RAISING AND ATTITUDES**  
**TOWARDS INVASIVE ALIEN SPECIES**



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## LIFE ASAP: "Alien Species Awareness Program" in Italy

### LIFE ASAP: program ozaveščanja o tujerodnih vrstah v Italiji

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In Italy, more than 3000 alien species are reported with an increase in the introduction rate of 96% in the last 30 years; 15% of them are considered invasive, being responsible for several environmental and socioeconomic impacts. The project Life ASAP (Alien Species Awareness Program; GIE/IT/001039: 2016-2020), co-financed by the European Commission, aims at increasing the awareness and the active participation of citizens concerning the problem of invasive alien species (IAS) in Italy and promoting their efficient management in accordance with the EU Regulation 1143/2014 (implemented at national level by the legislative decree 230/2017). The Italian National Institute for Environmental Protection and Research leads this project together with Legambiente, Regione Lazio, Federparchi Europarc, NEMO srl, University of Cagliari and TIC Media Art. Several actions target different stakeholders and actors involved in the issue of IAS such as personnel of national parks, protected areas, zoos, botanical gardens and scientific museums, citizens, schools, visitors of parks and travellers passing in the airport, personnel of all the public institutions involved in the implementation of the EU Regulation 1143/2014 (ministries, regions and autonomous provinces, border inspection points), scientific community that drafted the first black list of priority IAS for Italy, and professionals (e.g. green architects, agronomists, vets). Voluntary instruments such as the European codes of conduct on IAS have been translated to Italian and disseminated among many stakeholders (e.g. horticultural operators, pet retailers and owners, professionals, anglers and hunters), while guidelines for the management of IAS in protected areas will be promoted.

**Keywords:** awareness, management, code of conduct, stakeholders

V Italiji je evidentiranih več kot 3.000 tujerodnih vrst, stopnja vnosa pa se je v zadnjih 30 letih zvišala za 96 %. 15 % teh vrst se šteje za invazivne in različno vplivajo na okolje, družbo in gospodarstvo. Cilji projekta Life ASAP (program ozaveščanja o tujerodnih vrstah; GIE/IT/001039: 2016–2020), ki ga je sofinancirala Evropska komisija, so ozaveščanje o problemu invazivnih tujerodnih vrst v Italiji, spodbujanje aktivne udeležbe državljanov na tem področju in spodbujanje učinkovitega upravljanja teh vrst v skladu z Uredbo (EU) št. 1143/2014 (ki se na nacionalni ravni izvaja z zakonodajno uredbo št. 230/2017). Italijanski nacionalni inštitut za varstvo okolja in raziskave vodi ta projekt v sodelovanju z okoljevarstveno organizacijo Legambiente, deželo Lacij, združenjem Federparchi Europarc, podjetjem NEMO srl, Univerzo v Cagliariju in podjetjem TIC Media Art. Različni ukrepi so namenjeni različnim deležnikom in akterjem, ki jih zadeva vprašanje invazivnih tujerodnih vrst, kot so osebje narodnih parkov, zavarovanih območij, živalskih vrtov, botaničnih vrtov in znanstvenih muzejev, državljani, šole, obiskovalci parkov in potniki na letališčih, osebje vseh javnih institucij, vključenih v izvajanje Uredbe (EU) št. 1143/2014 (ministrstva, regije in avtonomne pokrajine, mejne kontrolne točke), znanstvena skupnost, ki je pripravila prvi opozorilni seznam invazivnih tujerodnih vrst za prednostno obravnavo v Italiji, in strokovnjaki (npr. zeleni arhitekti, agronomi, veterinarji). Prostovoljni instrumenti, kot je Evropski kodeks ravnanja z invazivnimi tujerodnimi vrstami, so bili prevedeni v italijanščino in razdeljeni številnim deležnikom (npr. vrtnarjem, prodajalcem in lastnikom hišnih ljubljencev, strokovnjakom, športnim ribičem in lovčem), zavzemali pa se bodo tudi za smernice za upravljanje invazivnih tujerodnih vrst na zavarovanih območjih.

**Ključne besede:** ozaveščenost, upravljanje, kodeks ravnanja, deležniki

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## Successive polling of Slovenes about invasive alien forest species

### Intervalno anketiranje Slovencev o invazivnih tujerodnih vrstah

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Two consecutive public surveys on public attitudes towards invasive alien species (IAS) were administered on a representative sample of Slovenes. Both were a part of LIFE ARTEMIS project activities intended to capture people's level of knowledge about IAS, their preferences for different control measures and support for having a system of early warning and rapid response (EWRR) implemented on a country level. The survey was designed as an internet poll with sets of ranking or pre-defined selection types of questions. The first poll (Jan. of 2017) was done on a sample of 953 and the second (Sep.-Oct. of 2018) with 515 respondents, where 503 were a part of both samples. A simple frequency analysis was employed to indicate differences/similarities in responses between surveys of 2017 and of 2018. Results show that more people knew about the ARTEMIS project, however they still consider IAS as less important environmental issue. The portion of those already knowing the term IAS has enlarged significantly more as the percentage of those who have experienced difficulties with IAS. Recognition of species on photos has improved as the level of correct identification has increased with all of eight IAS, but common ragweed where it remained unchanged. TV remains the most important source of information on IAS. Support for having EWRR is obvious as almost all respondents prefer to be implemented, and furthermore so is the willingness of people to remove IAS from their land. Concerning the attitude towards different IAS control measures, non-lethal are preferred over those which cause the killing of the species.

**Keywords:** early warning and rapid response system, public attitudes, management measures, alien insects, alien plants, alien fungi

Na reprezentativnem vzorcu polnoletnih Slovencev sta bili izvedeni dve zaporedni anketiranji o odnosu javnosti do invazivnih tujerodnih vrst (ITV). Obe poizvedbi sta bili del aktivnosti projekta LIFE ARTEMIS, ki so namenjene obravnavi znanja javnosti o ITV; njihovih preferenc do različnih ukrepov kontrole; in obsega podpore za vzpostavitev sistema zgodnjega opozarjanja in hitrega odziva (ZOHO) na ravni celotne države. Poizvedba je bila zasnovana kot spletna anketa z nizi ranžirnih in izbirnih vprašanj. Prvo anketiranje (jan. 2017) je bilo opravljeno na vzorcu 953 in drugo (sep.-okt. 2018) na 515 vprašanih, kjer so bile 503 osebe vključene v obe poizvedbi. Uporabili smo preprosto frekvenčno analizo in ugotovili razlike/podobnosti v odgovorih med obema anketiranjema. Rezultati kažejo, da je ob drugem anketiranju narasel delež tistih, ki poznajo ARTEMIS projekt, vendar še vedno prevladuje mnenje, da so ITV manj pomemben okoljski problem. Precej bolj se je povečal delež tistih, ki poznajo termin ITV, kot delež tistih, ki so že občutili težave povezane z ITV. Prepoznavanje ITV na fotografijah se je izboljšalo pri vseh osmih vrstah, razen pri pelinolistni ambroziji, kjer je nespremenjeno. TV ostaja najpomembnejši vir podatkov o ITV. Podpora sistemu ZOHO je očitna saj skoraj vsi anketiranci želijo njegovo uresničitev in tudi enako velja za pripravljenost ljudi, da na svojih zemljiščih odstranjujejo ITV. Glede odnosa do različnih ukrepov nadzora nad ITV so 'humani' načini bolj zaželeni kot tisti, kjer se osebkje uniči oziroma usmrti.

**Ključne besede:** sistem zgodnjega opozarjanja in hitrega odziva, odnos javnosti, upravljavski ukrepi, tujerodne žuželke, tujerodne rastline, tujerodne glive

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## Public knowledge and perceptions of suburban plant invasions: the role of residential gardens and garden waste deposits in forest fragments

### Poznavanje in dojemanje invazij tujerodnih rastlin med širšo javnostjo: pomen domačih vrtov in odlagališč vrtnih odpadkov v periurbanih gozdnih fragmentih

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Majority of the most aggressive invasive alien plants (IAPs) were deliberately introduced for ornamental and horticultural purposes. New escapes of ornamental flora from gardens are promoted by dumping of garden waste in nearby forest fragments. Surprisingly high number of illegal garden waste deposits was found in lowland periurban forest fragments in NE Slovenia. In their vicinity, we observed higher number of alien flora, which resprouted from discarded ornamental plants. This fact encouraged us to research public perceptions and knowledge on IAPs occurring in Slovenia by conducting a questionnaire-based survey. The aim of our study was to investigate the rate of garden owners, who are dumping garden waste in forests and whether are they aware of promoting new invasions by their actions. The highest rate of respondents were females between 21 and 40 year-old with tertiary-level education. Our results clearly show that inhabitants owning gardens did not perceive promoting new invasions by dumping garden waste in forests. Above 10 % of them report about this action, while only 17 % of respondents recognize the possible threat of promoting new alien invasions by dumping of garden waste in such habitats. However, given that most respondents had higher level of education, we could speculate that overall awareness is probably even lower. According to our results, there is still need for raising awareness about the IAPs and their possible introductory ways. In the future more activities to address this issue should be done. Our proposal is supported by the opinion of our respondents; 78 % of them think their knowledge about IAPs is insufficient.

**Keywords:** alien plants, private gardens, horticulture, ornamental flora, garden waste deposits

Večina najagresivnejših invazivnih tujerodnih rastlin (ITR) je bila namerno zanesena v vrtove v okrasne namene. Tveganje, da okrasne rastline zaidejo iz domačih vrtov v naravne habitate, povečujemo z odlaganjem vrtnih odpadkov v bližnje gozdne fragmente. Presenetljivo veliko število nezakonitih odlagališč vrtnih odpadkov smo našli v nižinskih gozdnih fragmentih v SV Sloveniji. V njihovi bližini smo opazili večje število tujerodnih rastlin, ki so izvirale iz teh odlagališč. To dejstvo nas je spodbudilo k raziskavi poznavanja in dojemanja ITR med slovensko javnostjo preko izvedbe spletne ankete. Cilj naše študije je bil raziskati, kolikšen delež lastnikov vrtov z okrasnimi tujerodnimi rastlinami odlaga vrtno odpadke v gozdove ter ali se zavedajo, da s svojim početjem tvegajo nove invazije. Največji delež anketirancev, ki so se odvali, so predstavljale ženske med 21 in 40 let z univerzitetno stopnjo izobrazbe. Naši rezultati kažejo, da lastniki vrtov večinoma ne dojemajo odlaganja vrtnih odpadkov v gozdove kot tveganje novih invazij. Več kot 10 % anketirancev vsaj občasno odlaga vrtno odpadke v gozdove, medtem ko se le 17 % anketirancev zaveda potencialne nevarnosti novih invazij z odlaganjem vrtnih odpadkov v gozdove. Glede na povprečno relativno visoko stopnjo izobrazbe naših anketirancev lahko predpostavljamo, da je splošna ozaveščenost verjetno še slabša. Glede na pridobljene rezultate menimo, da še vedno obstaja potreba po ozaveščanju o ITR in njihovih možnih vnosih v naravne habitate. V prihodnosti bi bilo treba načrtovati dejavnosti ciljnega ozaveščanja javnosti. Naš predlog o nadaljnjem ozaveščanju podpira tudi mnenje anketirancev; 78 % jih namreč meni, da njihovo znanje o ITR ni zadostno.

**Keywords:** tujerodne rastline, domači vrtovi, hortikultura, okrasna flora, odlagališča vrtnih odpadkov

**SECTION 6**  
**MONITORING AND CONTROL OF**  
**FOREST INVASIVE ALIEN SPECIES**

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## Practical experiences in invasive alien plant control in protected areas of Hungary

### Praktične izkušnje pri nadzoru nad invazivnimi tujerodnimi rastlinami na zavarovanih območjih Madžarske

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Our presentation gives an overview of the activities of invasive plant control carried out by the conservation managers in protected areas, based on Hungarian examples. Although the literature on the IAS (invasive alien species) biology is quite abundant, the practical experiences of their control are not collected and evaluated thus they cannot be used in subsequent interventions. We composed a questionnaire and distributed it among the conservation managers in 2016. The results showed that the most serious threat to Hungarian protected areas is the spread of IAS. To compensate for this deficiency, Duna-Ipoly National Park Directorate issued a handbook titled *Practical Experiences in Invasive Alien Plant Control* in 2017. On the basis of the above mentioned questionnaire, 7 of the 10 most problematic plant species were the following woody ones: black locust, tree of heaven, Russian olive, false indigo, box elder, green ash, and common hackberry. We present different practical possibilities, technologies and evaluation of mapping, surveying and controlling of IAS through the example of box elder. This woody species was widely planted since the end of the 1800s, primarily to sandy soils and later to floodplain areas. Its presence is significant mainly in plain areas.

The conservation management of the box elder in the surveyed infested areas ranged from the total exclusion of management activities to various non-chemical and chemical injection methods. Among the non-chemical methods, the traditional forest cultivation and mechanical methods, like root collar cut-off or girdling by chainsaw, proved to be effective. After two years of the latter treatment, 72% of the trees died, further 22% is suffering and the rate of sprouting is negligible. The choice of technology is influenced by the habitat type, the distance

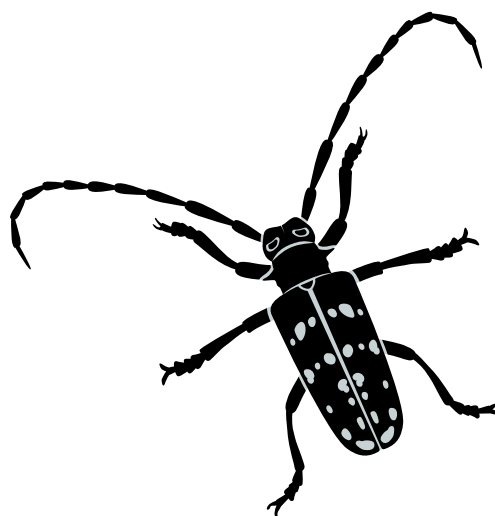
Predstavitev vsebuje pregled dejavnosti nadzora nad invazivnimi rastlinami, ki so jih izvedli naravovarstveniki na zavarovanih območjih, in sicer na madžarskih primerih. Čeprav je razmeroma veliko literature o biologiji invazivnih tujerodnih vrst, praktične izkušnje z njihovim nadzorom niso zbrane in ocenjene, zato jih ni mogoče uporabiti pri poznejših posegih. Leta 2016 smo sestavili vprašalnik in ga razdelili med naravovarstvenike. Rezultati so pokazali, da je najresnejša nevarnost za madžarska zavarovana območja širjenje invazivnih tujerodnih vrst. Da bi odpravil to vrzel, je Direktorat za narodni park Duna-Ipoly leta 2017 izdal priročnik z naslovom *Praktične izkušnje pri nadzoru nad invazivnimi tujerodnimi rastlinami*. Na podlagi zgoraj omenjenega vprašalnika je od desetih najbolj problematičnih rastlinskih vrst sedem lesnatih: navadna robinija, veliki pajesen, ozkolistna oljčica, baptisia, ameriški javor, pensilvanski jesen in ameriški koprivovec. Predstavljamo različne praktične možnosti, tehnologije in oceno kartiranja, sistematičnega raziskovanja in nadziranja invazivnih tujerodnih vrst na primeru ameriškega javorja. Ta lesnata vrsta se je od konca prvega desetletja 19. stoletja pogosto sadila, zlasti na peščena tla in pozneje na poplavne ravnice. Razširjena je zlasti na ravninah. Naravovarstveno upravljanje ameriškega javorja je na sistematično raziskanih napadenih območjih segalo od popoldne izključitve dejavnosti upravljanja do raznih nekemičnih metod in kemičnih metod vbrizgavanja. Med nekemičnimi metodami so se za učinkovite izkazali zlasti tradicionalno gojenje gozdov in mehanske metode, kot je rezanje koreninskega vratu ali obročkanje z verižno žago. Dve leti po zadnjem uvednem tretiranju je odmrlo 72 % dreves, nadaljnjih 22 % dreves je bolnih, delež tistih, ki poganjajo, pa je zanemarljiv. Na izbiro tehnologije vplivajo vrsta habitata, oddaljenost

of water body (in chemical treatment), the efficiency, the number of post-treatments and the disturbance rate caused by the interventions.

**Keywords:** invasive alien plant control, practical experiences, box elder

vodnega telesa (pri kemičnem tretiranju), učinkovitost, število nadaljnjih tretiranj in stopnja motenj, ki jih povzročijo posegi.

**Ključne besede:** nadzor nad invazivnimi tujerodnimi rastlinami, praktične izkušnje, ameriški javor





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# Alien invasive pathogens in the Czech Republic, their list, the most important recent findings and possible mitigation and adaptation strategies

## Invazivni tujerodni patogeni na Češkem, seznam teh patogenov, najpomembnejše najnovejše ugotovitve ter mogoče strategije za ublažitev in prilagajanje

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The first introduced alien tree pathogens were reported deeply in 19th century in the Czech Republic and list of these organisms contains around 100 species now. Number of reported introductions is connected with GDP growth rate and involvement of the country into world market. The most important invasive alien species as *Ophiostoma novo-ulmi*, *Phytophthora xalni*, *Hymenoscyphus fraxineus* were introduced after 1950 and they have caused substantial economic and environmental losses. Their naturalization, for instance, extremely aggravated standard cultivation of seven native tree taxa in the country. Moreover, many other invading or naturalised pathogens as *Phytophthora plurivora*, *P. cinnamomi*, *P. ramorum* and other *Phytophthora* species, *Gemmamyces piceae*, *Eutypella parasitica*, *Cryptostroma corticale*, *Mycosphaerella pini* etc. have significant potential to cause important losses in forests and natural ecosystems in the area. The situation has gradually risen into a huge problem and development of branch specialized mitigating and adaptive strategies aimed at particular pathogens or their ecological groups which are step-by-step implemented into the practice seems to be the only one reasonable solution. These measures are based on a broad scale of studies covering ecology of important pathogens, symptomatology and epidemiology of diseases they cause, statistical modelling, development of predictions of environmental suitability and their impact, evaluation of efficacy of fungicides, and many others. However, one of the most important contemporary challenges that we face is still underestimation and insufficient involvement of state administration, organizations and companies it may concern in this field.

The work is supported by research project "Alien invasive microorganisms as a risk for forest ecosystems of the Czech Republic" funded by Technology Agency of the Czech Republic no. TH03030306.

**Keywords:** alien forest pathogens, diversity, Czech Republic, management strategies

O prvih vnesenih tujerodnih patogenih za drevesa na Češkem so poročali že v 19. stoletju, seznam teh organizmov pa danes vsebuje približno sto vrst. Število poročanih vnosov je povezano s stopnjo rasti BDP in vključitvijo države na svetovni trg. Najpomembnejše invazivne tujerodne vrste, kot so *Ophiostoma novo-ulmi*, *Phytophthora xalni* in *Hymenoscyphus fraxineus*, so bile vnesene po letu 1950 in so povzročile precejšnje izgube za gospodarstvo in okolje. Njihova naselitev je na primer izjemno otežila uveljavljeno gojenje sedmih avtohtonih drevesnih taksonov v državi. Poleg tega lahko številni drugi vdirajoči ali naseljeni patogeni, kot so *Phytophthora plurivora*, *P. cinnamomi*, *P. ramorum* in druge vrste iz rodu *Phytophthora*, *Gemmamyces piceae*, *Eutypella parasitica*, *Cryptostroma corticale*, *Mycosphaerella pini*, zelo verjetno povzročijo pomembne izgube v gozdovih in naravnih ekosistemih na zadevnem območju. Stanje je postopoma prerastlo v veliko težavo in zdi se, da je edina razumna rešitev, da se razvijejo specializirane panožne strategije za ublažitev in prilagajanje, ki so usmerjene v posamezne patogene ali njihove ekološke skupine in se bodo postopoma uvedle v prakso. Ti ukrepi temeljijo na široko zasnovanih študijah, ki zajemajo ekologijo pomembnih patogenov, simptomatiko in epidemiologijo bolezni, ki jih povzročajo, statistično modeliranje, razvoj napovedovanja okoljske ustreznosti in njegovega vpliva, presojo učinkovitosti fungicidov in drugo. Vendar sta med najpomembnejšimi sodobnimi izzivi, s katerimi se spoprijemamo, še vedno podcenjevanje težave in nezadostna vključenost državne uprave, organizacij in podjetij, povezanih s tem področjem.

Delu podpora zagotavlja raziskovalni projekt Invazivni tujerodni mikroorganizmi – tveganje za gozdne ekosisteme na Češkem, ki ga financira Agencija za tehnologijo Češke republike, št. TH03030306.

**Ključne besede:** tujerodni patogeni v gozdu, raznovrstnost, Češka, strategije upravljanja

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## National monitoring of two non-native species in Slovakia: *Ips duplicatus* and *Xylosandrus germanus* (Curculionidae: Scolytinae)

### Nacionalno spremljanje dveh tujerodnih vrst na Slovaškem: *Ips duplicatus* in *Xylosandrus germanus* (Curculionidae: Scolytinae)

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Monitoring of *Ips duplicatus* and *Xylosandrus germanus* took place from 2016 - 2018.

*I. duplicatus* (ID) was recorded in 1992 for the first time in Slovakia. For monitoring of ID, we used more than 100 traps each year. The catches ranged from 0 to 11149 pieces per one trap (600 - 700 pieces on the average per season). Climate change creates favorable conditions for its spreading to habitats where it has not been previously observed. We found that ID is expanding to regions towards higher elevation where it was not present before. It is spreading to the deep valleys of the Low Tatra Mountains and the first catches in the High Tatra Mountains are alarming. We estimated that the volume of ID beetle-infested wood in Slovakia in the last 10 years averaged 10-50 thousand cubic meters per year. ID was also increasingly caught in the pine forests of Záhorie (western part of Slovakia), which means that this species has also been successfully developing on pine trees. In 2018 ID's monitoring continued only in selected locations (High and Low Tatra Mountains). These were the locations in higher altitudes, where the occurrence of ID was confirmed only last years.

*Xylosandrus germanus* (XG) was recorded in 2010 for the first time in Slovakia. Monitoring of XG was carried out in forest dispatch warehouses (58 traps) in cooperation with the forest state enterprise LESY SR. We caught almost 2000 individuals in 3 years. The results show that this technical pest has spread to the whole area of Slovakia. The beetles are occurring up to 1100 m a.s.l.

**Keywords:** monitoring, *Ips duplicatus*, *Xylosandrus germanus*, trap

Spremljanje vrst *Ips duplicatus* in *Xylosandrus germanus* je potekalo od leta 2016 do leta 2018.

Vrsta *I. duplicatus* je bila na Slovaškem prvič evidentirana leta 1992. Za spremljanje te vrste smo vsako leto uporabili več kot 100 pasti. Ulov je segal od 0 do 11.149 osebkov na eno past (povprečno 600 do 700 osebkov na sezono). Podnebne spremembe ustvarjajo ugodne razmere za širjenje vrste v habitate, kjer prej ni bila opažena. Ugotovili smo, da se vrsta *Ips duplicatus* širi v regije na višji nadmorski višini, kjer je prej ni bilo. Širi se v globoke doline Nizkih Tater, prvi ulovi v Visokih Tatrah pa so alarmantni. Ocenjujemo, da je bilo na Slovaškem v zadnjih desetih letih z vrsto *Ips duplicatus* letno okuženih povprečno 10 do 50 tisoč kubičnih metrov lesa. Vrsta *Ips duplicatus* je bila vedno pogosteje ulovljena tudi v borovih gozdovih v pokrajini Záhorie (zahodna Slovaška), kar pomeni, da se ta vrsta uspešno razvija tudi na boru. Leta 2018 se je spremljanje te vrste nadaljevalo samo na izbranih lokacijah (Nizke in Visoke Tatere). Te lokacije so na višji nadmorski višini, kjer je bilo pojavljanje te vrste potrjeno šele v zadnjih letih.

Vrsta *Xylosandrus germanus* je bila na Slovaškem prvič evidentirana leta 2010. Spremljanje te vrste je potekalo v gozdarskih distribucijskih skladiščih (58 pasti) v sodelovanju z državnim gozdarskim podjetjem LESY SR. V treh letih smo ulovili skoraj 2.000 osebkov. Rezultati kažejo, da se je ta škodljivi organizem razširil na celotno ozemlje Slovaške. Hrošči se pojavljajo na nadmorski višini do 1100 m.

**Ključne besede:** spremljanje, *Ips duplicatus*, *Xylosandrus germanus*, past

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## Recent experience with dealing with Invasive alien species threatening plant health in Northern Ireland

### Najnovejše izkušnje z obravnavo invazivnih tujerodnih vrst, ki ogrožajo zdravstveno varstvo rastlin na Severnem Irskem

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Northern Ireland is generally accepted to have a high plant health status, probably in part to its position as an island off the coast of mainland Europe. Northern Ireland and Ireland form the island of Ireland, and this is treated as a single epidemiological unit by both governments working closely together when dealing with plant health issues. Invasive pests tend to arrive later, potentially allowing for management lessons to be learned from the mainland Europe experience. Sampling for pests of forests is carried out as a collaborative effort between the state department of Agriculture and the research institute AFBI. Citizen science and amateur societies also has a part to play in early detection, though this is in need of further development. In recent years a number of pests of forests and woody plants have emerged and established, including *Phytophthora ramorum*, *Hymenoscyphus fraxineas*, *Tomostethus nigritus*, and *Cydalima perspectalis*. Ongoing research is examining the detection, epidemiology and management of these and other pests.

**Keywords:** forest pathology, plant health, protected zone

Za Severno Irsko je splošno znano, da ima visoko raven zdravstvenega varstva rastlin, verjetno delno zaradi njene lege na otoku stran od obale celinske Evrope. Severna Irska in Irska tvorita irski otok, ki ga obe vladi štejeta za eno epidemiološko enoto in tesno sodelujeta pri obravnavi vprašanj na področju zdravstvenega varstva rastlin. Invazivni škodljivi organizmi navadno prispejo pozneje, kar potencialno omogoča pridobivanje novih spoznanj pri upravljanju na podlagi izkušenj s celinske Evrope. Jemanje vzorcev za testiranje na gozdu škodljive organizme skupaj izvajata Ministrstvo za kmetijstvo in raziskovalni inštitut AFBI (Inštitut za agroživilstvo in bioznanost). Vlogo pri zgodnjem odkrivanju imajo tudi ljubiteljski poznavalci in ljubiteljska združenja, vendar je treba to področje dodatno razviti. V zadnjih letih se je pojavilo in naselilo več škodljivih organizmov za gozd in lesnate rastline, vključno z vrstami *Phytophthora ramorum*, *Hymenoscyphus fraxineas*, *Tomostethus nigritus* in *Cydalima perspectalis*. S stalnimi raziskavami se proučujejo odkrivanje in epidemiologija teh in drugih škodljivih organizmov ter ukrepi proti njim.

**Ključne besede:** gozdna patologija, varstvo rastlin, varovano območje

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## APPLAUSE: Combining satellite and ground survey data for effective IAPS data collection

### APPLAUSE: Združevanje satelitskih in terenskih podatkov za učinkovito zbiranje informacij o invazivnih tujerodnih rastlinah

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In the scope of APPLAUSE project, we propose a recognition of invasive alien plants species (IAPS) by combining time series optical remote sensing data approach and field survey. The identification and mapping of IAPS, especially Japanese knotweed, is done based on differences in spectral signature from time series Sentinel-2 optical satellite images, using dynamic time warping classification approach. Temporal patterns of the ground truth samples are first created and next analysed on pixels of Normalised difference vegetation index (NDVI) time series data. Each pixel is then assigned to a certain class based on previously calculated pattern. The final products are maps of Japanese knotweed locations obtained almost without human intervention in a fast manner. Field survey enables detection of smaller regions of IAPS and detection of plants, which are hard or impossible to be recognized from satellite photos. However, the process takes longer and requires skilled experts. To collect data more efficiently, software applications have been developed that combine expert observations with two other data sources. The first are companies executing the removal of the plants and using work orders system. The second data source are contributions of the citizens who use software module for the IAPS plant recognition being based on artificial intelligence algorithms. Citizens can then report findings with photos to the experts, who decide about including data into IAPS database.

Project APPLAUSE is co-financed by the European Regional Development Fund through the Urban Innovative Actions Initiative.

**Keywords:** invasive plant recognition, monitoring, Sentinel-2, time series

V okviru projekta APPLAUSE (Alien PLAnt SpECies) raziskujemo možnosti prepoznavanja invazivnih tujerodnih rastlinskih vrst z združevanjem optičnih satelitskih podatkov in terenskega popisovanja. Zaznavanje in kartiranje invazivk, zlasti japonskega dresnika, preučujemo z uporabo klasifikacijskega pristopa dynamic time warping (DTW) na podlagi spektralnega podpisa časovnih vrst optičnih satelitskih posnetkov senzorja Sentinel-2. S pomočjo terenskih podatkov najprej pridobimo časovne vzorce, ki jih nadalje analiziramo na pikselnem nivoju na časovnih vrstah indeksa NDVI (normirani diferencialni vegetacijski indeks). Z uporabljeno metodo je vsak piksel dodeljen določenemu razredu na podlagi predhodno izračunanega vzorca. Končni pridobljeni rezultati so karte, ki nam prikazujejo lokacije invazivk. Te karte lahko pridobimo hitro, za velika območja, z visoko natančnostjo in večjega človeškega posredovanja. Terenske meritve pa nam nasprotno omogočajo zaznavanje predvsem manjših območij prisotnosti invazivnih rastlinskih vrst, katere je zaradi prostorske ločljivosti praktično nemogoče zaznati iz satelitskih posnetkov. Ta postopek je sicer veliko dolgotrajnejši in zahteva znanje usposobljenih strokovnjakov. Za učinkovitejše zbiranje terenskih podatkov smo razvili informacijski sistem, ki podatke dopolnjuje še iz dveh virov. Prvi vir so podjetja, ki izvajajo odstranjevanje invazivnih rastlin na podlagi sistema delovnih nalogov. Drugi vir podatkov pa predstavljajo prispevki prebivalcev, ki uporabljajo programski modul za prepoznavanje invazivk, ki temelji na algoritmični umetni inteligenci. Prebivalci lahko svoje ugotovitve s priloženimi fotografijami posredujejo strokovnjakom, ki se potem odločijo ali te podatke vključijo v bazo tujerodnih invazivnih rastlinskih vrst.

Projekt APPLAUSE sofinancira Evropski sklad za regionalni razvoj preko pobude Urban Innovative Actions (UIA).

**Ključne besede:** prepoznavanje invazivnih tujerodnih rastlin, monitoring, Sentinel-2, časovne vrste

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## Outbreak of a quarantine organism in Slovenian forests: actions and challenges

### Izbruh karantenskega škodljivega organizma v slovenskih gozdovih: ukrepi in izzivi

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For effective management of outbreaks of quarantine organisms, rapid detection is needed, followed by rapid and effective action to eradicate the pest or stop its spread. Eradication actions in forests most often involve cutting trees and suitable destruction or special handling of infected or attacked material. The scope of needed work can be extremely extensive and can take place on an inaccessible terrain or in protected areas. Therefore, it is essential that pest management action plans are prepared at country level in advance. These should be tested in simulation exercises and carried out by suitably qualified personnel. For an effective response, a pre-prepared database of relevant forestry entrepreneurs with lists of equipment and assets are necessary. In our presentation, starting points in the development of organizational and technical support for effective actions against the outbreaks of quarantine organisms in Slovenian forests will be introduced. Also, critical points that have been identified by different stakeholders will be presented.

**Keywords:** forest, quarantine pests, forestry entrepreneurs, actions

Za učinkovito obvladovanje izbruhov karantenskih organizmov je pomembno hitro odkrivanje, ki mu sledi hitro in učinkovito ukrepanje z namenom izkoreninjenja ali zaustavitve širjenja takega organizma. Ukrepanje v gozdovih najpogosteje vključuje posek in ustrezno ravnanje z okuženim oziroma napadenim materialom. Obseg del je lahko izredno obsežen in lahko poteka na nedostopnem terenu in na zaščitenih območjih. Zato je nujno, da so načrti ukrepanja proti karantenskim škodljivim organizmom pripravljene vnaprej ter da se načrti preizkusijo v različnih teoretičnih simulacijah. Ukrepe morajo izvajati ustrezno usposobljeni izvajalci. Za učinkovit odziv je potrebna vnaprej pripravljena baza ustreznih gozdarskih izvajalcev, ki vključuje seznam opreme in sredstev. Predstavili bomo izhodišča za razvoj organizacijske in tehnične podpore za učinkovito ukrepanje pri izbruhih karantenskih organizmov v slovenskih gozdovih. Predstavljene bodo tudi kritične točke v procesu ukrepanja v gozdovih, ki so jih prepoznali različni deležniki.

**Ključne besede:** gozd, karantenski škodljivi organizmi, gozdarski izvajalci, ukrepi



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# Evolving grey squirrel management techniques in Europe

## Razvoj tehnik upravljanja sive veverice v Evropi

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The North American eastern grey squirrel (*Sciurus carolinensis*) has negative impacts on European biodiversity and has caused regional native red squirrel (*Sciurus vulgaris*) extinction through resource competition and the spread of pathogenic infection. In addition, bark stripping of hardwood timber crop tree species is economically damaging. We report upon the EU LIFE14 NAT/UK/000467 project which aims to control invasive grey squirrels to protect woodland landscapes in the United Kingdom. Community-based early warning surveillance has detected incursion onto the 720 km<sup>2</sup> island of Anglesey and prevented re-establishment of the species following an earlier successful eradication. In remote upland forest habitat, local volunteers have used online software to co-ordinate measures to detect and remove grey squirrels which threaten one of only two remnant mainland red squirrel populations in Wales. The creation of local red squirrel community groups in Northern Ireland has led to a growing national network of volunteers empowered with the skills and confidence to manage grey squirrels and monitor native woodland species. The evolution of innovative methods to help detect grey squirrels, encourage public participation in invasive species control and to monitor infection amongst residual populations are described. We highlight opportunities for the transferability of our findings to the management of other invasive species in Europe and to eastern grey squirrels in western Canada.

**Keywords:** grey squirrel, red squirrel, volunteers, camera traps

Severnoameriška siva veverica (*Sciurus carolinensis*) negativno vpliva na evropsko biotsko raznovrstnost in povzroča, da domorodna navadna veverica (*Sciurus vulgaris*) zaradi tekmovanja za vire in širjenja okužb s patogeni v regiji izumira. Poleg tega lupljenje lubja listavcev povzroča gospodarsko škodo. Poročamo o projektu EU LIFE14 NAT/UK/000467, katerega cilj je nadzor nad invazivnimi sivimi vevericami za zaščito gozdnih pokrajin v Združenem kraljestvu. Pri nadzoru z zgodnjim opozarjanjem, ki temelji na delovanju skupnosti, je bil odkrit vdor na otok Anglesey, ki meri 720 km<sup>2</sup>, in preprečena je bila ponovna naselitev vrste po predhodnem uspešnem izkoreninjenju. V odmaknjenem visokogorskem gozdnem habitatu so lokalni prostovoljci uporabljali programsko opremo na spletu za koordiniranje ukrepov za odkrivanje in odstranjevanje sivih veveric, ki ogrožajo eno od samo dveh preostalih populacij navadne veverice v celinskem Walesu. Z oblikovanjem lokalnih skupin za navadno veverico se na Severnem Irskem povečuje nacionalna mreža prostovoljcev, ki imajo potrebne veščine za upravljanje sivih veveric in spremljanje domorodnih gozdnih vrst ter verjamejo, da bodo pri tem uspešni. Opisan je razvoj inovativnih metod za pomoč pri odkrivanju sivih veveric, spodbujanju sodelovanja javnosti pri nadzoru nad invazivnimi vrstami in spremljanju okužb v preostali populaciji. Predstavljamo možnosti za prenos naših ugotovitev na področje upravljanja drugih invazivnih vrst v Evropi in sivih veveric v zahodni Kanadi.

**Ključne besede:** siva veverica, navadna veverica, prostovoljci, fotopasti



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## Evaluating the pest status in Europe of the oak lace bug, *Corythucha arcuata* (Heteroptera, Tingidae), and developing survey, control and management strategies

### Ocenjevanje statusa škodljivega organizma v Evropi za hrastovo čipkarko, *Corythucha arcuata* (Heteroptera, Tingidae), in razvoj strategij stalnega raziskovanja, nadzora in upravljanja

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A new Euphresco project 'OLBIE' (Oak Lace Bug in Europe) focuses on the oak lace bug (OLB), *Corythucha arcuata*, an invasive Hemipteran insect introduced into Europe from its native range in North America. Since its first discovery in Europe, in Italy in 2000, it has subsequently spread rapidly over a wide geographical area and can now be found in over a dozen other European countries. In some countries, such as Hungary and Croatia its population has reached substantial levels where there is now serious concern that the pest may have significant impacts on oak health, as well as potentially increasing the susceptibility of oaks to other pests and diseases. Within its natural range *Corythucha arcuata* is generally regarded as a nuisance pest, causing only minimal damage, although high populations can cause early leaf fall. Within Europe there is considerable variation in its reported impacts, so there is a real need to understand what factors are influential in the development of this invasive insect and how it might affect oak health. The OLBIE project will address key questions and gaps in the knowledge of *Corythucha arcuata*, particularly in relation to the biology, dispersal, control and management options and the wider environmental impacts. The project is co-ordinated through Euphresco, which facilitates the collaboration and networking of organisations to undertake national research in the phytosanitary area. See <https://www.euphresco.net/> for specific details.

**Keywords:** impacts, invasive insect, oaks, tree health

Nov projekt Euphresco OLBIE (Hrastova čipkarka v Evropi) se osredotoča na hrastovo čipkarko, *Corythucha arcuata*, invazivnega polkrilca, ki je bil v Evropo vnesen z domorodnega območja v Severni Ameriki. Od prvega odkritja v Evropi, v Italiji leta 2000, se je hrastova čipkarka pozneje hitro razširila po velikem geografskem območju in jo je danes mogoče najti v več kot ducatu drugih evropskih držav. V nekaterih državah, kot sta Madžarska in Hrvaška, je njena populacija dosegla precej visoko raven in pomeni resno težavo, saj bi lahko škodljivi organizem precej vplival na zdravje hrastov in potencialno povečal njihovo dovzetnost za druge škodljive organizme in bolezni.

Na naravnem območju razširjenosti vrsta *Corythucha arcuata* na splošno velja za nadležen škodljivi organizem, ki povzroča samo minimalno škodo, čeprav lahko velike populacije povzročijo zgodnje odpadanje listov. V Evropi so evidentirani vplivi precej raznovrstni, zato je resnično treba razumeti, kateri dejavniki vplivajo na razvoj te invazivne žuželke in kako lahko vpliva na zdravje hrastov. Projekt OLBIE obravnava ključna vprašanja in vrzeli v poznavanju vrste *Corythucha arcuata*, zlasti na področju biologije, širjenja, možnosti nadzora in upravljanja ter širših okoljskih vplivov. Projekt koordinira mreža Euphresco, ki omogoča sodelovanje in povezovanje organizacij za izvajanje nacionalnih raziskav na fitosanitarnem področju. Več podrobnosti je na voljo na spletnem naslovu <https://www.euphresco.net/>.

**Ključne besede:** vplivi, invazivna žuželka, hrasti, zdravje dreves

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## Action plan for invasive alien species (IAS) management in the Landscape park Tivoli, Rožnik and Šišenski hrib (LPTRŠ) near Ljubljana, Slovenia – stakeholders' involvement

### Akcijski načrt za obvladovanje invazivnih tujerodnih vrst (ITV) v Krajinskem parku Tivoli, Rožnik in Šišenski hrib (KP TRŠ) pri Ljubljani, Slovenija – vključevanje deležnikov

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The presentation will explain the importance of stakeholder involvement in the process of the preparation of the Action plan for IAS management in the protected area.

The LPTRŠ encompasses 459 ha of hilly, forested land and a city park Tivoli in the south-western part of Ljubljana, the capital of Slovenia. Only the western part of the park is opened to the agricultural land, however on the North, South and East the area around the park is highly urbanised. That is the reason for high infestation with IAS in the area. Among IAS ornamental plants and alien tree species are dominant.

Action plan has been prepared through the LIFE ARTEMIS project. One of the goals of the Action plan has been rising public awareness. Thus, IAS inventory was made by volunteers, which have been trained to recognise IAS. The central IAS information system ([www.invazivke.si](http://www.invazivke.si)) developed in the project was used for collecting data. Ten species were selected for the eradication action carried out with the help of volunteers in 2018 and 2019. Schools have also participated in the eradication actions. For the preparation of the action plan many stakeholders have been involved in workshops and meetings, with the emphasis on the Manager of the LP TRŠ, Municipality of Ljubljana and the park's landowners.

Stakeholders' involvement in the preparation of the action plan is important for its acceptance and implementation.

**Keywords:** LIFE ARTEMIS, action plan, invasive alien species management, stakeholders' involvement

Predstavili bomo pomen vključevanja deležnikov v proces priprave akcijskega načrta za obvladovanje ITV v zavarovanem območju.

KP TRŠ obsega 495 ha gričevnatega, z gozdom poraslega sveta in mestni park Tivoli na jugozahodnem delu Ljubljane, glavnega mesta Slovenije. Samo zahodni del krajinskega parka se navezuje na kmetijsko krajino, severno, južno in vzhodno pa ga obdaja gosto poseljeno območje. To so razlogi, da je na območju veliko ITV, med katerimi prevladujejo okrasne rastline in tujerodna drevesa.

Akcijski načrt smo pripravili v sklopu projekta LIFE ARTEMIS. Eden od ciljev Akcijskega načrta je bil tudi povečanje ozaveščenosti javnosti. Zato smo popis ITV izvedli s pomočjo prostovoljcev, ki smo jih izobraževali v prepoznavanju ITV. Podatke smo vnašali v centralni informacijski sistem za zbiranje podatkov o ITV ([www.invazivke.si](http://www.invazivke.si)), ki smo ga razvili tekom projekta. Izbrali smo deset vrst, ki smo jih v letih 2018 in 2019 odstranjevali s pomočjo prostovoljcev. Pri tem so sodelovale tudi šole. V pripravo akcijskega načrta smo vključili številne deležnike, ki smo jih povabili na sestanke in delavnice. Ključni deležniki pri tem so bili upravljavec KP TRŠ, Mestna občina Ljubljana in lastniki zemljišč.

Vključevanje deležnikov v pripravo akcijskega načrta je zelo pomembno za pozitiven odnos do načrta in njegovo dosledno izvajanje.

**Ključne besede:** LIFE ARTEMIS, akcijski načrt, obvladovanje invazivnih tujerodnih vrst, vključevanje deležnikov

# **SECTION 7**

## **ECOLOGY AND INVASIVE ALIEN SPECIES**

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## Effects of *Robinia pseudoacacia* in Natura 2000 sites in Italy: a comparison with *Castanea sativa* woods

### Vplivi drevesa *Robinia pseudoacacia* na območjih Natura 2000 v Italiji: primerjava z gozdovi *Castanea sativa*

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*Robinia pseudoacacia* is the most commonly spread and well-known alien species forming forests in Europe. Many of these forests are found within protected areas (e.g. Natura 2000 sites). However, little is known of the specific impacts that this species can have on the structure and functions of protected natural and semi-natural habitats. In this study we report results from an investigation of paired plots dominated by black locust and chestnut within the Natura 2000 network in the Veneto region (north-eastern Italy). Paired plots have a minimum distance of 1 km and are a commonly applied sampling method for studying effects of invasive species. We surveyed and analysed vascular plant species composition and forest structure. Management was also recorded by differentiating between coppiced and abandoned stands. Results are discussed with reference to the possible effects on biodiversity and structural and functional changes as those derived from variations in snags and logs quantity. These outcomes can help to indicate possible guidelines for the application of prevention and management actions to contrast the threat posed by invasive alien tree species.

**Keywords:** black locust, non-native tree, exotic tree, forest management

*Robinia pseudoacacia* je najbolj razširjena in znana tujerodna vrsta, ki tvori gozdove v Evropi. Številni od teh gozdov so na zavarovanih območjih (npr. na območjih Natura 2000). Vendar je o specifičnih vplivih, ki jih ima lahko ta vrsta na strukturo in funkcije zavarovanih naravnih in polnaravnih habitatov, malo znanega. V tej študiji poročamo o rezultatih raziskave dvojic parcel, na katerih prevladujeta navadna robinija in kostanj, v omrežju Natura 2000 v regiji Benečija (severovzhodna Italija). Najmanjša razdalja med dvojicami parcel, ki so splošna uporabna metoda vzorčenja za proučevanje vplivov tujerodnih vrst, je 1 km. Sistematično raziskali in analizirali smo vrstno sestavo višjih rastlin in gozdno strukturo. Dokumentirano je bilo tudi upravljanje ob razlikovanju med sestojema nizki gozd in zapuščeni gozd. Rezultati so obravnavani glede na mogoče vplive na biotsko raznovrstnost ter strukturne in funkcijske spremembe, kot so spremembe, izpeljane iz razlik v količini stoječega in ležečega mrtvega drevja. Ti rezultati lahko pomagajo pri iskanju mogočih usmeritev pri uporabi preventivnih ukrepov in ukrepov upravljanja, s katerimi se bo mogoče odzvati na nevarnost, ki jo ustvarjajo invazivne tujerodne drevesne vrste.

**Ključne besede:** navadna robinija, tujerodna drevesna vrsta, tujerodna drevesna vrsta, gospodarjenje z gozdovi

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## Presence of invasive alien plants in canopy gaps of different forest communities

### Prisotnost invazivnih tujerodnih rastlin v vrzelih v različnih gozdnih združbah

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The successful implementation of continuous cover forestry raises several practical and theoretical challenges from the natural conservation point of view and forestry as well. One of the essential questions is the assurance of various and sufficient tree species in the regeneration. Natural regeneration is highly compromised by the presence of alien plant species. Hungarian forests are mainly affected by the presence of adventive species, although we have little information about their impacts on natural regeneration.

To address this question vegetation of 140 artificial forest canopy gaps have been studied in five forest communities (sessile oak – hornbeam forest, Turkey oak – sessile oak forest, thermophilous oak forest, mixed coniferous forest, screes forest), in ten study areas of Hungary. The cover of invasive species in forest gaps showed big variety within the study areas and between forest communities. Sessile oak – hornbeam forest proved to be the most infected forest community, where the average invasive cover reached 47 % of forest gap area through the dominance of giant goldenrod (*Solidago gigantea*), American pokeweed (*Phytolacca americana*) and Canadian fleabane (*Conyza canadensis*) in one of the study areas. The most considerable alien species and woody plant species separated according to the gap size. Bigger gap area significantly correlated with increased invasive weed cover, while smaller gap area optimally affected woody regrowth. According to our results, the presence of invasive species in studied forest gaps was relatively low but showed wide variety in plant species composition and cover.

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**Keywords:** continuous cover forestry, forest gap, natural regeneration, invasive alien plants

Uspešno izvajanje gozdarstva na podlagi stalne pokritosti ustvarja razne praktične in teoretične izzive s stališča ohranjanja narave in gozdarstva. Eno od poglavitnih vprašanj je zagotavljanje različnih drevesnih vrst in njihovo zadostno število pri pomlajevanju. Naravno pomlajevanje gozdov je močno ogroženo zaradi prisotnosti tujerodnih rastlinskih vrst. Madžarske gozdove ogrožajo predvsem adventivne vrste, čeprav imamo malo podatkov o njihovem vplivu na naravno pomlajevanje gozdov.

Za obravnavo tega vprašanja je bila proučena vegetacija 140 vrzeli v krošnjah umetnih gozdov v petih gozdnih združbah (gradnov in gabrov gozd, cerov in gradnov gozd, toploljubni hrastov gozd, mešani iglasti gozd, gozd na melišču) na desetih proučevanih območjih na Madžarskem. Pri pokritosti z invazivnimi vrstami v sestojnih vrzelih so se pokazale velike razlike v sklopu proučevanih območij in med gozdnimi združbami. Izkazalo se je, da je gradnov in gabrov gozd najbolj okužena gozdna združba, kjer je povprečna pokritost z invazivnimi vrstami dosegla 47 % območja sestojnih vrzeli, pri čemer so na enem od proučevanih območij prevladovali orjaška zlata rozga (*Solidago gigantea*), navadna barvilnica (*Phytolacca americana*) in kanadska hudoletnica (*Conyza canadensis*). Najpomembnejše tujerodne vrste in lesnate rastlinske vrste so bile različne glede na velikost vrzeli. Večje območje vrzeli je bilo pomembno povezano s povečano pokritostjo z invazivnim plevelom, manjše območje vrzeli pa je optimalno vplivalo na ponovno rast lesnatih rastlin. V skladu z rezultati je prisotnost invazivnih vrst v proučevanih sestojnih vrzelih razmeroma majhna, razlike v vrstni sestavi rastlin in pokritosti z rastlinskimi vrstami pa so bile velike.

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**Ključne besede:** gozdarstvo na podlagi stalne pokritosti, sestojna vrzel, naravno pomlajevanje gozdov, invazivne tujerodne rastline

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# Thermal requirements for seed germination of three invasive alien species (IAS)

## Toplotne zahteve za klitje semen treh invazivnih tujerodnih vrst

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Invasive alien species (IAS) have been introduced outside their native sites by humans and becoming part of local flora. The IAS number is strongly increased worldwide during the past two centuries, redefining the classical biogeography boundaries, affecting ecosystem functioning, human health and economies. IAS represent one of the main threats to biodiversity and interconnected ecosystem services.

This work aimed to investigate thermal requirements for seed germination of *Ailanthus altissima* (Mill.) Swingle, *Robinia pseudoacacia* L. and *Phytolacca americana* L. Germination tests were carried out at the Germplasm Bank (Botanical Garden of Rome). Seeds were incubated in the dark, and in the light (12 h light/12 h darkness) at three range temperatures (15/6, 20/10 and 30/20 °C). For *A. altissima* and *P. americana* cold stratification (4 °C, for 1 month) was investigated as potential factor improving seed germination. Differently, no cold stratification was applied to *R. pseudoacacia*, which shows pronounced physical dormancy due to an impermeable seed coat. In this case a seed piercing to determine a higher germination was applied.

*A. altissima* and *P. americana* showed a higher germination rate at 30/20 °C than at 20/10 and 15/6 °C. *R. pseudoacacia* showed a high germination rate after piercing at 15/6 °C and 20/10 °C, whereas at 30/20 °C a high seed mortality was observed. Expanding knowledge on IAS seed germination is crucial to better understand the invasiveness process. This information can help to find and apply incisive and more appropriate actions to limit the establishment and survival of IAS, whose invasiveness could benefit from climate change in progress.

**Keywords:** IAS, germination test, temperatures, seed dormancy

Invazivne tujerodne vrste so na območja zunaj domorodnih območij vnesli ljudje in postajajo del lokalne flore. Število invazivnih tujerodnih vrst je v zadnjih dveh stoletjih močno naraslo po vsem svetu, zaradi česar se na novo določajo klasične biogeografske meje, to pa vpliva na delovanje ekosistemov, zdravje ljudi in gospodarstvo. Invazivne tujerodne vrste so ena od glavnih groženj biotski raznovrstnosti in povezanim ekosistemskim storitvam.

Cilj te študije je raziskati toplotne zahteve za klitje semen vrst *Ailanthus altissima* ((Mill.) Swingle), *Robinia pseudoacacia* L. in *Phytolacca americana* L. Testi kalivosti so bili izvedeni v semenski banki (Botanični vrt v Rimu). Semena so bila inkubirana v temi in na svetlobi (12 ur na svetlobi/12 ur v temi) pri treh temperaturnih razponih (15/6, 20/10 in 30/20 °C). Za vrsti *A. altissima* in *P. americana* je bila kot potencialni dejavnik izboljšanja kalivosti semen raziskana hladna stratifikacija (4 °C, 1 mesec). Za vrsto *R. pseudoacacia*, ki ima izrazito fizično dormanco zaradi nepropustne semenske ovojnice, pa hladna stratifikacija, nasprotno, ni bila uporabljena. Pri tej vrsti je bila za določanje večje kalivosti uporabljena perforacija semen.

Pri vrstah *A. altissima* in *P. americana* je bila pri temperaturnem razponu 30/20 °C ugotovljena večja kalivost kot pri temperaturnih razponih 20/10 in 15/6 °C. Pri vrsti *R. pseudoacacia* je bila ugotovljena večja kalivost po perforaciji pri temperaturnih razponih 15/6 °C in 20/10 °C, pri temperaturnem razponu 30/20 °C pa je bila ugotovljena velika smrtnost semen. Razvijanje znanja o kalivosti semen invazivnih tujerodnih vrst je ključno za boljše razumevanje procesa invazivnosti. Te informacije lahko pomagajo pri iskanju in uvedbi učinkovitih in primernejših ukrepov za omejitev naselitve in preživetja invazivnih tujerodnih vrst, saj lahko na njihovo invazivnost ugodno vplivajo trenutne podnebne spremembe.

**Ključne besede:** invazivne tujerodne vrste, test kalivosti, temperature, dormanca semen



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## **Analysis of fungal community associated to the alien invasive ambrosia beetle *Xylosandrus compactus*: a specific contribute to the project LIFE17 NAT/IT/000609 SAMFIX: SAVING Mediterranean Forests from Invasions of *Xylosandrus* beetles and associated pathogenic fungi.**

### **Analiza glivne združbe, povezane z invazivnim tujerodnim ambrozijskim podlubnikom *Xylosandrus compactus*: posebni prispevek k projektu LIFE17 NAT/IT/000609 SAMFIX: Reševanje sredozemskih gozdov pred vnosi hroščev *Xylosandrus* in povezanih patogenih gliv**

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Following the outbreak of infestation of the alien invasive ambrosia beetle *Xylosandrus compactus* in the Mediterranean maquis in Central Italy, the Life project SAMFIX was launched in 2018 to implement monitoring, control and communication strategies to mitigate the damages and to raise the public awareness around the problem. The project joins together researchers, managers and rangers of natural areas and public bodies of Mediterranean regions of Italy, Spain, and France in 4 years of coordinated activity.

Invasive ambrosia beetles live in symbiosis with a fungal community characterized by a variate functionality, including mutualists, plant pathogens, entomopathogens, and pure saprotrophs. The widespread decline and mortality of natural and cultivated Lauraceae species in South East United States driven by the Ambrosia beetle *Xyleborus glabratus* and the associated pathogenic fungus *Raffaelea lauricola* represents a Black Swan event caused by an unexpected association between two alien invasive pests.

The present study proposes a novel approach to describe and to rank for the risk they can pose, the fungal community associated to the invasive *Xylosandrus* spp., based on HTS technology, metacommunity analysis, and functional guild's assessment. HTS analysis of adults of *X. compactus* captured from galleries of the different host, resulted in a total of 179 fungal OTU's, many with plant pathogenic lifestyle. Beta-diversity assessment by weighted UniFrac distance revealed a significant difference between fungal community associated with insects from different hosts.

The variety of interactions between the beetles and the fungal community, highlight the risk of insurgence of novel interactions with alien invasive

Po izbruhu napadenosti makije z invazivnim tujerodnim ambrozijskim podlubnikom *Xylosandrus compactus* v osrednji Italiji se je leta 2018 začel projekt Life SAMFIX za izvajanje strategij spremljanja, nadzora in komuniciranja za ublažitev škode in ozaveščanje javnosti o problemu. Projekt združuje raziskovalce, upravitelje in čuvaje naravnih območij ter javne organizacije sredozemskih regij v Italiji, Španiji in Franciji v usklajeni dejavnosti, ki traja štiri leta. Invazivni ambrozijski podlubniki živijo v simbiozi z glivno združbo, za katero je značilna spremenljiva funkcionalnost, vključno z mutualisti, povzročitelji bolezni rastlin, entomopatogenimi glivami in pravimi saprotrofi. Zmanjšanje razširjenosti ter smrtnost naravnih in gojenih vrst lovorovk v jugovzhodnem delu ZDA zaradi ambrozijskega podlubnika *Xyleborus glabratus* in povezane patogene glive *Raffaelea lauricola* sta nepričakovana dogodka, ki ju je povzročila nepričakovana povezava dveh invazivnih tujerodnih škodljivih organizmov.

V tej študiji je predlagan nov pristop k opisu in razvrstitvi tveganja, ki ga lahko ustvarja glivna združba, povezana z invazivnimi vrstami *Xylosandrus* spp., ta pristop pa temelji na tehnologiji HTS, analizi metazdružbe in oceni funkcionalne združbe. Rezultat analize odraslih osebkov *X. compactus*, ujetih v rovih različnih gostiteljev, s tehnologijo HTS je bilo skupno 179 glivnih operativnih taksonomskih enot, številne od njih so imele življenjski slog povzročiteljev bolezni rastlin. Ocena beta-diverzitete s tehtano razdaljo UniFrac je pokazala pomembno razliko med glivnimi združbami, povezanimi z žuželkami iz različnih gostiteljev.

Raznolikost interakcij med hrošči in glivno združbo poudarja nevarnost pojava novih interakcij z

species that might evolve in stable associations. Such event is favored by the wide host range of *X. compactus* spanning from exotic to native European species in nurseries and natural environments, that could facilitate the host shift of associated fungi.

**Keywords:** alien invasive plant pests; symbiotic interactions, ambrosia beetles, HTS analysis

invazivnimi tujerodnimi vrstami, ki bi se lahko razvile v stalne povezave. Tak razplet bi lahko spodbudila raznolikost gostiteljev škodljivega organizma *X. compactus*, ki sega od tujerodnih do domorodnih evropskih vrst v drevesnicah in naravnem okolju ter bi lahko olajšala preusmeritev povezanih gliv na druge gostitelje.

**Ključne besede:** invazivni tujerodni škodljivi organizmi za rastline, simbiotične interakcije, ambrozijski podlubniki, analiza HTS

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## The oak lace bug (*Corythucha arcuata*) – a multiple threat on oak ecosystems

### Hrastova čipkarka (*Corythucha arcuata*) – večkratna nevarnost za hrastove ekosisteme

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The North American oak lace bug was first found in Italy (spring 2000) and two years later in Switzerland and in Turkey. Up until autumn 2018, it had been recorded in Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Hungary, Iran, Romania, Russia, Serbia, Slovakia and Slovenia.

To predict its potential host range, more than 40 oak species were checked in arboreta and botanical gardens between 2013 and 2018. Close to 30 species of Eurasian oaks (both in section *Quercus* and section *Cerris*) were accepted as host plants. No species in section *Lobatae* or *Ilex* group were accepted as hosts. Based on these findings, we predict that the lack of suitable hosts will not restrict the oak lace bug's further area expansion either in the North, West or East.

The overwintering success of the oak lace bug was first studied after winters 2016/2017 and 2018/2019, at five locations in Hungary. Far more than 50% of the bugs survived the winter.

The long-term impact of the OLB damage is not yet known, but there are good reasons to assume that the "chronic" infestations will have significant negative effects on the growth, health status and fecundity of the oak stands that already suffer from both direct and indirect effects of climate change.

It is also still unknown how the mass presence of oak lace bug will influence the rich herbivore communities (including protected and even endangered species) thriving on oaks.

Our present research intends to clarify these direct and indirect impacts.

**Keywords:** invasive species, oak lace bug, *Quercus*, host range, negative impacts

Severnoameriško hrastovo čipkarko so prvič našli v Italiji (spomladi leta 2000), dve leti pozneje pa tudi v Švici in Turčiji. Do jeseni leta 2018 so jo evidentirali v Albaniji, Bosni in Hercegovini, Bolgariji, na Hrvaškem, v Grčiji, na Madžarskem, v Iranu, Romuniji, Rusiji, Srbiji, na Slovaškem in v Sloveniji. Za napovedovanje njenih potencialnih gostiteljev je bilo med letoma 2013 in 2018 pregledanih več kot 40 vrst hrasta v arboretumih in botaničnih vrtovih. Kot gostiteljske rastline je bilo potrjenih skoraj 30 vrst evrazijskega hrasta (v sekciji *Quercus* in *Cerris*). Za gostiteljsko rastlino ni bila potrjena nobena iz vrste v sekciji *Lobatae* ali skupini *Ilex*. Na podlagi teh ugotovitev napovedujemo, da pomanjkanje primernih gostiteljev ne bo omejilo nadaljnega širjenja območja pojavljanja hrastove čipkarke, in sicer niti na severu, zahodu ali vzhodu.

Uspešnost prezimovanja hrastove čipkarke je bila prvič proučevana po zimah 2016/2017 in 2018/2019 na petih lokacijah na Madžarskem. Zimo je preživel precej več kot 50 % hrastovih čipkark. Dolgoročni vpliv škode, ki jo povzroči hrastova čipkarka, še ni znan, vendar obstajajo dobri razlogi za domnevo, da bo imela kronična napadenost pomembne negativne učinke na rast, zdravstveno stanje in reprodukcijsko sposobnost hrastovih sestojev, ki so jih že prizadeli neposredni in posredni učinki podnebnih sprememb.

Poleg tega še vedno ni znano, kako bo množična pojavnost hrastove čipkarke vplivala na bogate združbe herbivorov (vključno z zavarovanimi in ogroženimi vrstami), ki se razvijajo na hrastih.

Namen trenutne raziskave je pojasniti te neposredne in posredne vplive.

**Ključne besede:** invazivne vrste, hrastova čipkarka, *Quercus*, gostitelji škodljivega organizma, negativni učinki

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## WORKSHOP 3

### **Communicating on invasive alien species: exchange of tips and tricks for successful outreach**

### **Komuniciranje o invazivnih tujerodnih vrstah: izmenjava izkušenj in pristopov, ki delujejo**

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Awareness-raising is an important component of the management of invasive alien species (IAS) at all levels. It can help us prevent the introduction and spread of (potentially) invasive alien species and to involve the public in collecting data. We can also seek to ensure support of the public or involvement of volunteers in eradication measures. Several approaches can be used to address invasive alien species, but the messages have to be appropriately phrased and adapted to different target groups. Particularly challenging may be communicating on the newly arriving, potentially invasive alien species which do not yet cause visible damage and may not seem to be a reason for concern. In the last years, there are many new possibilities available to communicate through on-line media and social networks, but it is challenging to ensure correct and unbiased reporting in the press. Often, campaigns on invasive alien species are challenged by denialism of the environmental threats posed by IAS. At the workshop, we will, with examples of selected alien species, discuss appropriate communication approaches and prepare ideas of effective communication messages.

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## WORKSHOP 4

### **Rapid response and invasive alien species**

### **Hitro odzivanje in invazivne tujerodne vrste**

moderators: A. Marinšek\*

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The workshop will deal with a mechanism of early warning and rapid response in case of invasive alien species (IAS) in our environment. The main goal will be to find out answers to problems of rapid response, and to search in-depth for solutions. With regards to applicability, participants will be working in small groups and will be focusing on different organisms (i.e. plant, insect, fungus, and mammal).

# POSTERS



## Bilateral cooperation on citizen science: US-Slovenia GeoBioBlitz 2019 – invasives: the threat to biodiversity

### Dvostransko sodelovanje z ljubiteljskimi poznavalci: ameriško-slovenski dogodek GeoBioBlitz 2019 – Invazivke: grožnja biodiverziteti

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The 4<sup>th</sup> Annual US Embassy supported GeoBioBlitz: Invasives – The Threat to Biodiversity by Land and Water took place in Slovenia on June 14-15, 2019 primarily at Lake Bohinj in Triglav National Park in Slovenia. The bioblitz is a hands-on citizen science approach where a group of people aims to document as much biodiversity as possible in a given area in a limited amount of time, in our case with a strong emphasis on the interaction of the geographical and the biological. This year the aim was to raise awareness, document, and show solutions to one of the more insidious threats to biodiversity: invasive alien species. As part of its public diplomacy outreach, the US Embassy seeks to promote bilateral cooperation in areas of mutual interest to the US and Slovenia. This year's GeoBioBlitz again brought together experts from the US and Slovenia, sister parks Triglav National Park Slovenia and Crater Lake National Park, Oregon, USA, Slovenian school teams and US students teams from international schools in Slovenia to explore a problem common to both the US and Slovenia: invasive alien species. Thus we created a program using citizen science as both a scientific and educational tool that encourages bilateral cooperation between Slovenians and Americans on a variety of levels, whether university, research institution, elementary or high school, or national park, in an area of mutual interest.

**Keywords:** citizen science, bilateral cooperation, US Embassy, national parks

Četrty vsakoletni dogodek GeoBioBlitz: Invazivke – grožnja biodiverziteti na kopnem in v vodi, ki ga podpira Veleposlaništvo ZDA, je potekal v Sloveniji od 14. do 15. junija 2019, večinoma ob Bohinjskem jezeru v Triglavskem narodnem parku. Bioblitz je praktičen pristop z ljubiteljskimi poznavalci, pri katerem si skupina ljudi prizadeva v omejenem času čim bolj popisati biotsko raznovrstnost na nekem območju, v našem primeru z močnim poudarkom na interakciji med geografi in biologi. Letos je bil cilj ozaveščati o eni od najbolj zahrbtnih groženj biotski raznovrstnosti: o invazivnih tujerodnih vrstah, jih popisati in prikazati rešitve. Kot del ozaveščanja na področju javne diplomacije si Veleposlaništvo ZDA prizadeva za spodbujanje dvostranskega sodelovanja na področjih skupnega interesa za ZDA in Slovenijo. Letošnji dogodek GeoBioBlitz je pri raziskovanju problema, ki je skupen ZDA in Sloveniji, tj. invazivnih tujerodnih vrst, znova združil strokovnjake iz ZDA in Slovenije, pobratena narodna parka Triglavski narodni park in Narodni park Kraterskega jezera v Oregonu, ZDA, skupine slovenskih učencev in skupine ameriških učencev iz mednarodnih šol v Sloveniji. Tako smo ustvarili program, ki vključuje ljubiteljske poznavalce kot znanstveni in izobraževalni temelj, ki spodbuja dvostransko sodelovanje med Slovenci in Američani na različnih ravneh, ne glede na to, ali gre za univerzo, raziskovalno ustanovo, osnovno šolo, gimnazijo ali narodni park, na področjih skupnega interesa.

**Ključne besede:** ljubiteljska znanost, dvostransko sodelovanje, Veleposlaništvo ZDA, narodni parki

## Predictive modelling and maps as a strategic tool for effective management and protection of forests under alien tree pathogens invasions

### Napovedno modeliranje in zemljevidi kot strateška orodja za učinkovito gospodarjenje z gozdovi in varstvo gozdov pri vnosih tujerodnih patogenov za drevesa

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The increase in number of invasive alien tree pathogens and severity of diseases caused by them over the last few decades has led to the perception of tree pathogens as a driving force forming forest ecosystems. They represent a global challenge for sustainable forestry, landscape management, nature and landscape protection and rural economies. Suitable predictive models and maps of pathogens distribution and impacts on forests and landscapes at the local level are often lacking. Even though, the identification of locations at the highest as well as the lowest risk of invasion and damage is crucial for the implementation of effective management strategies to control invasions and protect forests and landscapes at the state level. We aimed to develop spatial predictions of i) the environmental suitability for the pathogens potentially having the highest impact on the Czech nature and/or ii) the potential severity of their impact on Czech forests. We used geographic information systems in conjunction with species distribution models to solve the task. Statistical models were developed for species widespread in the Czech Republic and with enough location data available for modelling and expert models for dangerous species whose invasion into the country threatens in the near future. The poster presents statistical models and maps for *Hymenoscyphus fraxineus*, the first one predicting the current ash dieback severity and the second one the environmental suitability for the disease in all forests containing ash trees across the Czech Republic, and an expert model and map predicting the environmental suitability for *Phytophthora cinnamomi*.

This work was supported by the Technology Agency of the Czech Republic under the Grant TH03030306.

**Keywords:** predictive modelling, invasive alien tree pathogens, landscape pathology, forest disease management, Czech Republic

Zaradi povečanja števila invazivnih tujerodnih patogenov za drevesa in resnosti bolezni, ki so jih povzročili v zadnjih nekaj desetletjih, patogene za drevesa dojemamo kot gonilno silo pri oblikovanju gozdnih ekosistemov. So globalni izziv za trajnostno gozdarstvo, izvajanje ukrepov za ohranjanje krajine, varstvo narave in krajine ter podeželsko gospodarstvo. Primernih napovednih modelov in zemljevidov razširjenosti patogenov in vplivov na gozdove in krajine na lokalni ravni pogosto ni. Kljub temu je prepoznavanje lokacij z največjim in najmanjšim tveganjem za vnos in nastanek škode ključno za izvajanje učinkovitih strategij upravljanja za nadzor nad vnosi ter varstvo gozdov in krajin na državni ravni. Naš cilj je bil razviti prostorsko napovedovanje i) okoljske ustreznosti za patogene, ki imajo lahko potencialno največji vpliv na naravo na Češkem in/ali ii) potencialne resnosti njihovega vpliva na gozdove na Češkem. Pri reševanju naloge smo uporabljali geografske informacijske sisteme v povezavi z modeli razširjenosti vrst. Razviti so bili statistični modeli za vrste, razširjene na Češkem, z dovolj razpoložljivimi podatki o lokaciji za modeliranje in strokovne modele za nevarne vrste, ki se lahko vsiljivo naseli v državo v bližnji prihodnosti. Na plakatu so navedeni statistični modeli in zemljevidi pojavljanja patogena *Hymenoscyphus fraxineus*, in sicer prvi napoveduje trenutno resnost jesenovega ožiga, drugi pa okoljsko ustreznost za bolezen v vseh gozdovih z jesenom na Češkem ter strokovni model in zemljevid, ki napovedujeta okoljsko ustreznost za plesen *Phytophthora cinnamomi*.

To delo je z nepovratnimi sredstvi podprla Agencija Češke za tehnologijo, št. TH03030306.

**Ključne besede:** napovedno modeliranje, invazivni tujerodni patogeni za drevesa, patologija krajine, obravnava bolezni v gozdovih, Češka

## Risk assessment of shade-tolerant, non-native species escaped from botanic garden

### Ocena tveganja sencovzdržnih tujerodnih vrst, ki so ušle iz botaničnega vrta

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Botanic gardens are increasingly recognized as sources and facilitators of plant invasions by non-native species worldwide. Deliberate or accidental introductions, early cultivation and local disseminations are the key processes that may help the potential invasive species. Those species that escape cultivation and become abundant in botanic gardens should be subjected to risk assessments.

We chose three highly abundant, shade-tolerant non-native species from the 'Al. Borza' Botanical Garden, Cluj, Romania (*Impatiens parviflora*, *Geranium sibiricum* and *Duchesnea indica*), and addressed the following questions as the basis of a detailed risk assessment: (1) Can these potentially invasive species establish in natural forests? (2) Does the soil biota of these forests help/hinder the performance of these species? (3) Do these species show higher establishment and growth potential than native woody species?

We performed a pot experiment with these three non-native and six native woody species collected from a nearby forest. We put the seeds to germinate in sterile and non-sterile soils collected from under beech or hornbeam trees. We followed the germination and performance of plants for four months.

We found that all three potentially invasive species had high establishment rate in both woody soils, although sterile soils significantly reduced their germination rate, except in case of *G. sibiricum*. Their biomass gain was generally higher in hornbeam soil. Compared to native species, *I. parviflora* and *G. sibiricum* showed significantly quicker biomass gain and higher final biomass. In conclusion, all three non-native species have high potential to establish and spread in natural forest nearby the city.

**Keywords:** woody invasive, potential invasive species, botanic garden, pot experiment

Botanični vrtovi vedno bolj veljajo za vire in pospeševalce vnosov tujerodnih vrst rastlin po vsem svetu. Namerni ali nenamerni vnosi, zgodnje gojenje in lokalno razširjanje so ključni procesi, ki lahko pomagajo potencialno invazivnim vrstam. Tiste vrste, ki uidejo gojenju in se razširijo v botaničnih vrtovih, bi morale biti predmet ocen tveganja.

Izbrali smo tri zelo razširjene sencovzdržne tujerodne vrste iz botaničnega vrta Al. Borza, Cluj, Romunija (*Impatiens parviflora*, *Geranium sibiricum* in *Duchesnea indica*), in obravnavali naslednja vprašanja, na katerih je temeljila podrobna ocena tveganja: (1) ali se lahko te potencialno invazivne vrste naselijo v naravnih gozdovih, (2) ali lahko talni organizmi v teh gozdovih spodbujajo/ovirajo uspevanje teh vrst, (3) ali imajo te vrste večji naselitveni in rastni potencial kot domorodne lesnate vrste.

Izvedli smo lončni poskus s temi tremi tujerodnimi in šestimi domorodnimi lesnatimi vrstami, ki smo jih prinesli iz bližnjega gozda. Semena smo pustili kaliti v sterilni in nesterilni prsti, ki smo jo nabrali pod bukovimi drevesi ali drevesi belega gabra. Klitje in uspevanje rastlin smo spremljali štiri mesece.

Ugotovili smo, da so imele vse tri potencialno invazivne vrste visoko stopnjo naselitve v obeh vrstah gozdne prsti, čeprav je sterilna prst precej zmanjšala njihovo kalivost, razen v primeru *G. sibiricum*. Njihov prirast biomase je bil na splošno večji v gabrovi prsti. V primerjavi z domorodnimi vrstami je bil prirast biomase pri *I. parviflora* in *G. sibiricum* precej hitrejši, končna biomasa pa večja. Če povzamemo, imajo vse tri tujerodne vrste visok potencial naselitve in širjenja v naravnem gozdu v bližini mesta.

**Ključne besede:** lesnate invazivne, potencialno invazivne vrste, botanični vrt, lončni poskus

## First detection of kudzu (*Pueraria montana* var. *lobata*) in Slovenia: potential threat for Slovenian forests

### Prva najdba kudzuja (*Pueraria montana* var. *lobata*) v Sloveniji: potencialna grožnja za slovenske gozdove

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Based on the EU regulations, kudzu (*Pueraria montana* var. *lobata*) is listed as invasive alien species (IAS) of European Union concern, with a high risk of causing adverse impacts in the natural environment. Where it spreads invasively, it can overgrow and outcompete native vegetation, leading to the formation of mono-specific stands. In the late summer of 2018, the first two detections of kudzu were reported in the Invazivke.si database, where the information on IAS is collected as a part of the LIFE ARTEMIS project. Both localities, where kudzu was found, are in the Sub-Mediterranean region of Slovenia. In Strunjan, kudzu smothered mature trees in a small forest patch. Intensive measures for its eradication (cutting and digging of the above- and below-ground parts) were already done in December 2018. In Dekani, the plant covers much larger area (~500 m<sup>2</sup>). It spreads along the railroad close to the forest, and forms very dense cover. Initial eradication treatments (above-ground mulching) started at this location, but further repeated interventions are needed. Moreover, detailed monitoring of species response to eradication is advised in the following years. Early warning and rapid response in the initial stages of the invasion are key activities that largely contribute to the effective mitigation of the uncontrolled spread and subsequent negative impacts of IAS. Kudzu may, among many other IAS, pose a serious threat to some forest ecosystems in Slovenia, particularly those which experienced significant changes in stand structure (reduced canopy cover) due to large-scale disturbances in the last few years.

**Keywords:** kudzu, first detection, eradication, EU regulation, Invazivke.si

Na podlagi pravnih aktov EU je kudzu (*Pueraria montana* var. *lobata*) uvrščen na seznam invazivnih tujerodnih vrst (ITV), ki zadevajo Evropsko Unijo in za katere obstaja veliko tveganje, da bodo z nenadzorovanim širjenjem povzročile veliko okoljsko in gospodarsko škodo. Z invazivnim širjenjem lahko kudzu povsem preraste in izpodrine domače vrste rastlin, kar vodi v oblikovanje zelo gostih in neprehodnih sestojev. Poleti 2018 sta bili v informacijskem sistemu Invazivke.si, ki je namenjen zbiranju podatkov o ITV v okviru projekta LIFE ARTEMIS, potrjeni prvi najdbi kudzuja pri nas v naravnem okolju. Obe nahajališči kudzuja sta v submediteranskem fitogeografskem območju Slovenije. V bližini Strunjana je kudzu v obcestni mejici prerasel posamezna drevesa. Intenzivni ukrepi za njegovo izkoreninjenje (izkop nadzemnih in podzemnih delov) so že bili izvedeni v decembru 2018. Na drugem nahajališču, v Dekanih, kudzu prerašča veliko večjo površino (prib. 500 m<sup>2</sup>). Raste vzdolž železniške proge v bližini gozda in tvori zelo gost sestoj. Na tej lokaciji so se že pričele aktivnosti odstranjevanja (mulčenje in nadzorovan požig), vendar bo potrebno ukrepe zatiranja redno ponavljati tudi v prihodnje. Poleg tega se priporoča redni monitoring odziva rastline na izvedene ukrepe. Zgodnje obveščanje in hitro odzivanje v začetnih fazah širjenja sta ključni dejavnosti, ki bistveno pripomoreta k učinkovitemu zmanjševanju negativnih vplivov ITV. Kudzu je, poleg številnih drugih ITV, rastlinska vrsta, ki lahko resno ogrozi nekatere gozdne ekosisteme v Sloveniji. Za vdor in širjenje ITV so še posebej dovzetni tisti gozdovi, kjer je v zadnjem obdobju prišlo do izrazitih sprememb v strukturi gozdnih sestojev (npr. zmanjšan zastor drevesnih krošenj) in ekoloških razmerah, predvsem zaradi vpliva velikopovršinskih ujm oz. motenj.

**Ključne besede:** kudzu, prva najdba, ukrepi odstranjevanja, EU Uredba, Invazivke.si

## First record of *Corythucha arcuata* in Slovakia

### Prva najdba vrste *Corythucha arcuata* na Slovaškem

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In June 2018, the presence of one adult specimen and one egg cluster of the North-American oak lace bug *Corythucha arcuata* were recorded near the village of Mužla, close to the Danube River, in southern Slovakia. They were found on leaves of *Quercus cerris* growing in a mixed stand. In August 2018, other specimens (nymphs and adults) were observed on *Q. robur* leaves, near Čičarovce, in eastern Slovakia. This is the first record of *C. arcuata* in our country. The oak lace bug probably reached us while invading from Hungary, where heavy infestation is reported from several parts of the country.

**Keywords:** oak lace bug, *Quercus* spp., invasive species

Junija 2018 je bila evidentirana navzočnost odraslega osebka in jajčnega legla severnoameriške hrastove čipkarke *Corythucha arcuata* v bližini vasi Mužla blizu Donave na južnem Slovaškem. Najdena sta bila na listih vrste *Quercus cerris*, ki raste v mešanem sestoj. Avgusta 2018 so bili opaženi drugi osebki (nimfe in odrasli osebki) na listih vrste *Q. robur* v bližini Čičarovcev na vzhodnem Slovaškem. To je prva evidenca vrste *C. arcuata* v naši državi. Hrastova čipkarka je verjetno prišla z Madžarskega, kjer poročajo o hudih napadih v več delih države.

**Ključne besede:** hrastova čipkarka, *Quercus* spp., invazivne vrste



## Involvement of Volunteers in Invasive Alien Species Management in Urban Forest of Ljubljana (Slovenia)

### Vključevanje prostovoljcev v upravljanje z invazivnimi tujerodnimi rastlinskimi vrstami v mestnem gozdu Mestne občine Ljubljana

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In order to prevent the increasing damage caused by invasive alien species (IAS), we have set up a system for rapid detection of potentially invasive alien species in the territory of Slovenia. This system enables us to detect new IAS in the early stages of spreading and to implement various measures preventing them from forming permanent, large-scale populations that would cause harm. We tested the system in the target area of urban forest of Landscape park Tivoli, Rožnik, and Šiška hill in Ljubljana. This was the only area planned for the eradication of selected IAS in Slovenia within the LIFE ARTEMIS Project.

Under the LIFE ARTEMIS project - Action B.4 (Involvement of volunteers in the management of IAS in urban forests), we envisaged and implemented the following activities:

1. Activation and education of volunteers,
2. Inventory of IAS and selection of priority areas within the target area,
3. Preparation of action plan for removal of selected IAS plants,
4. Eradication of certain IAS plants in the target area.

As a part of the project activities, we activated 24 volunteers. We trained them at two workshops. In September and October 2017, we conducted two inventories of IAS in the target area. The total length of the transects recorded for IAS detection was 48 380 meters. The work was completed by 16 volunteers, eight people who are part of the LIFE ARTEMIS Project team, and two people who work professionally at the Landscape park. In total, the IAS census was performed by 26 persons with varying degrees of IAS recognition skills. The total number of recorded and geocoded IAS was 1402. On the LIFE ARTEMIS Warning or Observation List (de Groot et al. 2017), 25 different plant species (out of 60) were recorded, of which 10 were selected for further eradication by volunteers and were eradicated in 2018 and 2019.

**Keywords:** urban forest, invasive alien plant species, eradication, training volunteers, management, protected area

Z namenom, da bi preprečili naraščajočo škodo, ki jo povzročajo invazivne tujerodne vrste (ITV), smo na območju Slovenije vzpostavili sistem za hitro odkrivanje potencialno invazivnih tujerodnih vrst. Tak sistem nam omogoča, da odkrijemo nove ITV v zgodnjih fazah širjenja in različne ukrepe, ki preprečujejo, da bi oblikovali trajno populacijo večjega obsega, ki bi lahko povzročila škodo. Ta sistem smo preizkusili na območju mestnega gozda Krajinskega parka Tivoli, Rožnik in Šišenski hrib v Ljubljani. V projektu LIFE ARTEMIS je bilo to edino območje v Sloveniji, predvideno za izkoreninjenje izbranih ITV. V okviru projekta LIFE ARTEMIS - Akcija B.4 - Vključevanje prostovoljcev pri upravljanju ITV v mestnih gozdovih smo predvideli in izvedli naslednje dejavnosti:

1. Aktivacija in izobraževanje prostovoljcev
2. Popis ITV in izbira prednostnih delov območja popisa
3. Priprava akcijskega načrta za odstranitev izbranih ITV
4. Odstranjevanje izbranih ITV rastlin na ciljnem območju

V okviru projektnih aktivnosti smo uspeli aktivirati 24 prostovoljcev, ki so se usposabljali na dveh delavnicah. Septembra in oktobra 2017 smo na ciljnem območju opravili dva popisa ITV. Skupna dolžina transektov, zabeleženih za odkrivanje ITV, je bila 48 380 m. Delo je opravilo 16 prostovoljcev, 8 ljudi, ki so del projektne skupine LIFE ARTEMIS, in dve osebi, ki profesionalno delata v krajinskem parku. Popis ITV je tako opravilo 26 oseb z različnimi stopnjami poznavanja ITV. Skupno število zabeleženih in geokodiranih ITV je bilo 1402. Od 60 ITV iz Opozorilnega seznama LIFE ARTEMIS (de Groot in sod. 2017) je bilo zabeleženih 25 različnih rastlinskih vrst, od katerih jih je bilo 10 izbranih za nadaljnje odstranjevanje, ki je bilo nato izvedeno v letih 2018 in 2019.

**Ključne besede:** mestni gozd, invazivne rastline, izkoreninjenje, usposabljanje prostovoljcev, prostovoljstvo, gospodarjenje z gozdom



## The spread and host plants of *Metcalfa pruinosa* (Say, 1830) (Insecta: Hemiptera: Flatidae) in Bulgaria

### Širjenje in gostiteljske rastline vrste *Metcalfa pruinosa* (Say, 1830) (Insecta: Hemiptera: Flatidae) v Bolgariji

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*Metcalfa pruinosa* (Say, 1830) was first collected in Bulgaria at 2004 in a garden center in Plovdiv on *Tuja occidentalis* and in 2013 an outbreak of the pest was observed in the Botanical Garden in Balchik. In 2015, except in the northern parts of the Black Sea coast, a large infestation from planthopper was registered in the town of Pleven and Plovdiv.

The aim of this study was to identify distribution areas, habitat types and host plants of *M. pruinosa* in Bulgaria. The monitoring surveys were carried out during July – September 2016-2019 in urban green areas, vineyards and orchards in different regions in Bulgaria.

In 2016, *M. pruinosa* was established in the following regions, of the country: Varna, Vratsa, Blagoevgrad, Dobrich, Pleven, Rousse, Shumen, Bourgas, Plovdiv and single individuals are also caught in one garden in Sofia. The highest infestation level and the highest number of host species (41) was register in Varna on a total infested area of 0,4 h. In 2017, an extension of *M. pruinosa* distribution area was also found in the regions of Kardzhali, Stara Zagora and Vidin.

In 2018, 30 areas were surveyed in Sofia city and the species was established in 8 of them on 36 host species. In 2019 *M. pruinosa* was spread in many new areas in Sofia and the infestation become similar to that in Varna, 2016. A comparison of the attack from *M. pruinosa* in Varna and Sofia was made, where different levels of population size of the species was register with different levels of infestation, different numbers of host plants and the presence or absence of biological agent *Neodryinus typhlocybae* (Ashmead, 1893) (Hymenoptera: Dryinidae).

**Keywords:** *Metcalfa pruinosa*, host plants, distribution in Bulgaria

Vrsta *Metcalfa pruinosa* (Say, 1830) je bila v Bolgariji prvič najdena leta 2004 v vrtnem centru v Plovdivu na ameriškem kleku, leta 2013 pa je bil zaznan izbruh škodljivega organizma v botaničnem vrtu v Balchiku. Leta 2015 je bila z izjemo severnih delov črnomske obale opažena velika napadenost s škržatkom v mestih Pleven in Plovdiv.

Cilj študije je bil ugotoviti območja razširjenosti, vrste habitata in gostiteljske rastline vrste *M. pruinosa* v Bolgariji. Stalne sistematične raziskave so bile izvedene med julijem in septembrom v letih od 2016 do 2019 na urbanih zelenih območjih, v vinogradih in nasadih v več regijah v Bolgariji.

Leta 2016 je bila vrsta *M. pruinosa* naseljena v naslednjih okrajih v državi: Varna, Vratsa, Blagoevgrad, Dobrič, Pleven, Ruse, Šumen, Burgas, Plovdiv, posamezni osebki pa so bili ujeti tudi v nekem vrtu v Sofiji. Največja stopnja napadenosti in največje število gostiteljskih vrst (41) sta bila evidentirana v Varni na 0,4 ha infestirane površine. Leta 2017 je bilo ugotovljeno, da se je območje razširjenosti vrste *M. pruinosa* povečalo in je zajemalo tudi okraje Krdžali, Stara Zagora in Vidin. Leta 2018 je bila sistematična raziskava izvedena na 30 območjih v Sofiji, vrsta je bila naseljena na 8 območjih na 36 gostiteljskih vrstah. Leta 2019 je bila vrsta *M. pruinosa* razširjena na številnih novih območjih v Sofiji, napad pa je postal podoben napadu v Varni leta 2016. Narejena je bila raziskava napada vrste *M. pruinosa* v Varni in Sofiji, v kateri so primerjali različne velikosti populacije te vrste z različnimi stopnjami napada, različnim številom gostiteljskih rastlin in navzočnostjo naravnega sovražnika, predatorske in parazitoidne osice *Neodryinus typhlocybae* (Ashmead, 1893) (Hymenoptera: Dryinidae).

**Ključne besede:** *Metcalfa pruinosa*, gostiteljske rastline, razširjenost v Bolgariji

## Invasive plants in riparian forests of Nature Park Ljubljansko barje, Slovenia

### Invazivne vrste v obrežnih gozdovih Krajinskega parka Ljubljansko barje

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Riparian forests are one of the most important ecosystems, which provide numerous services to the nature and society, such as the erosion prevention and phytoremediation. At the same time, they are also one of the most vulnerable ecosystems in general, particularly exposed to the threat of biological invasions. Many of the invasive plants we know today are easily spread by rivers, prefer moist and nitrophilous soils and easily out-compete autochthonous species. Nature park Ljubljansko barje is one of the examples, where invasive plants have widely spread over the recent years and threaten the diversity of already sparsely present forests, moist grasslands and marshes. The research will focus on inventorying the invasive plants in forests of black alder, common oak, white elm, common hornbeam and white birch, in period of summer of 2019. Similar studies have already been done, so the aim of the work is to check the presence of already known species and potentially new invasive plants. The list will be shown, along with the basic information about invasive species and their threats to the protected area of Ljubljansko barje.

**Keywords:** riparian forests, invasive plants

Obrežni gozdovi predstavljajo enega od najbolj pomembnih ekosistemov, ki družbi in naravi zagotavljajo veliko ekoloških storitev, kot so na primer preprečevanje erozije in fitoremediacija. Hkrati so pa tudi eden od najbolj občutljivih ekosistemov na splošno, močno izpostavljeni vdoru novih vrst. Veliko invazivnih vrst, ki jih poznamo danes, se lahko širi z vodo, preferirajo vlažna in obremenjena rastišča in izpodrivajo avtohtone vrste. Krajinski park Ljubljansko barje je primer takega območja, kjer se invazivne vrste v zadnjem času hitro širijo in predstavljajo grožnjo diverziteti in že poslabšani kvaliteti gozdov, travnikov in mokrišč. Preko poletja 2019 je bil opravljen popis invazivnih tujerodnih vrst v obrežnih gozdovih črne jelše, navadnega hrasta, bresta, gabra in breze. Podobne študije sicer že obstajajo, tako da je cilj našega dela in plakata preverjanje prisotnosti že znanih vrst, ter potencialno novih tujerodnih vrst. Predstavljen bo seznam najpogostejših invazivnih tujerodnih vrst na območju Ljubljanskega barja, ter na kratko opisan njihov negativen vpliv na naravo.

**Ključne besede:** obrežni gozdovi, invazivne tujerodne rastline

## Spatial distribution of the invasive alien plant *Ailanthus altissima* (Mill.) Swingle in the towns of Zagreb county

### Prostorska razširjenost invazivne tujerodne rastline *Ailanthus altissima* (Mill.) Swingle v mestih Zagrebske županije

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The County of Zagreb consists of rural, urban and forest areas, which are extremely affected by invasive alien species, and hence their mapping has begun in 2012. An especially frequent invasive woody species in the area is *Ailanthus altissima*, for which the preliminary research of spatial distribution in all nine towns of the Zagreb County was performed during the year 2012. Altogether, 541 plots of 250x250 m<sup>2</sup> were investigated, and *A. altissima* was found in all towns, in total on 84 plots (15.5 %). In Ivanić Grad, the species was established on 9 of 73 surveyed plots (12.3 %), in Jastrebarsko on 10 of 48 plots (20.8 %), in Sveti Ivan Zelina on 4 of 44 plots (9.1 %), in Sveta Nedjelja on 2 of 31 plots (6.5%), in Velika Gorica on 18 of 76 plots (23.7 %), in Vrbovec on 5 of 48 plots (10.4 %), in Zaprešić on 7 of 58 plots (12.1 %), in Dugo Selo on 5 of 54 plots (9.3 %), and in Samobor on 24 of 109 surveyed plots (22.0 %). The repeated research in 2016 in Dugo Selo and Samobor showed that the number of new plots with *A. altissima* has increased by 22.2 % in Dugo Selo, and by 39.4 % in Samobor, and the increase was more significant in urban parts of the towns. The research has pointed to the need for more intensive and constant monitoring of *A. altissima* distribution in order to control its further spread within and outside the Zagreb County.

**Keywords:** mapping of invasive alien species, northwest Croatia, tree of heaven, urban areas

Zagrebsko županijo sestavljajo ruralna, urbana in gozdna območja, ki jim izjemno veliko škodo povzročajo invazivne tujerodne vrste, zato se je leta 2012 začelo njihovo kartiranje. Posebno pogosta invazivna lesnata vrsta na tem območju je *Ailanthus altissima*, za katero je bila leta 2012 izvedena predhodna raziskava prostorske razširjenosti v vseh devetih mestih Zagrebske županije. Skupno je bilo raziskanih 541 parcel velikosti 250 x 250 m<sup>2</sup>, vrsta *A. altissima* pa je bila najdena v vseh mestih, na skupno 84 parcelah (15,5 %). V Ivanić Gradu je bila vrsta naseljena na 9 od 73 sistematično raziskanih parcel (12,3 %), v Jastrebarskem na 10 od 48 parcel (20,8 %), v Svetem Ivanu Zelini na 4 od 44 parcel (9,1 %), v Svetem Nedjelji na 2 od 31 parcel (6,5 %), v Veliki Gorici na 18 od 76 parcel (23,7 %), v Vrbovcu na 5 od 48 parcel (10,4 %), v Zaprešiću na 7 od 58 parcel (12,1 %), v Dugem Selu na 5 od 54 parcel (9,3 %) in v Samoboru na 24 od 109 sistematično raziskanih parcel (22,0 %). Raziskava, ponovljena leta 2016 v Dugem Selu in Samoboru, je pokazala, da se je število novih parcel z vrsto *A. altissima* povečalo za 22,2 % v Dugem Selu in za 39,4 % v Samoboru, število pa se je očitneje povečalo v urbanih predelih mest. Raziskava je pokazala, da je treba intenzivneje in stalno spremljati razširjenost vrste *A. altissima* za nadzor njenega prihodnjega širjenja v Zagrebski županiji in zunaj nje.

**Ključne besede:** kartiranje invazivnih tujerodnih vrst, severozahodna Hrvaška, veliki pajesen, urbana območja

## Pollen concentrations of common ragweed (*Ambrosia artemisiifolia* L.) between 2016 and 2018 in Kecskemét, Hungary

### Koncentracije peloda pelinolistne ambrozije (*Ambrosia artemisiifolia* L.) med letoma 2016 in 2018 v Kecskemétu na Madžarskem

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Ragweed pollen allergy has become a major public health problem. In Hungary, more than 1 million people suffer from ragweed pollen allergy. The pollen concentration of ragweed (*Ambrosia artemisiifolia* L.) was analysed in air samples collected in the airspace of the city of Kecskemét (in Hungary) at the height of 14 m with a 7-day Hirst-type (Burkard) pollen trap between 2016 and 2018. The pollen season was determined as follows: for the beginning of the season, the day at which the average daily pollen concentration reached 1% of the final sum, until the end of the season, reached 99%. The ragweed bloom began in the years 2016 on the 218th day, in the years 2017 on the 217th day and in the years 2018 on the 208th day. The peak period was relatively long: 30 days in 2016 and 35 days in 2017. The 2018 pollen season lasted for 44 days. The August-September rainy periods reduced pollen concentrations from time to time. In 2016, a total of 11,782 ragweed pollens were detected. Most pollen grains were calculated on August 30th (824 pollen/m<sup>3</sup>). In 2017, the annual number of ragweed pollen was 11,849, with the highest amount of pollen (761 pollen/m<sup>3</sup>) recorded on 26<sup>th</sup> August. In 2018, we counted 15,042 *A. artemisiifolia* ragweed pollens. The highest number of ragweed pollen was detected on September 1<sup>st</sup> 2018, which was 658 pollen/m<sup>3</sup>. The total ragweed pollens in 2016 and in 2017 were similar values. The highest pollen/m<sup>3</sup> (824) was in 2016.

**Keywords:** common ragweed (*Ambrosia artemisiifolia* L.), pollen concentration, pollen allergy, Kecskemét (in Hungary)

Alergija na pelod ambrozije je postala velika težava na področju javnega zdravja. Na Madžarskem za alergijo na pelod ambrozije trpi več kot milijon ljudi. Koncentracija peloda ambrozije (*Ambrosia artemisiifolia* L.) je bila analizirana v vzorcih zraka, odvzetih v zračnem prostoru mesta Kecskemét (na Madžarskem) na višini 14 m s sedemdnevnikom peloda vrste Hirst (Burkard) med letoma 2016 in 2018. Sezona peloda je bila določena tako: za začetek sezone je bil določen dan, na katerega je povprečna dnevna koncentracija peloda dosegla 1 % končnega števila pelodnih zrn, za konec sezone pa dan, ko je koncentracija dosegla 99 % končnega števila pelodnih zrn. Cvetenje ambrozije se je leta 2016 začelo na 218. dan, leta 2017 na 217. dan in leta 2018 na 208. dan leta. Glavna sezona je bila razmeroma dolga: 30 dni leta 2016 in 35 dni leta 2017. Leta 2018 je sezona peloda trajala 44 dni. Deževna obdobja v avgustu in septembru so občasno zmanjšala koncentracijo peloda. Leta 2016 je bilo skupno evidentiranih 11.782 pelodnih zrn ambrozije. Največ jih je bilo ugotovljenih 30. avgusta (824 pelodnih zrn/m<sup>3</sup>). Leta 2017 je letno število pelodnih zrn ambrozije doseglo 11.849, največ pelodnih zrn (761 pelodnih zrn/m<sup>3</sup>) pa je bilo evidentiranih 26. avgusta. Leta 2018 smo ugotovili 15.042 pelodnih zrn ambrozije vrste *A. artemisiifolia*. Največ pelodnih zrn ambrozije je bilo evidentiranih 1. septembra 2018, in sicer 658 pelodnih zrn/m<sup>3</sup>. Skupno število pelodnih zrn ambrozije je bilo v letih 2016 in 2017 podobno. Največ pelodnih zrn na kubični meter (824) je bilo evidentiranih leta 2016.

**Ključne besede:** pelinolistna ambrozija (*Ambrosia artemisiifolia* L.), koncentracija peloda, alergija na pelod, Kecskemét (Madžarska)

## Economic evaluation of rapid response system and mitigation measures in case of invasive species *Ailanthus altissima*

### Ekonomska ocena sistema hitrega odzivanja ter omejitvenih ukrepov v primeru invazivne vrste *Ailanthus altissima*

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Tree-of-heaven (*Ailanthus altissima*) is among the most invasive tree species in Europe and Slovenia. The species is highly adaptable and able to outcompete native vegetation. Extreme weather events (e.g. windthrows and ice storms) in recent years become more frequent. The resulting forest disturbances represent a greater opportunity for invasion by *A. altissima*. Prevention and early detection measures are thus important to limit the unintentional spread of this species. Several early detection and rapid eradication (EDRE) measures for invasive species were suggested (e.g. Brundu 2017). For example, early detection can be achieved by surveying areas with highest risk of invasion (e.g. near rivers, roads, power lines and urban areas) (e.g. Arnšek 2009). In case of early phase of invasion hand pulling of seedlings can be applied in combination with other measures (Urbas 2017). In some cases, EDRE measures are no longer an option due to high regenerative capacity of the species, therefore mitigation measures could be suggested. *A. altissima* wood could be used for producing of pulp and paper, wood panels, fuel wood (e.g. pellets or briquets) and as non-load bearing timber (Asaro et al. 2009). Other studies suggest these species could also be used as source of pharmaceutically active compounds as well as environmentally friendly herbicides (Sladonja et al. 2015).

The goal of this study was to compare the costs of a rapid response system (e.g. EDRE measures) for the invasive species *A. altissima* in Slovenia with mitigation measures (i.e. using *A. altissima* wood/biomass as a partial substitute in Slovenian forest-wood production chains).

**Keywords:** tree-of-heaven, early detection and rapid eradication (EDRE), wood properties, wood fuels

Visoki pajesen (*Ailanthus altissima*) sodi med najbolj invazivne drevesne vrste v Evropi in Sloveniji. Vrsta je zelo prilagodljiva in lahko izpodrine avtohtono vegetacijo. Ekstremni vremenski dogodki (npr. vetrolomi in žledolomi) v zadnjih letih postajajo vse pogostejši. Motnje v gozdovih pa predstavljajo večjo priložnost za širjenje *A. altissima*. Za omejitev nenamerne širjenje te vrste so pomembni ukrepi preprečevanja širjenja in pravočasnega odkrivanja. Predlaganih je bilo že več ukrepov zgodnjega odkrivanja in hitrega odstranjevanja (EDRE) (npr. Brundu 2017). Tako je na primer zgodnje odkrivanje mogoče doseči s pregledovanjem območij z največjim tveganjem (npr. v bližini rek, cest, daljnovodov in mestnih območij) (npr. Arnšek 2009). V zgodnjih fazah širjenja se lahko izvaja ročno izruvanje mladih rastlin v kombinaciji z drugimi ukrepi (Urbas 2017). V nekaterih primerih pa ti ukrepi (EDRE) niso več možni zaradi velike regenerativne sposobnosti vrste, zato se lahko predlaga omilitvene ukrepe. Les *A. altissima* je možno uporabljati za proizvodnjo celuloze in papirja, lesnih plošč, goriva (npr. peletov ali briketov) ter za nenosilne lesene konstrukcije (Asaro in sod. 2009). Druge študije kažejo, da bi se to vrsto lahko uporabljalo tudi kot surovino za aktivne farmacevtske sestavine in okolju prijazne herbicide (Sladonja in sod. 2015).

Cilj te študije je bil primerjati stroške sistema hitrega odzivanja (npr. ukrepi EDRE) pri invazivni vrsti *A. altissima* v Sloveniji z omejitvenimi ukrepi (tj. z uporabo lesa/lesne biomase *A. altissima* kot delnega nadomestka v slovenski gozdno-lesni proizvodni verigi).

**Ključne besede:** visoki pajesen, zgodnje odkrivanje in hitro izkoreninjenje (EDRE), lastnosti lesa, lesna goriva



## A decision support system simulating the effect of control measures on outbreaks of *Anoplophora* spp. in Belgium

### Sistem za podporo odločanju s simulacijo učinka ukrepov nadzora izbruhov *Anoplophora* spp. v Belgiji

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The Asian longhorned beetle (ALB), *Anoplophora glabripennis* (Motchulsky), and the citrus longhorn beetle (CLB), *Anoplophora chinensis* (Forster), are two non-native pests that are extremely damaging to a wide range of broadleaved trees and shrubs. Both are quarantine pests for the European Union. The natural range of the beetles includes China, Japan and other countries in southeast Asia. ALB has been introduced into North America, Europe and Japan on several occasions, most probably through trade of goods in infested wood packaging material. The main pathway of introduction of CLB into Europe has been with ornamental trees (bonsai) from Asia. To date, no outbreaks have been observed in Belgium, but two interceptions, in 2004 and 2008, and several outbreaks in neighbouring countries have shown that ALB and CLB both pose a serious threat to horticulture, forestry and native trees in Belgium. Because eradication requires drastic measures and will have a serious economic impact (especially on tree nurseries or fruit farms, but also in forests and public green spaces), it is essential to thoroughly consider which control techniques should be applied. A decision-support tool indicating the most suitable control strategy against these pests has been developed based on a simulation model. The tool visualises the effect of the chosen measure (from an ample list of known physical, biological and chemical control measures, including official EU measures) on the pest population and spread, and provides information on the application costs. The main user will be the government, but the tool is also appropriate for use by foresters and nursery growers.

**Keywords:** longhorn beetles, quarantine pests, population outbreak, control strategy, simulation model

Azijski kozliček, *Anoplophora glabripennis* (Motchulsky), in kitajski kozliček, *Anoplophora chinensis* (Forster), sta tujerodna škodljiva organizma, ki povzročata izjemno veliko škodo na številnih listavcih in grmih. Sta karantenska škodljiva organizma za Evropsko unijo. Naravno območje razširjenosti hroščev obsega Kitajsko, Japonsko in druge države jugovzhodne Azije. Azijski kozliček je bil večkrat vnesen v Severno Ameriko, Evropo in na Japonsko, najverjetneje z menjavo blaga v pakirnem materialu iz napadenega lesa. Kitajski kozliček se v Evropo večinoma vnaša z okrasnimi drevesi (bonsaji) iz Azije. Do zdaj v Belgiji izbruhi niso bili opaženi, vendar so prestrežbi v letih 2004 in 2008 ter več izbruhov v sosednjih državah pokazali, da azijski in kitajski kozliček resno ogrožata vrtnarstvo, gozdarstvo in avtohtona drevesa v Belgiji. Ker so za izkoreninjenje potrebni drastični ukrepi in bo imelo velik gospodarski vpliv (zlasti na drevesnice ali sadjarske kmetije ter na gozdove in na javne zelene površine), je ključen temeljit razmislek o tem, katere tehnike nadzora bi bilo treba uporabiti. Orodje za podporo odločanju, ki kaže na najprimernejšo strategijo nadzora nad tema škodljivima organizmoma, je bilo razvito na podlagi simulacijskega modela. Orodje omogoča pogled na vpliv izbranega ukrepa (z obsežnega seznama znanih fizičnih, bioloških in kemičnih nadzornih ukrepov, vključno z uradnimi ukrepi EU) na populacijo in širjenje škodljivega organizma in daje informacije o stroških uporabe. Glavni uporabnik bo država, vendar je orodje primerno tudi za gozdarje in gojitelje v drevesnicah.

**Ključne besede:** kozlički, karantenski škodljivi organizmi, izbruh populacije, strategija nadzora, simulacijski model



## Invasive plant species and their suppression in the Maribor forest management region

### Invazivne rastlinske vrste in poskusi njihovega zatiranja v gozdovih v Gozdnogospodarskem območju Maribor

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In the sixties of the 20<sup>th</sup> century Slovenian foresters began systematic planting of alien tree species. The most popular were Douglas fir, white pine, Sudetian and Japanese larch, Austrian pine, red oak, eastern black walnut and black locust. Some of them, especially red oak and black locust, became dominant and even invasive in some places.

The situation worsened after the sleet in 2014, as the invasive alien species (IAS) have expanded in Slovenian forests. In recent years, IAS have become more conspicuous in the forest clearings, which were caused as a result of natural disasters, bark beetle hot spots, and regular logging. The forest edges and the forests along the watercourses are also exposed to great intrusion of IAS.

Methods and their effectiveness of suppressing IAS depend on the type of plant, extent and costs of suppression. The suppressing methods and techniques should be based on examples of good practice. With such measures we can efficiently reduce the number of IAS, but it is important to act quickly.

In the case of invasive alien tree species, we try to reduce their abundance with silvicultural measures. The main silvicultural problem in our area presents difficulties with the regeneration of forests due to large coverage of American pokeweed, partly due to princess tree and Himalayan balsam. Suppression of these species by pulling them out is too expensive. We have tried to suppress them in the early stages of forest development by harvesting twice a year. We want to help the native species to reach higher density as soon as possible because it is known that invasive species are less competitive in conditions of shading.

**Keywords:** alien tree species, invasive alien species (IAS), suppressing IAS, silvicultural measures

V gozdovih Gozdnogospodarskega območja Maribor se je že v šestdesetih letih prejšnjega stoletja začelo načrtno gospodariti s tujerodnimi drevesnimi vrstami. Najpogosteje so vnašali duglazijo, zeleni bor, sudetski in japonski macesen, črni bor, rdeči hrast, črni oreh in navadno robinijo. V nekaterih primerih so te vrste postale dominantne in celo invazivne (predvsem navadna robinija in rdeči hrast).

Invazivne tujerodne rastlinske vrste (ITRV) so se v gozdovih v večji meri razširile po žledu leta 2014. V zadnjih letih se v gozdovih na večjih posekah, ki so nastale kot posledica ujm, žarišč lubadarja in tudi rednih pomladitvenih sečenj, vse bolj uveljavljajo. Velikemu vdoru ITRV so izpostavljeni še gozdni robovi in gozdovi ob vodotokih.

Metode za zatiranje ITRV ter njihova učinkovitost so odvisne od vrste rastline, obsega razširjenosti ter stroškov zatiranja. Načine zatiranja je potrebno graditi na primerih dobre prakse. Z ukrepi omejevanja in odstranjevanja lahko njihovo populacijo bistveno zmanjšamo. Zelo pomembno je hitro ukrepanje.

Pri invazivnih tujerodnih drevesnih vrstah poskušamo gozdarji z gozdnogojitvenimi ukrepi zmanjšati njihov delež ter preprečiti širjenje teh vrst na nove površine. Največji gozdnogojitveni problem v našem območju trenutno predstavlja oteženo pomlajevanje gozdov zaradi velike pokrovnosti navadne barvilnice, delno tudi pavlovnije in žlezave nedotike. Zaradi velike številčnosti teh vrst v gozdovih je zatiranje s puljenjem predrago. Zadnja leta poskušamo v mladih fazah gozda te vrste zatirati z obžetvijo dvakrat letno. S tem ukrepom želimo pomagati naravnim vrstam, da čim prej ustvarijo strnjen sestoj, saj je znano, da so invazivne vrste v pogojih zasenčenosti manj konkurenčne.

**Ključne besede:** tujerodne invazivne rastlinske vrste, metode zatiranja, gozdnogojitveni ukrepi

## Invasive alien plant species as potential raw material for wooden and paper products

### Invazivne tujerodne rastline kot potencialna surovina za lesene in papirne izdelke

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Invasive Alien Plant Species (IAPS) are one of the biggest challenges in European ecosystems. They displace local vegetation, destroy agricultural land and cause damage to European economy in billions of euros every year. Many of them are daily removed and mainly burned or composted. In the frame of Applause project (<https://www.ljubljana.si/sl/moja-ljubljana/applause/>), City of Ljubljana together with several partners addresses unsolved questions regarding invasive alien species in terms of the zero waste approach and circular economy. First of all, we want to make it easier for the citizens to recognize and identify invasive non-native plant species and then properly remove and process them into useful products. Department of Wood Science and Technology and Pulp and Paper Institute are researching the potential for transforming the IAPS biomass of collected plants into useful and innovative products made of wood and paper.

For innovative high added value products, it is necessary to know raw material properties. For this purpose, 17 different woody and 4 green plant species were examined. Currently already more than 10 wooden and 3 products made from machine produced IAPS paper were designed and prototypes were made.

During research a list of appropriate IAPS for paper, wood and food products, dyes and home-made formulations against plant harmful organisms will be prepared. One of the biggest challenges is to develop successful and trustworthy circular economy model, finding new use for all parts of collected IAPS and upcycling the residual materials.

Project Applause is co-financed by the European Regional Development Fund through the Urban Innovative Actions Initiative.

**Keywords:** asive species, wood, paper, products

Invazivne tujerodne rastline (ITR) so ena največjih groženj v evropskih ekosistemih. Izpodrivajo domače rastlinstvo, uničujejo kmetijska zemljišča in povzročajo gospodarsko škodo, ki se letno šteje v milijardah evrov. Večino teh rastlin se vsakodnevno odstranjuje in večinoma sežiga ali kompostira. Mestna občina Ljubljana skupaj z več partnerji v okviru projekta Applause (<https://www.ljubljana.si/sl/moja-ljubljana/applause/>) obravnava nerešena vprašanja v zvezi z invazivnimi tujerodnimi rastlinami v smislu njihove uporabe s pristopom krožnega gospodarstva in proizvodnje z nič odpadkov. Najprej želijo prebivalce naučiti prepoznavanja invazivnih tujerodnih rastlinskih vrst, nato pa jih poučiti o pravilnem odstranjevanju in predelavi v uporabne izdelke. Oddelek za lesarstvo na Biotehniški fakulteti in Inštitut za celulozo in papir raziskujejo potencial za preoblikovanje te biomase v uporabne in inovativne izdelke iz lesa in papirja.

Za inovativne izdelke z visoko dodano vrednostjo pa je treba poznati lastnosti surovin. V ta namen je bilo proučevanih 17 lesnih in 4 zelzate invazivne rastlinske vrste. Trenutno je bilo zasnovanih in v obliki prototipov narejenih že več kot 10 lesenih in trije izdelki iz strojno izdelanega papirja.

V okviru projekta bo na podlagi ciljev raziskav pripravljen seznam invazivnih vrst primernih za izdelavo papirja, lesenih izdelkov, barvil, prehrabnenih izdelkov in izdelave domačih pripravkov proti rastlinskim škodljivim organizmom. Eden največjih izzivov je razvoj uspešnega in zanesljivega poslovnega modela krožnega gospodarstva, iskanje novih uporab za vse dele proučevanih rastlin. Projekt Applause sofinancira Evropski sklad za regionalni razvoj s pobudo Urban Innovative Action.

**Ključne besede:** invazivne vrste, les, papir, izdelki

## Evaluation of the potential of *Ailanthus altissima* for pellet production

### Ocena potenciala vrste *Ailanthus altissima* za proizvodnjo peletov

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Tree-of-heaven (*Ailanthus altissima*) is a fast-growing invasive species with wood properties similar to *Fraxinus excelsior*. The density of the oven dry wood is 614 kg/m<sup>3</sup> and calorific value is comparable to other hardwoods, such as ash, oak, maple, beech (Gorišek et al. 2018). Thus, the aboveground biomass of *A. altissima* could be potentially used for production of solid biofuels. In the recent years the demand for pellets is rising in Slovenia, consequently the prices of raw material (i.e. sawdust from sawmills) increased. As a mitigation/management measure to limit the spread of *A. altissima* part of plants biomass could be used for pellet production. The objective of this study was to investigate the quality of pellets made from different mixtures of *Picea abies* and *A. altissima* wood sawdust. The *P. abies* sawdust was obtained from a sawmill plant near Ljubljana and the *A. altissima* wood chips from a forest site near Nova Gorica. In the laboratory the raw material was first reduced with a cutting mill (final size of particles was 2 mm) and then conditioned (moisture content of raw material should be around 15%). Three different mixtures were prepared with increasing share of *A. altissima* wood (25%-75%; 50%-50% and 75%-25%). The prepared material was pelletized in vertical pellet press (Pellet Press 14-175; Amandus Kahl) using die with a diameter of die openings of 6 mm and a thickness of 28 mm. To assess the quality of pellets their physical and mechanical characteristics have been determined (mechanical durability, moisture content, ash content and bulk density) according to methodologies listed in the European standards (EN ISO 17225). The properties of pellets produced from different mixtures were compared and evaluated based on their usability according to the relevant standards.

**Keywords:** tree-of-heaven, invasive species, solid biofuels, pellet properties, fuel pellets

Visoki pajesen (*Ailanthus altissima*) je hitro rastoča invazivna drevesna vrsta s podobnimi lastnostmi lesa, kot jih ima jesen. Gostota lesa v absolutno suhem stanju je 614 kg/m<sup>3</sup>, kurilna vrednost je primerljiva s kurilno vrednostjo ostalih trdih listavcev, kot so jesen, hrast, javor in bukev (Gorišek in sod. 2018). Lesno biomaso *A. altissima* bi tako potencialno lahko uporabili za proizvodnjo trdih biogoriv. V zadnjih letih se povpraševanje po peletih v Sloveniji povečuje, posledično pa so se dvignile tudi cene surovin (t. j. žagovina iz lesno-predelovalnih obratov). Kot ukrep za omejevanje širjenja *A. altissima* bi lahko les uporabili za proizvodnjo peletov. Cilj te raziskave je oceniti kakovost peletov, narejenih iz različnih mešanic žagovin od *Picea abies* in *A. altissima*. Žagovina od *P. abies* je bila pridobljena iz žage v bližini Ljubljane, sekanci *A. altissima* pa iz gozda v bližini Nove Gorice. V laboratoriju je bila surovina najprej zmleta v mlinu (končna velikost delcev je bila 2 mm) in nato navlažena (vsebnost vlage v surovini naj bi bila približno 15 %). Pripravljene so bile tri različne mešanice z večanjem deleža lesa *A. altissima* (25 %-75 %; 50 %-50 % in 75 %-25 %). Pripravljen material smo stisnili v laboratorijski peletirni napravi (Pellet Press 14-175; Amandus Kahl) z uporabo matrike debeline 28 mm in premerom odprtin 6 mm. Kakovost peletov, opredeljujejo njihove fizikalne in mehanske lastnosti (mehanska obstojnost, vsebnost vode, vsebnost pepela in gostota nasutja), ki smo jih določili skladno z evropskimi standardi (EN ISO 17225). Lastnosti peletov, proizvedenih iz različnih zmesi, smo primerjali in ocenili na podlagi njihove uporabnosti v skladu z ustreznimi standardi.

**Ključne besede:** visoki pajesen, invazivne vrste, trda biogoriva, lastnosti peletov, peleti

## Modeling of *Gemmamyces* bud blight impact on Colorado blue spruce plantations in the Ore Mts. (the Czech Republic)

### Modeliranje vpliva odmiranja brstov bodeče smreke *Gemmamyces piceae* na nasade srebrne bodeče smreke na Rudni gori (Češka)

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Since 1960, due to the tolerance to CO<sub>2</sub> pollution, Colorado blue spruce (*Picea pungens* Engelm.) became one of the key woody species in the newly established substitute tree stands planted in areas damaged by air pollution in the Ore Mts. (the Czech Republic). However, its plantations have been extremely damaged after 2000 by quickly spreading disease called Cucurbitaria bud blight – caused by pathogenic fungus *Gemmamyces piceae* (Borthw.) Casagrande. Our recent investigations were aimed with use of general linear model at (1) analysing the influence of environmental and silvicultural characteristics on extent of the disease in *Picea pungens* stands and predicting (2) the damage of all *Picea pungens* stands and (3) the environmental suitability of the Ore Mts. for *Gemmamyces piceae*.

Firstly, we found out many of characteristics that had a positive or negative impact on the disease level. In the second phase we predicted the disease impact with use of developed model for 5,359 *P. pungens* stands covering total area about 200 km<sup>2</sup>. The most threatened stands were located on the plateau with high humidity and low temperature or in deep valley with temperature inversion. Finally, a prediction of the suitability environment for the Ore Mts. covering ca 1,814 km<sup>2</sup> showed that 42.8% of the Ore Mts. had extremely high suitability for the pathogen. This finding together with the possibility of pathogen transition to *Picea abies* recently should raise an attention of foresters in the area.

**Keywords:** *Gemmamyces piceae*, *Picea pungens*, disease prediction, environmental suitability, Ore Mountains

Po letu 1960 je srebrna bodeča smreka (*Picea pungens* Engelm.) zaradi tolerance na onesnaženost s CO<sub>2</sub> postala ena glavnih lesnatih vrst v novih sestojih nadomestnih dreves, zasajenih na območjih na Rudni gori (Češka), prizadetih zaradi onesnaženosti zraka. Vendar je nasade po letu 2000 močno poškodovalo hitro širjenje bolezni, imenovane odmiranje brstov bodeče smreke, ki jo povzroča patogena gliva *Gemmamyces piceae* (Borthw.) Casagrande. Cilji nedavnih raziskav z uporabo splošnega linearnega modela so bili (1) analiza vpliva okoljskih in gozdnogojitvenih značilnosti na obseg bolezni v sestojih *Picea pungens* ter napovedovanje (2) škode na vseh sestojih *Picea pungens* in (3) okoljske ustreznosti Rudne gore za *Gemmamyces piceae*.

Najprej smo ugotovili številne značilnosti, ki so imele pozitiven ali negativen učinek na stopnjo bolezni. V drugi fazi smo napovedali vpliv bolezni z uporabo razvitega modela za sestoj 5.359 dreves *P. pungens*, ki pokrivajo skupno površino približno 200 km<sup>2</sup>. Najbolj ogroženi sestoji so bili na visoki planoti z visoko vlažnostjo in nizkimi temperaturami ali v globokih dolinah s temperaturno inverzijo. Na koncu je napovedovanje okoljske ustreznosti Rudne gore, ki pokriva približno 1.814 km<sup>2</sup>, pokazalo, da je 42,8 % Rudne gore izjemno ustreznih za patogen. Ta ugotovitev in možnost prehoda patogena na vrsto *Picea abies* bi morali vzbuditi pozornost gozdarjev na tem območju.

**Ključne besede:** *Gemmamyces piceae*, *Picea pungens*, napovedovanje bolezni, okoljska ustreznost, Rudna gora

## Presentation of the publication "Invasive and non-native species in forests of Slovakia: insects, fungal pathogens, plants"

### Predstavitev publikacije *Invázne a nepôvodné druhy v lesoch Slovenska: hmyz – huby – rastliny (Invazivne in tujerodne vrste v slovaških gozdovih: žuželke, glivni patogeni, rastline)*

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The book lists the most significant invasive and non-native species of insects, fungal pathogens, and plants that are either already present in our territory and causing damage to the forest or "knocking on the door", i. e. they cause damage in neighboring states or in the European region and pose a future threat to forest ecosystems. This book is intended for forest owners and managers, forest policy analysts and decision-makers, nature conservationists, state administration workers in the field of forestry and environment, gardeners, students, and for all friends of nature. In the introductory sections, legislation at national and European level on invasive and non-native species is discussed. In the main section, 38 selected invasive and non-native species are described supplemented with more than 160 photographs, mostly from members of the authors' collections. The main section is divided into three parts where INSECTS, FUNGAL PATHOGENS, and PLANTS species are described in detail. For each species there is information about their presence in Slovakia, about the area of origin and area outside of its native distribution, taxonomic classification, the characteristics of the species, the endangered areas in Slovakia and possibilities of forest protection against these pests. At the end of the publication, we summarize the main possibilities, ways, and principles of forest protection against individual groups of invasive and non-native species. We briefly described 71 other, less significant, invasive and non-native species that have the potential to threaten our forest ecosystems in the future. The main aim of the book is to provide basic information about invasive and non-native species. Because if we recognize the "enemy" on time and the risks it brings, only then we can successfully use appropriate measures. The publication is currently available only in the Slovak language (free download here: <http://www.los.sk/knihy.html>).

**Keywords:** invase species, non-native species, insects, fungal pathogens, plants

Knjiga vsebuje seznam najpomembnejših invazivnih in tujerodnih vrst žuželk, glivnih patogenov in rastlin, ki so na našem ozemlju že prisotni in povzročajo škodo v gozdovih ali so v naši bližini, torej povzročajo škodo v sosednjih državah ali v evropski regiji in pomenijo prihodnjo grožnjo gozdnim ekosistemom. Knjiga je namenjena lastnikom in upraviteljem gozdov, analitikom gozdarske politike in nosilcem odločanja, naravovarstvenikom, delavcem na področju gozdarstva in okolja v javni upravi, vrtnarjem, študentom in vsem ljubiteljem narave. V uvodnem delu sta obravnavani nacionalna in evropska zakonodaja o invazivnih in tujerodnih vrstah. V glavnem delu je opisanih 38 izbranih invazivnih in tujerodnih vrst z več kot 160 fotografijami, večinoma iz zbirk avtorjev. Glavni del je razdeljen na tri dele, v katerih so podrobno opisane vrste ŽUŽELK, GLIVNIH PATOGENOV in RASTLIN. Za vsako vrsto so navedeni podatki o prisotnosti na Slovaškem, območju izvora in območju zunaj domorodnega območja, taksonomska klasifikacija, značilnosti, ogrožena območja na Slovaškem in možnosti varstva gozdov pred temi škodljivimi organizmi. Na koncu publikacije je povzetek glavnih možnosti, načinov in načel varstva gozdov pred posameznimi skupinami invazivnih in tujerodnih vrst. Na kratko smo opisali še 71 drugih, manj pomembnih invazivnih in tujerodnih vrst, ki lahko ogrozijo naše gozdne ekosisteme v prihodnosti. Glavni namen knjige je podati osnovne informacije o invazivnih in tujerodnih vrstah. Samo če pravočasno prepoznamo sovražnika in tveganja, ki jih prinaša, lahko uspešno uvedemo primerne ukrepe. Publikacija je trenutno na voljo samo v slovaškem jeziku (brezplačen prenos je mogoč na strani: <http://www.los.sk/knihy.html>).

**Ključne besede:** invazivne vrste, tujerodne vrste, žuželke, glivni patogeni, rastline



## Surveying escapes in botanic gardens and arboreta for evaluating the invasive potential of woody species

### Sistematično raziskovanje pobegov iz botaničnih vrtov in arboretumov za vrednotenje invazivnega potenciala lesnatih vrst

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Botanic gardens and arboreta worldwide contain large and diverse collections of non-native trees. Together, they hold about one quarter of all known plant species. Some of the exotic plants in the collections display invasive tendencies and can escape into the near or more remote surroundings, either by vegetative propagation or by seeding. It is therefore appropriate to monitor the spread of the trees from the collections, as these data can yield valuable information about the invasive potential of the woody species. This study focuses on woody escapes from collections in some botanic gardens and arboreta in Belgium. Several parameters about the escapes are recorded, such as their number and the distance on which they spread, as well as about the environment, such as soil type. In this poster we present some results of trees displaying invasive tendencies; a few of them are already well known as invasive alien species (in Belgium), whilst other are not.

**Keywords:** botanic gardens, arboreta, collections, invasive potential

V botaničnih vrtovih in arboretumih so po vsem svetu velike in raznovrstne zbirke tujerodnih dreves. Skupaj imajo približno eno četrtnino vseh znanih rastlinskih vrst. Nekatere tujerodne rastline v zbirkah kažejo nagnjenost k invazivnosti in lahko z vegetativnim razmnoževanjem ali semeni uidejo v bližnjo ali bolj oddaljeno okolico. Zato je treba spremljati širjenje dreves iz zbirk, saj so to lahko koristne informacije o invazivnem potencialu lesnatih vrst. Ta študija se osredotoča na pobege lesnatih rastlin iz zbirk nekaterih botaničnih vrtov in arboretumov v Belgiji. Evidentiranih je več parametrov pobegov, kot je njihovo število ali razdalja širitve, in okoljskih parametrov, kot je vrsta prsti. Na tem plakatu smo navedli nekatere rezultate o drevesih, ki kažejo nagnjenost k invazivnosti; nekatera od teh dreves so že dobro znana kot invazivne tujerodne vrste (v Belgiji).

**Ključne besede:** botanični vrtovi, arboretumi, zbirke, invazivni potencial



## Finvasive LIFE promotes citizen science and multi-stakeholder cooperation against IAS in Finland

### Projekt Finvasive LIFE spodbuja ljubiteljsko znanost in sodelovanje med več deležniki v boju proti invazivnim tujerodnim vrstam na Finskem

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Finland has thus far been relatively untouched by the invasion of many harmful invasive species – only few invasive alien species survive the cold winters and shorter growing season. That situation that will change for worse with the warming climate.

Finvasive LIFE -project (2018–2023), known as VieKas LIFE in Finland, aims to raise invasive species awareness among Finns to help prevent future invasions triggered by the warming climate. Finvasive LIFE promotes surveying, eradicating and the use of citizen science in preventing and controlling the spread of harmful invasive species in Finland. Project focuses on four invasive plant species of EU concern (*Impatiens glandulifera*, two Hogweed species (*Heracleum mantegazzianum* & *H. persicum*) and *Lysichiton americanus*). These species illustrate IAS's negative impact to nature, human health and economy and teach basic skills to identify, survey and control IAS.

Finvasive LIFE has released (spring 2019) Finland's first smartphone-optimised reporting tool (web form) to incorporate the use of citizen science in gathering sighting data. The use of the reporting tool is presented and promoted in various awareness building events hosted by Finvasive LIFE or one of its partners.

As the spread of invasive species is not restricted by borders, one of Finvasive LIFE main goals is to facilitate a growing trend in multi-stakeholder cooperation locally and regionally among citizens, municipalities, government agencies, NGO's and businesses.

Partially funded by the EU LIFE -programme, Finvasive LIFE (LIFE17/NAT/FI/00528) is coordinated by FANC (Finland's Association for Nature Conservation), an environmental NGO.

Project site in English: [www.sll.fi/viekas-life/en](http://www.sll.fi/viekas-life/en)

**Keywords:** Finvasive LIFE, citizen science, multi-stakeholder cooperation, EU LIFE, mobile reporting tool, awareness building, IAS

Finska je bila do zdaj razmeroma neprizadeta zaradi vnosov številnih škodljivih invazivnih vrst – le redke invazivne tujerodne vrste preživijo mrzle zime in krajšo rastno sezono. S segrevanjem podnebja se bo to stanje spremenilo na slabše.

Cilj projekta Finvasive LIFE (2018–2023), na Finskem znanega kot VieKas LIFE, je Fince ozaveščati o invazivnih vrstah in pomagati pri preprečevanju vnosov, ki jih bo v prihodnosti spodbudilo segrevanje podnebja.

Projekt Finvasive LIFE spodbuja sistematično raziskovanje in izkoreninjenje škodljivih invazivnih vrst na Finskem ter preprečevanje in nadzorovanje njihovega širjenja ob podpori ljubiteljskih poznavalcev. Osredotoča se na štiri invazivne rastlinske vrste, ki vzbujajo skrb v EU (*Impatiens glandulifera*, dve vrsti dežena (*Heracleum mantegazzianum* in *H. persicum*) ter *Lysichiton americanus*). Na podlagi teh vrst je mogoče prepoznati negativne učinke invazivnih tujerodnih vrst na naravo, zdravje ljudi in gospodarstvo ter se naučiti osnovnih veščin za njihovo prepoznavanje, sistematično raziskovanje in nadzorovanje.

V okviru projekta Finvasive LIFE je bilo (spomladi leta 2019) izdano prvo orodje za poročanje, optimizirano za pametne telefone (spletni obrazec), da bi se ljudski poznavalci vključili v zbiranje podatkov o opažanju. Uporaba orodja za poročanje se predstavlja in spodbuja na raznih dogodkih za ozaveščanje, ki jih gosti projekt Finvasive LIFE ali kateri od njegovih partnerjev. Ker širjenja invazivnih vrst ne omejujejo meje, je eden od glavnih ciljev projekta Finvasive LIFE olajšati čedalje večje sodelovanje med več deležniki na lokalni in regionalni ravni, in sicer med državljani, občinami, vladnimi agencijami, nevladnimi organizacijami in podjetji.

Projekt Finvasive LIFE (LIFE17/NAT/FI/00528) je delno financiran s sredstvi iz programa EU LIFE in ga koordinira okoljska nevladna organizacija FANC (Finsko združenje za ohranjanje narave).

Spletišče projekta v angleščini: [www.sll.fi/viekas-life/en](http://www.sll.fi/viekas-life/en)

**Ključne besede:** botanični vrtovi, arboretumi, zbirke, invazivni potencial

## Biodiversity of the Landscape park Tivoli, Rožnik and Šiška hill (Ljubljana, Slovenia) and its connection to invasive alien species problem

### Biotska pestrost Krajinskega parka Tivoli, Rožnik in Šišenski hrib (Ljubljana, Slovenija) in njena povezanost s problematiko invazivnih tujerodnih vrst

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The Landscape park Tivoli, Rožnik and Šiška hill is located in the urban area of Ljubljana, the capital of Slovenia. It covers an area of 459 ha, out of which 70% is forest cover, 8,2% extensive grasslands and 8.7% covers the city park Tivoli.

This urban green area is of big importance for recreation, walking, jogging or just daily relaxation. Many users and visitors of park appreciate the possibility of connecting with nature, which is not possible in many other capitals. Furthermore, this nature protected area is rich in biodiversity. More than 1500 living species have been recorded by now. There are more than 600 plant species, more than 500 moth and butterfly species, more than 100 beetle species, 102 bird species and many other groups of organisms. In addition, we anticipate to find more than hundred species of spiders and more than thousand species of fungi in the park area. To raise awareness for protection of this precious space, it is important to continue the monitoring and inventory field work.

Our main activity regarding invasive species problem is to raise awareness and to work on preventive measures. We communicate to different companies that work in the park, landowners and park users. We cooperate with LIFE ARTEMIS project team in field activities and work on action plan for management of invasive alien species (IAS) in the park. Together, we have eradicated removed IAS plants from a considerate forest area. Each year, we are organizing actions of invasive alien plant species eradication and cooperating with the City of Ljubljana, that has active policy on eradication and prevention of IAS.

**Keywords:** biodiversity, urban, landscape park, Ljubljana, management

Krajinski park Tivoli, Rožnik in Šišenski hrib je umeščen v urbano območje Ljubljane, glavnega mesta Slovenije. Obsega 459 ha območja, od katerega je 70 % gozdov, 8,2 % ekstenzivnih travnikov in 8,7 % mestni park Tivoli.

To zeleno območje v urbani krajini ima velik pomen za rekreacijo, sprehod, tek ali katero od mnogih dnevnih sprostitvev. Številni uporabniki in obiskovalci parka cenijo možnost povezovanja z naravo v obsegu, ki ni običajen v drugih evropskih prestolnicah. To zavarovano območje narave je tudi vrstno zelo pestro. Do sedaj je bilo zabeleženih več kot 1500 vrst. Tukaj uspeva več kot 600 vrst rastlin, več kot 500 vrst nočnih in dnevnih metuljev, več kot 100 vrst hroščev, več kot 100 vrsti ptic in številne druge skupine organizmov. Predvidevamo, da na območju parka živi več kot 100 vrst pajkov in več kot 1000 vrst gliv. Z željo dvigniti zavest o pomenu zaščite tega dragocenega območja, je pomembno nadaljevati s spremljanjem in popisi organizmov.

Glavne aktivnosti upravljavca parka v navezavi na problematiko invazivnih tujerodnih vrst so širiti zavest javnosti in delovati preventivno. Redna komunikacija s številnimi deležniki v parku, lastniki parcel in uporabniki so med prednostnimi nalogami. S terenskimi akcijami upravljavec sodeluje tudi s projektno ekipo LIFE ARTEMIS. Med drugim skupaj pripravljamo akcijski načrt upravljanja z invazivnimi tujerodnimi vrstami v parku. Skupaj smo z več gozdnih površin odstranili invazivne tujerodne rastline. Vsako leto organiziramo akcije odstranjevanja invazivnih tujerodnih rastlin, v sodelovanju z Mestno občino Ljubljana, ki izvaja aktivno politiko preventive in odstranjevanja invazivnih tujerodnih vrst.

**Ključne besede:** biodiverziteteta, urbano, krajinski park, Ljubljana, upravljanje



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## Fied excursion / Terenska ekskurzija

**Meeting point:** M hotel (conference venue) at 8:30. *Please be on time!*

A whole day field excursion to the SW part of Slovenia will be organized on the last day of the conference. We will visit some areas near Nova Gorica (close to Italy) where a large diversity of invasive alien plants grows and presence of some invasive alien insect species could be observed. After lunch (included) we will continue to the typical karst area of Slovenia (Rakov Škocjan) where forests heavily damaged by natural disturbances e.g. ice breaks and bark beetles' attacks could be seen and where newly open areas in forest were ideal for establishment of some invasive alien plant species. Some natural monuments of this karst area will also be visited. The return to Ljubljana is planned at around 17:30.



Zbornno mesto: pred M Hotelom ob 8:30. *Prosimo, da ste točni!*

Za zadnji dan konference smo pripravili celodnevno terensko ekskurzijo v JZ del Slovenije. Obiskali bomo območja v bližini Nove Gorice, kjer se razrašča velika pestrost invazivnih tujerodnih rastlinskih vrst, prisotnih pa je tudi nekaj žuželčjih in glivnih tujerodnih vrst. Po kosilu nadaljujemo do kraškega dela Slovenije, do Rakovega Škocjana, kjer si bomo ogledali močno poškodovan gozdni sestoj, kjer se po žledolomu in napadih podlubnikov močno razraščajo invazivne tujerodne vrste rastlin. Ogledali si bomo tudi Veliki naravni most.

Povratak v Ljubljano (pred M Hotel) je načrtovan do 17:30.



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# Notes / Zapiski

A series of horizontal dotted lines for taking notes.







