

Citizen science and forest protection

– lessons learned from LIFE ARTEMIS project

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INTRODUCTION

In Slovenia in the years 2016 – 2020 LIFE ARTEMIS project took place, with special focus on invasive alien species in forests – “Awareness raising, Training and Measures on Invasive Alien Species in Forests (LIFE15 GIE/SI/00070)”. The goals of the project were to improve national capacity for the early detection of alien species in forests by mobilizing and training professionals and citizen scientists and to prepare an efficient national framework for early detection and rapid response for alien species in forests.

EARLY WARNING RAPID RESPONSE

In the initial stages of invasion, invasive alien species (IAS) can often be contained and eradicated at a reasonable cost, so the principles of **early warning and rapid response** (EWRR) are important in managing these species. The essential components of an EWRR system are:

1. an alert list of species,
2. a pool of well-trained observers (citizen scientists),
3. reporting tool,
4. verification of data and
5. efficient response protocol.

CITIZEN SCIENCE

In the initial stages, IAS are difficult to detect. Well informed citizen scientists in addition to professionals can contribute to the EWRR system to detect new forest pests and diseases more successfully. Many participants can share observations from large geographic areas.

ALERT LIST

First alert list of IAS in Slovenian forests was drawn up based on an extensive study on potentially harmful species occurring in the neighboring countries and/or showing clear tendencies towards expanding their range to or in EU. The list includes alien species covered by the EU Plant Health legislation.

The alert list of potentially invasive alien species in Slovenian forest had:

- 13 species of alien fungi
- 15 species of alien insects,
- 1 phytophthora species,
- 7 species of alien mammals and
- 58 alien plant species.

With descriptions, pictures, and identification characteristics all alert list species were presented in the **Field Guide to Invasive Alien Species in Forests**. The field guide was later additionally translated and adapted to English with the financial support of the Alien CSI project.



INFORMATION SYSTEM “INVAZIVKE”

In the project, we developed an essential tool for EWRR system to enable easy reporting of alien species sightings and quick transfer of findings to experts. An **information system** called “INVAZIVKE” was developed and set up in 2017 within the project. For citizen scientists there are two ways of use:

- **web application** (www.invazivke.si) and
- **mobile application** (for Android and iOS).



Application INVAZIVKE is a user-friendly tool for reporting the sightings of IAS. Users must first register. The easiest way is to use a mobile device (mobile phone or tablet). The user then takes a photo and location (GPS coordinates) is automatically saved. In the drop-down menu the species is chosen. For help with determining IAS, a presentation of species from alert list with illustrations of distinguished characteristics and photos are added. For web application users, the exact location should be decided on a map or added manually with GPS coordinates.

Once per day the designated taxonomic group experts are then informed and asked to **verify the determination**. In case of finding new or harmful IAS the steps of verification in the field and containment take place. Once the identification is confirmed the author of the finding gets feedback on the correctness of the data and additional comments from the expert if needed. System enables instant information transfer to the authorities if new IAS is detected.

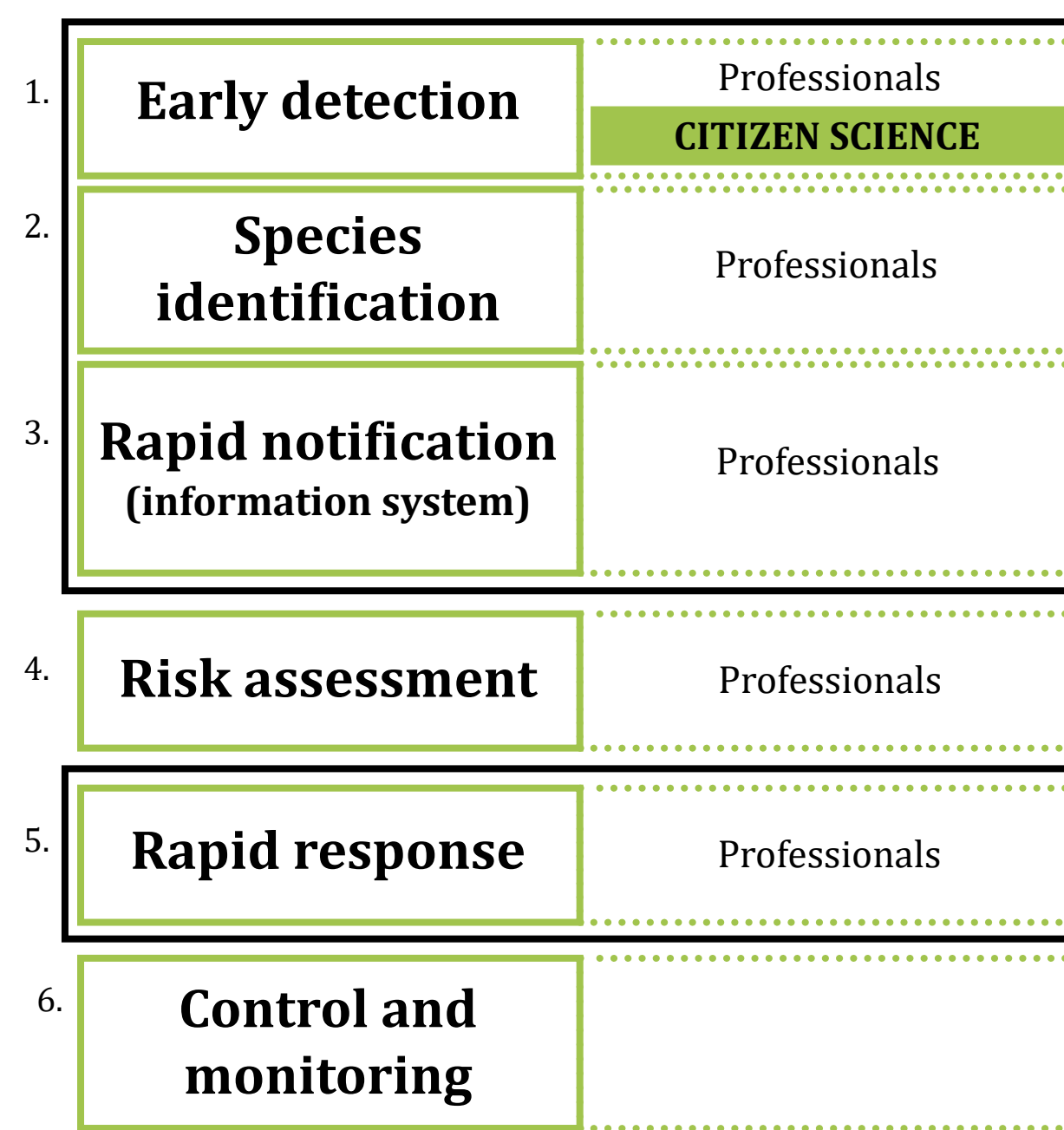
TRAININGS AND AWARENESS RAISING

Although citizen scientists can have strong motivation to take part, they should be adequately trained and informed. In the project LIFE ARTEMIS various activities were carried out through which volunteers were encouraged to observe their surrounding and report the findings of IAS in the INVAZIVKE app. **Training workshops, guided walks, and special media campaigns** with focus on a certain IAS species were organized in the project.

CONCLUSIONS

- Citizen science is a valuable tool for detecting forest protection problems and a lot of useful data can be collected.
- Citizen scientists should be focused on a limited number of target species, therefore an alert list or a priority list should be prepared.
- Not all IAS can be included in citizen science project – easy to recognize species are more likely to be reported.
- List of species can include more common species to test the functionality of the EWRR system and to monitor the spreading of already present IAS.
- Tools for collecting data, such as mobile apps, should be user friendly, easy to use and adapted for different users (e.g., Android and IOS operating system on mobile devices).
- It is important to train citizen scientists and offer them different information materials and tools. Feedback information to the observers is crucial to enhance their motivation.
- It is challenging to keep high motivation of the citizen scientists, therefore continuous educational and raising awareness activities should be organized.
- Yearly campaigns to promote reporting of one chosen IAS are a promising idea to promote citizen science projects in forest protection.
- Tailor-made CS projects are needed because every citizen science group is different.
- The EWRR system proved operating well - new regulated invasive alien plant species for Slovenia (*kudzu (Pueraria montana var. lobata)*) was successfully detected and eradicated.

EARLY WARNING AND RAPID RESPONSE SYSTEM

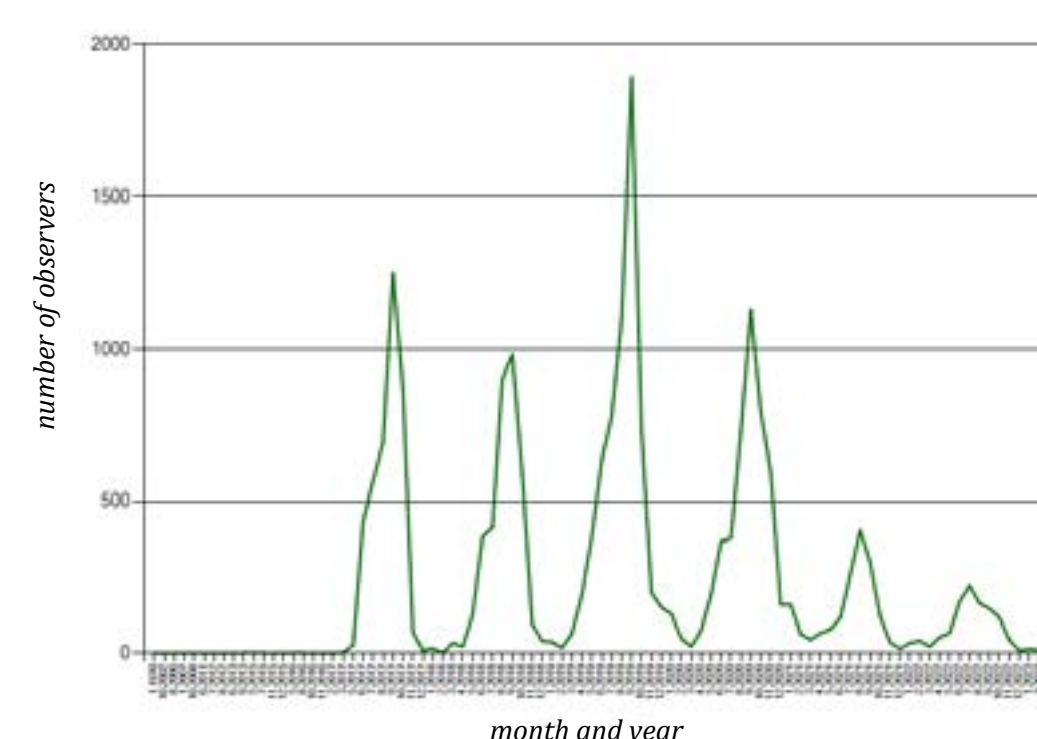


EARLY WARNING

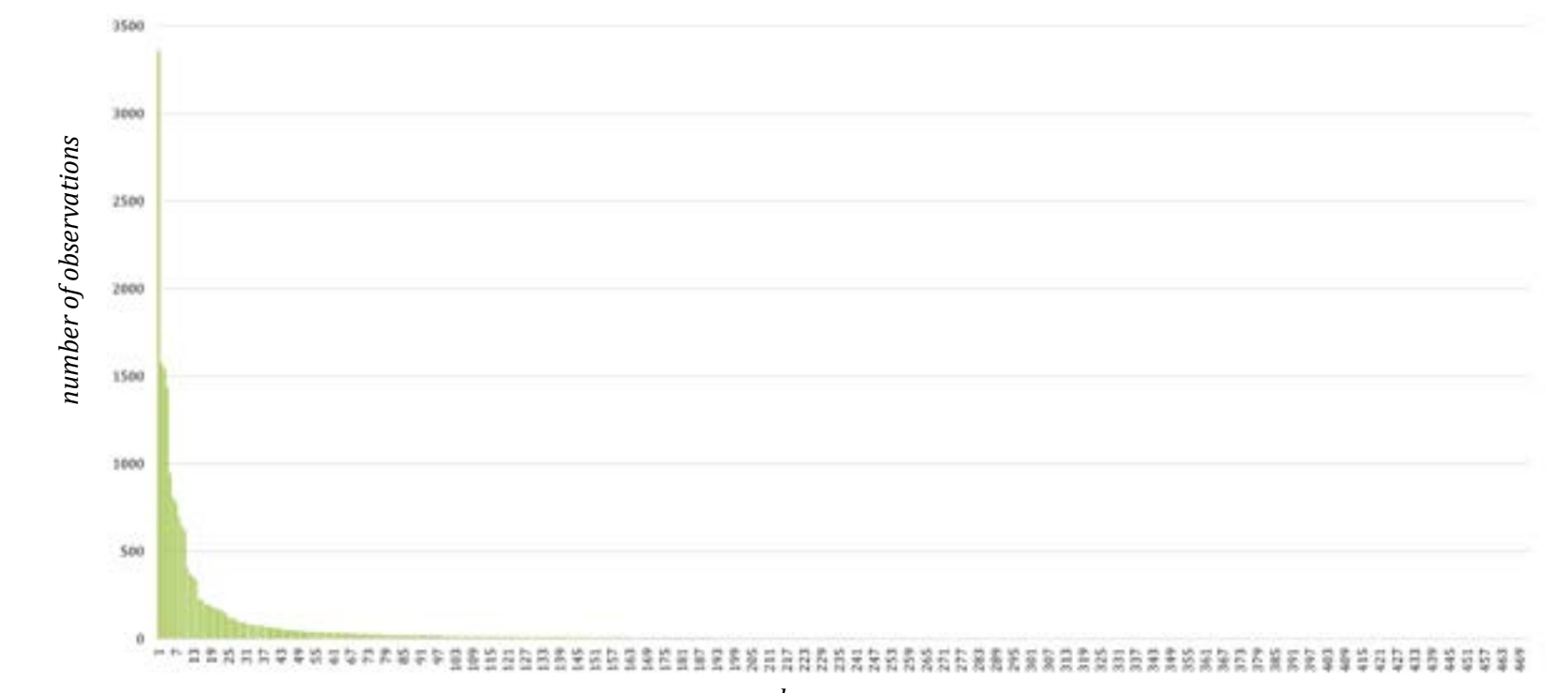
RAPID RESPONSE



INVAZIVKE information system (june 2017 – 16. 3. 2023)



No. of observations in information system INVAZIVKE per month



No. of observations in information system INVAZIVKE per observer

Number of observations

Web app: 2259
Mobile app: 18958
No. of data including different databases on IAS: 113791
No. of observations per observer: from 1 to 3362
No. of observers with at least one reported data: 475

Share of records by groups of organisms in the web and mobile app INVAZIVKE:

- Plants: 78,5 %
- Insects: 6,4 %
- Fungi: 3,6 %
- Bacteria: 0,4 %
- Phytophthora: 0,2 %

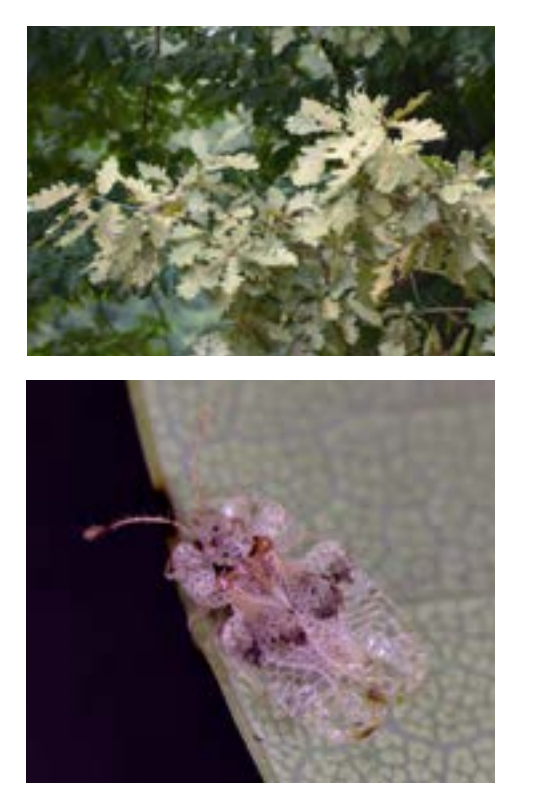
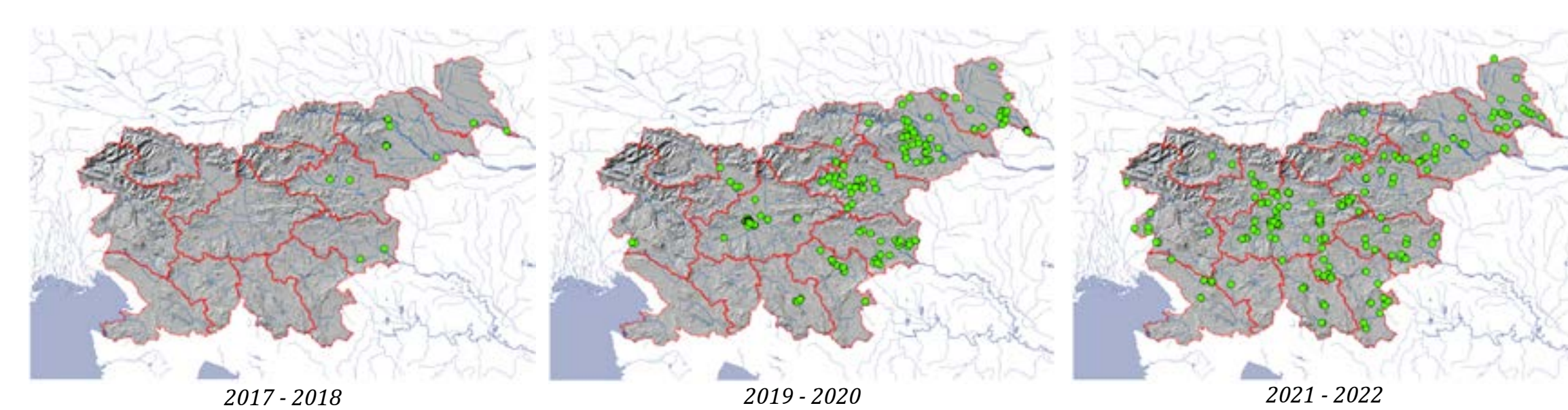
Ten most reported species of forest pests and diseases

Species	No. of data in the web and mobile app Invazivke
<i>Corythucha arcuata</i>	389
<i>Parectopa robinella</i>	345
<i>Hymenoscyphus fraxineus</i>	336
<i>Eutypella parasitica</i>	157
<i>Corythucha ciliata</i>	135
<i>Leptoglossus occidentalis</i>	94
<i>Cameraria ohridella</i>	77
<i>Antheraea yamamai</i>	69
<i>Halyomorpha halys</i>	42
<i>Obolodiplosis robiniae</i>	38

EXAMPLE: oak lace bug (*Corythucha arcuata*)

No. of data in web and mobile app: 389

Outputs: With CS the spreading of the oak lace bug through Slovenia was followed from 2017 onwards.



EXAMPLE: canker of maple (*Eutypella parasitica*)

No. of data in web and mobile app: 157

Outputs: Majority of the identified infected trees were felled, and the infected parts of the trunk were placed on the ground with the canker facing towards the forest floor to prevent further spread of the disease.



Further reading:

- de Groot, M., Ogris, N., van der Meij, M. et al. *Where to search: the use of opportunistic data for the detection of an invasive forest pest*. Biol Invasions 24, 3523–3537 (2022).
- Crow P, Perez-Sierra A, Kavčič A, Lewthwaite K, Kolšek M, Ogris N, Piškur B, Kus Veenvliet J, Zidar S, Sancisi-Frey S, de Groot M. *Using Citizen Science to monitor the spread of tree pests and diseases: outcomes of two projects in Slovenia and the UK*. Management of Biological Invasions 11(4): 703–719 (2020).
- de Groot, M., Pocock, M.J.O., Bonte, J. et al. *Citizen Science and Monitoring Forest Pests: a Beneficial Alliance?*. Curr Forestry Rep 9, 15–32 (2023).

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