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Assessing changing Biodiversity

*Public engagement in the
monitoring of invasive alien
species in Europe*

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Abstract

Invasive Alien Species (IAS) are one of the main drivers of biodiversity loss globally. Citizen Science (CS) plays a positive role in influencing the way in which society values and perceives biodiversity and can contribute to its protection by collecting valuable data. The involvement of the public in IAS recording through CS initiatives using innovative smartphone applications (apps) already complements several official surveillance systems in EU Member States. However, the quality of data may hinder the use of CS data for early warning, management and control of IAS. The Joint Research Centre has developed a smartphone app called “Invasive Alien Species in Europe” (JRC IAS app), allowing users to report the presence of IAS of Union concern (EU Regulation 1143/2014) in Europe. The JRC Proof of Concept (PoC) project “CS data supporting IAS policy in Europe” aims at consolidating the framework for CS IAS data in Europe. Towards this objective, it explores automated solutions for validation of IAS records from the JRC IAS app and looks at ways to increase people’s awareness and long term engagement.

This report describes the initiatives developed by the European Alien Species Information Network (EASIN) under Working package 2 of the PoC aimed at increasing people’s awareness and education on IAS, fostering engagement and active involvement in IAS monitoring through the use of the JRC app. In this endeavour, education was identified as key to the creation of a community of trainers. Likewise, scientific communication including via social media, was considered complementary to the achievement of the engagement objectives.

The activities performed also aimed to improve the experience of the JRC app users, by providing feedback which helped increase the quality of data submitted, facilitating data validators in performing record checks.

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- the JRC School Programme, the EU Academy team, and the teachers for the collaboration in the development of the Massive Open Online Course (MOOC) “Have you seen an alien?”;
- the national projects and entities contributing to the development of local catalogues of species in the “Invasive Alien Species in Europe” app (Sava TIES Interreg, Government of Malta, DANUBE project, LIFE INVASAQUA).

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1 Introduction

Alien Species (AS) have increased their spread worldwide, becoming in some cases invasive (IAS), threatening native species and biodiversity, and affecting human health, the economy, and the environment, compromising its capacity to provide essential ecosystem services.

IAS constitute one of the main drivers of biodiversity loss at global level. The protection of the environment and biodiversity is amongst the priorities of the EU Commission. To achieve the objectives of the EU Biodiversity strategy 2030 it is important to increase education and social awareness, to achieve a widespread recognition of biodiversity value. A dedicated communication strategy is fundamental to reach out the largest possible audience.

Citizen Science, defined as the public participation in scientific research, can play a role in influencing society's perceived value of biodiversity, contributing to the collection of valuable data on IAS occurrences and distribution, supporting the effective implementation of the EU Regulation 1143/2014 on IAS (IAS Regulation) and adoption of management measures. Citizen Science (CS) can play a significant role in public engagement in the monitoring and management of IAS. Improved education, increase of awareness on environmental issues are fundamental for alien species policies to be effective (Caffrey et al. 2014).

CS outcomes are also advancements in scientific research as they improve the scientific community's knowledge and capacity, and invite the public to a first-hand based understanding of science.

The involvement of the public in IAS recording through innovative CS initiatives via smartphone apps already complements existing official surveillance systems in EU Member States. However, high quality data for early warning, management and control of IAS, could be acquired by increasing citizens' engagement and long-term commitment.

The European Alien Species Information Network (EASIN) facilitates the exploration of information and spatial data on Alien Species, and is the official information system supporting EU MS in the implementation of the IAS Regulation. EASIN aims to assist policy makers and scientists in their efforts to tackle biological invasions, and it is committed to public engagement through dedicated actions towards the public and the teaching community.

The JRC smartphone application called "Invasive Alien Species in Europe" facilitates the involvement of the public in IAS recording, and shares IAS records with EASIN geodatabase (Schade et al. 2019). Concurrently the participation of volunteers, boosted by the EASIN science communication, has improved the development of the JRC app.

EASIN implements a dedicated science communication strategy which includes: news on the website, a dedicated page on citizen science, social media accounts, participation to science popularization events and development of educational products for the teaching community to raise awareness and increase people's engagement in IAS monitoring and management. The Massive Open Online Course (MOOC) "Have you seen an alien? - Public's engagement in the monitoring of invasive alien species in Europe", which benefited from direct involvement and input from teachers, responds to the need of increasing people's education on biodiversity and IAS.

The activities described above carefully considered people's perception about nature, including their motivation, expectations and objectives, and aimed at increasing people's empowerment in biodiversity protection. These activities stimulate the establishment of a long-term European community of interest on IAS, helping biodiversity and ecosystems conservation.

2 Proof of Concept 2020–2021 on IAS App

The JRC Proof of Concept (PoC) “Invasive Alien Species in Europe app: engaging citizens in alien species surveillance” (2018-2019) focused inter alia on developing a community of users of the IAS app, with particular consideration to the engagement of EU Member States national competent authorities in charge of the implementation of the IAS Regulation.

The new PoC project 2020-2021 “Citizen Science data supporting Invasive Alien Species policy in Europe” included among its objectives to enhance the engagement of citizens. The aims of the project include fostering volunteers’ recruitment and stimulate long-term engagement of citizens in IAS monitoring. Availing of the scientific background of EASIN, Citizen Science data will support research and EU policy on IAS. The following actions were implemented:

- set-up of a network of trainers (e.g. school teachers, bioblitz organizers)
- provision of digital training on biodiversity and IAS (MOOC, Massive Open Online Courses)
- translation of the JRC IAS app content into additional EU languages
- first steps towards the development of a web application for reporting IAS, mirroring the features of the IAS app
- digitalization of an educational board game
- first steps towards the development of online games to provide immersive educational experiences (Augmented Reality)
- context-dependent promotion of the IAS app (e.g. participation to science popularization events, engagement of specific stakeholders groups also through social media).

Here we report the results obtained in implementing each of the actions of the PoC 2020-2021, deliverable 1 (D1), and lessons learned. Furthermore, we formulate some recommendations to improve people’s engagement in biodiversity monitoring across Europe through the use of the IAS app.

3 EASIN activities on Citizen Science

Civic engagement in scientific processes plays an increasingly important role, widely acknowledged, not limited to large scale data provision and research advancing. Citizen Science encompasses the active participation by citizens in various phases of the research process in natural and social sciences, creating mutual learning opportunities between scientists and participants (citizen scientists). Citizen Science can generate significant added value for the society, by enhancing people's scientific literacy and increasing the public's understanding of science.

JRC has placed Citizen Science high on its agenda and set initiatives aimed at citizens' engagement. Citizen Science festivals were attended by EASIN members. EASIN participates also to the JRC community of practice on citizens' engagement <https://webgate.ec.europa.eu/connected/groups/jrc-community-of-practice-on-citizen-engagement> and to the JRC community of practice for the development of smartphone applications <https://webgate.ec.europa.eu/connected/groups/mobile-apps-at-the-jrc-experience-sharing>.

Citizen Science projects have a strong social component, which needs to be duly considered from the project conception, since it will have an influence on its design and the development of decisions (Sturm et al., 2018). The involvement of citizens through Citizen Science for monitoring and surveying alien species has been applied in many instances and encourages participation and ownership (Delaney et al., 2008).

EASIN Citizen Science activities consider advances in research on this topic, best practices and makes reference to the 10 principles of Citizen Science laid down by the European Citizen Science Association (ECSA) <https://ecsa.citizen-science.net/2016/05/17/10-principles-of-citizen-science/>.

The following initiatives were implemented:

- a specific EASIN webpage on Citizen Science, created in 2017, was upgraded and further developed including a repository of Citizen Science projects on biodiversity and IAS in Europe
- tailored periodic news to the general public on EASIN website
- communication via EASIN social media accounts (Twitter and Facebook)
- IAS of Union concern factsheets
- Training: EU Academy MOOC "Have you seen an alien?"
- promotion of EASIN Citizen Science initiatives in Conferences, webinars and science popularization events (2019-2021).

3.1 EASIN website

The EASIN webpage on Citizen Science aims at informing the general public on biodiversity issues, on IAS features and the threat they pose to the European biodiversity, stimulating the engagement of citizens in their monitoring and management.

The webpage hosts a Citizen Science projects repository collecting CS initiatives (projects, CS national organizations) in Europe allowing interested people to see existing initiatives close to their areas of residence.

The information collected from CS projects was used to create a database with the following attributes:

Table 1. Citizen Science projects attributes

Attribute id	Attribute	Attribute type (# categories)	Attribute values	Description
1	Title	(text)		Name of the project/activity
2	Project link	(text)	hyperlink	Link to the project's website
3	Description	(text)		Short description of the project
4	Level	Category (9)	Europe European Union Mediterranean Region Mediterranean Sea Black Sea Caspian Sea Baltic Sea Natura 2000 Network Other	The spatial scale at which the project is implemented. The categorization has been recently updated based on the needs of update of the current database
5	Country	List	Name of country(ies)	The countries involved in the project
6	Type	Category (4)	CS Project CS Organization National Organization Other projects	Type of organisation represented by the lead partner
7	Environment	Category (5)	Freshwater Marine Terrestrial Urban area Other (adding new environment)	The target environment. One or more are eligible
8	Target	Category (5)	Animals Plants Microorganisms Fungi Other (adding new environment)	The target type of organism tackled by the project activities. One or more are eligible
9	Start date	dd/mm/yyyy		
10	End date	dd/mm/yyyy		
11	Life Project link	(text)	hyperlink	If the activity is a LIFE Project, link to LIFE website
12	IOS	(text)	hyperlink	If the project includes a smartphone app for AS/IAS monitoring, IOS link
13	Android	(text)	hyperlink	If the project includes a smartphone app for AS/IAS monitoring, Android link

The repository includes 111 Citizen Science projects related to biodiversity and IAS in European countries as of December 2021. 102 projects out of 111 are unique initiatives in a country and/or shared amongst neighbouring countries e.g. (Iberian Peninsula), while 9 projects are shared among several EU regions and countries outside the EU.

CS project managers were invited through social media or direct contact to review and supplement the relevant information contained in the EASIN CS repository.

In addition, a mapping exercise was performed to harmonize the information in the EASIN CS repository with that contained in the JRC repository of environmental CS projects, based on Sustainable Development Goals (SDGs) and Policy relevance, and the data gathered in the COST Action 17122 Alien CSI projects database. This activity aimed at synchronizing information on CS projects on biodiversity and alien species at European level, facilitating access and comparison of existing initiatives, fostering collaboration among experts, and avoiding duplicates.

Figure 1. Number of CS initiatives in European countries.

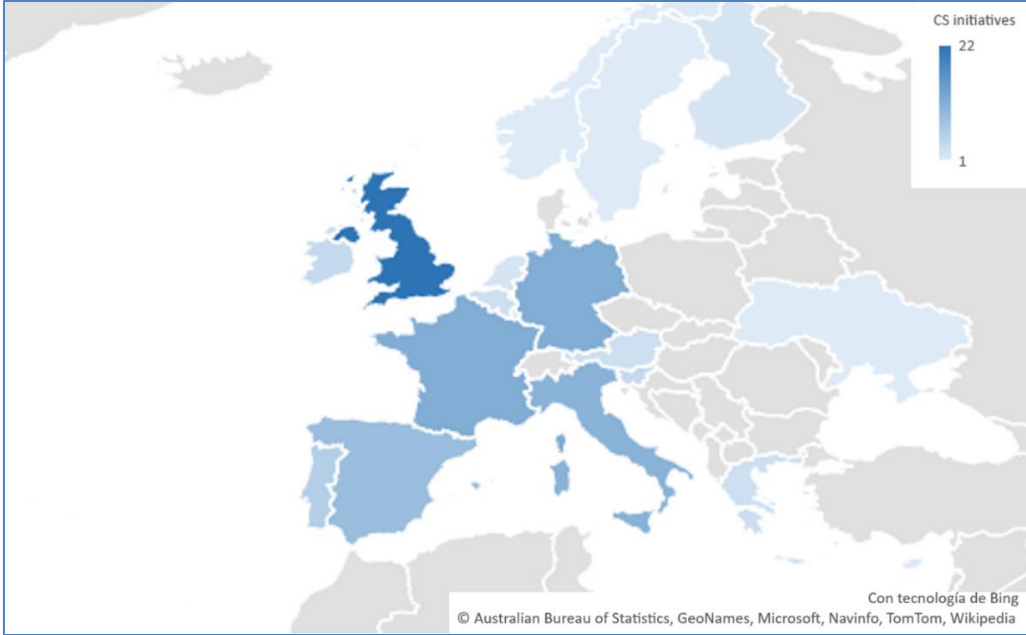
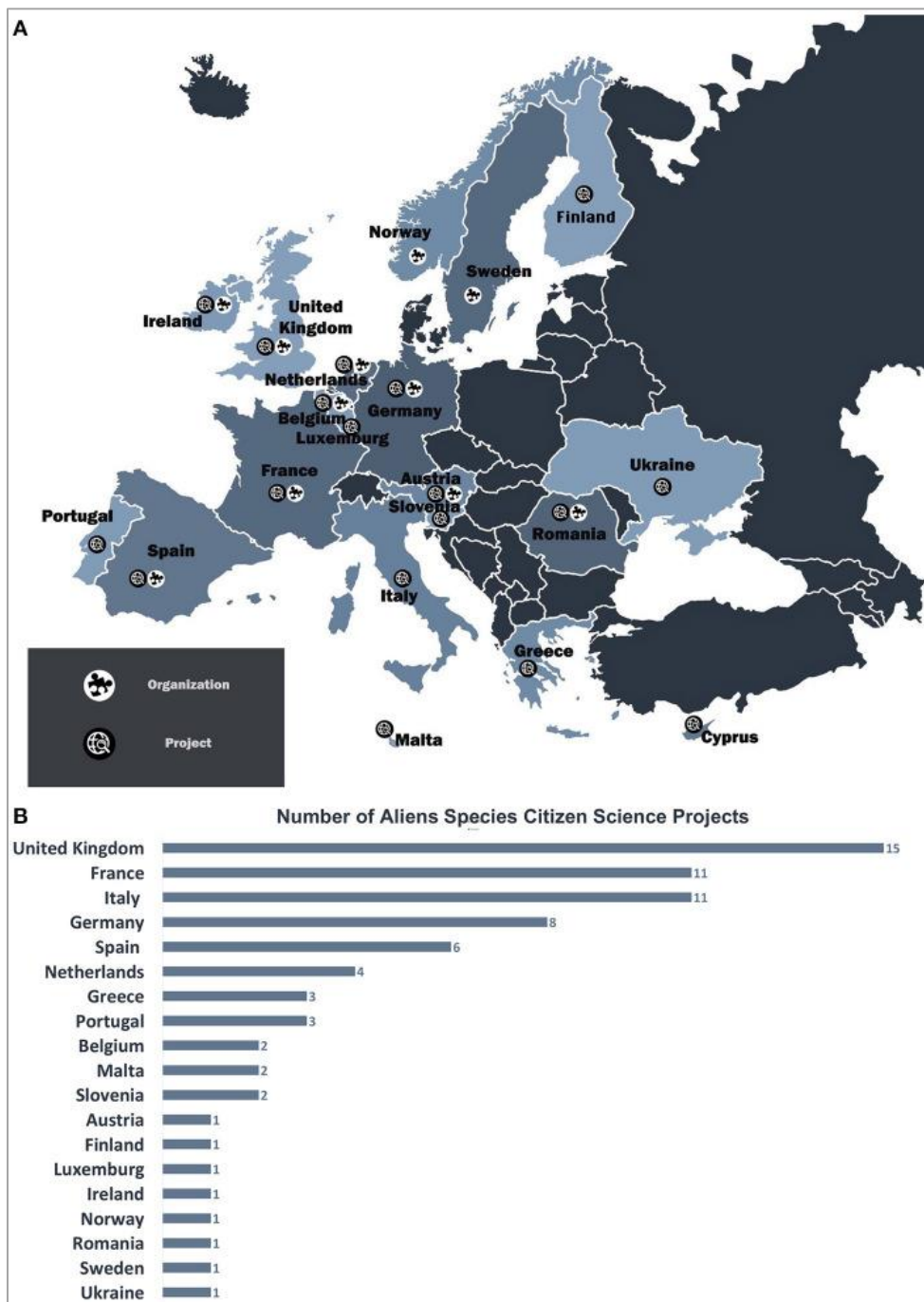


Figure 2. (A) Citizen Science projects and organizations recorded in the EASIN repository. (B) Number of Citizen Science projects related to alien species by country (from Giovos et al. 2021)



3.1.1 EASIN news

Outreach, learning activities, education and reward for participation are important components of a Citizen Science project (Sturm et al., 2018). Regular communication on CS projects achievements strengthens volunteers' motivation (West and Pateman, 2016) and stimulates long term engagement.

English is the main language in the EASIN website, which raised the problem of linguistic barriers, considering that 24 languages are spoken in the 27 EU MS, as well as the problem of having a communication that truly considered and addressed the local context, values, and people's perception and feelings about nature.

Table 2. Published EASIN news

Published News (2012-2021)	264
On #CitizenScience	60
On the #IASApp	14

To overcome this problem and ease the access to information on IAS in all EU national languages, EASIN promoted and developed a webpage, in collaboration with DG ENV and EU MS competent authorities in charge of the implementation of the EU Regulation 1143/2014 <https://easin.jrc.ec.europa.eu/easin/MSCAuthorities>. The contribution of Member States was very active and the webpage welcomed by the EASIN wide community of users.

3.2 EASIN on social media

The social aspect of biological recording is a key motivation for many volunteers, and has resulted in vibrant recording communities worldwide (August et al. 2015). Social media can provide the setting for an online community of practice that can support groups of volunteers and requires little daily input from administrators (Liberatore et al., 2018). Social media (SM) are widely used to communicate and exchange information. While websites can be considered more as “notice boards”, SM offer users the possibility to form communities in which individual or groups can easily and swiftly communicate (August et al, 2015). Social media are effective channels to convey key messages on biodiversity, stimulating engagement and participation aiming at a behavioural change.

As from 2018, based on an established and systematically updated communication strategy, EASIN communication focused on scientific advances on alien species, sharing also details on how EASIN works, connecting the project development with website updates and posting contents on social media (e.g. on the species Catalogue, the CS projects repository, app upgrades, participation of the EASIN Team to science popularization events).

The communication strategy determined a positive impact, witnessed by users’ feedback who contacted us with comments and proposals for improvement.

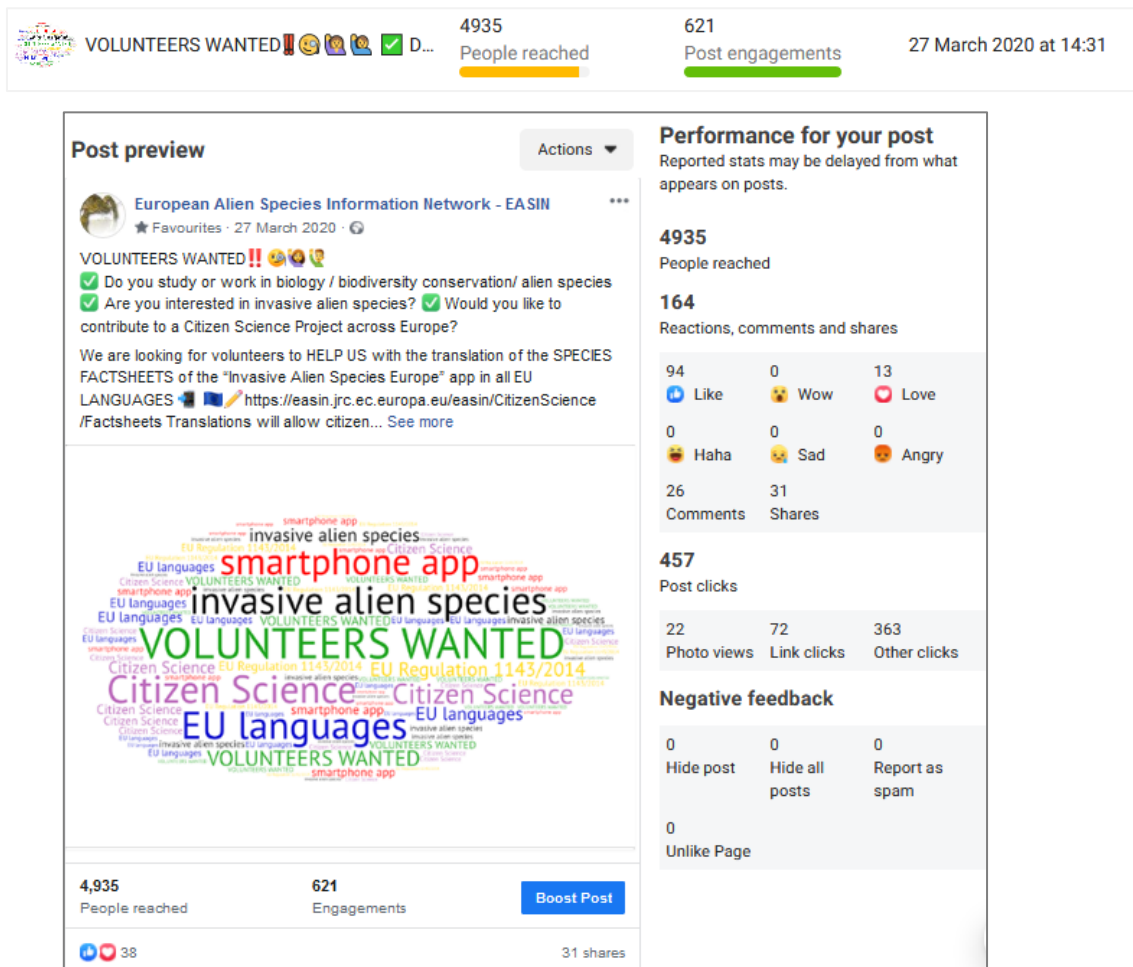
In addition, in 2020 the EASIN SM Team boosted the online interactions with the public during the Covid-19 pandemic confinement period (see table 3 and picture 2). This was achieved through the promotion of “to-do at home” activities (biodiversity observations in home gardens and neighbourhood), and engaging people in the translation of the app content in more EU national languages. The participation of the EASIN Team in webinars, online workshops, or training initiatives was also promoted and provided an opportunity to inform the public on IAS issues and to invite people to explore the renovated EASIN website, and use web services for retrieving, map and download data on IAS. In 2021 the communication strategy focused on the promotion of new developments (translation of the app in new languages and species local catalogues, online training course (MOOC), new website sections).

Table 3. Followers of EASIN social media accounts

	Twitter - @EU_Aliens	Facebook - @EUAliens
N° Followers (December 2021)	2,075	2,380

“Volunteers wanted”: SM campaign for the engagement of the public in the improvement and translation of the content of the IAS app. The result of this campaign was the translation and update of the app content by volunteers in 5 additional languages in 2020 and 8 in 2021.

Figure 3. Twitter original post with highest impact in 2021 (based on rate impressions / engagements)



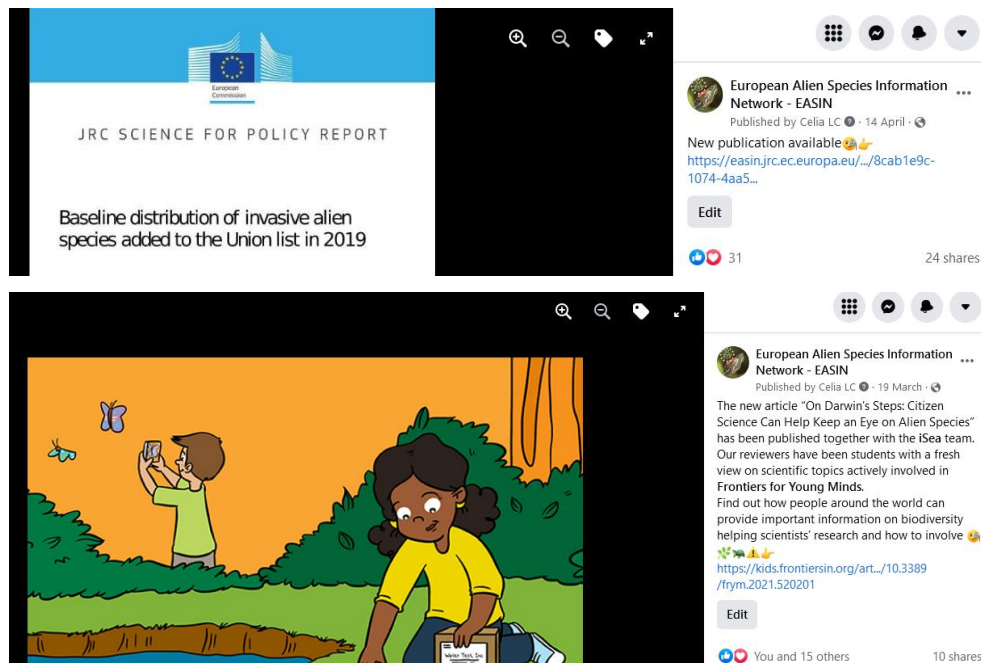
The EASIN original post on Twitter with the highest impact in 2021 was the one on the support to the #UnitedforBiodiversity campaign launched by DG ENV and integrated by a network of partners and entities, followed by the promotion of the JRC EASIN MOOC (Massive Open Online Course) "Have you seen an alien?" hosted on the EU Academy platform. This shows the interest and appreciation of EASIN audience towards concerted and recognizable actions to protect biodiversity and manage IAS, also through awareness raising and education, which in turn stimulates engagement and participation. The feedback received from social media was used to review and fine tune the communication strategy.

Figure 4. Most successful EASIN posts on Twitter



On Facebook, two EASIN posts advertising EASIN publications on IAS recorded the highest impact in terms of impressions and visits to EASIN website in 2021, followed by posts related to the IAS app and the “Have you seen an alien?” MOOC:

Figure 5. Posts on EASIN publications with highest impact on Facebook

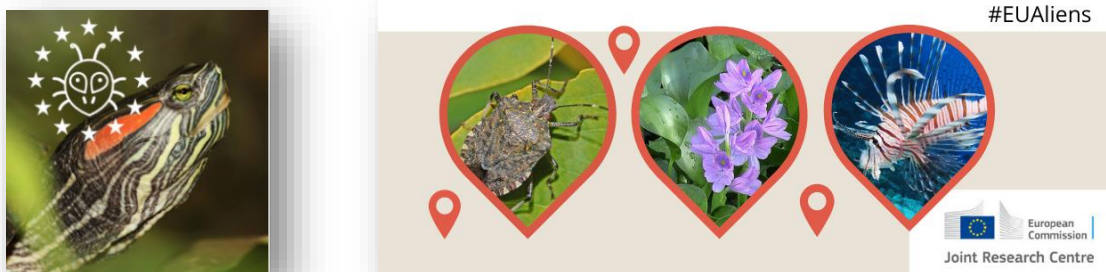


3.2.1 EASIN social media accounts updates in 2020-21

Several updates were implemented in the EASIN SM accounts, in agreement with JRC SM and visual identity Team, and in collaboration with DG ENV SM teams. This followed the participation of the EASIN SM managers to “JRC ISPRA Science and knowledge communication on social media – advanced” (30 January 2020) and to the “JRC ISPRA Citizen Engagement in a nutshell” (19-20 February 2020). These two initiatives provided inputs and perspectives to improve EASIN SM accounts through:

- Updates of user's name account: @EUAliens (Facebook) and @EU_Aliens (Twitter)
- Implementation of new visuals in line with the development of the EU Academy MOOC on Invasive Alien Species, liaising with the JRC SM team: <https://academy.europa.eu/local/euacademy/pages/course/overview.php?id=126>
- Update of the EASIN Twitter profile visual (developed in 2020, implemented in 2021). This is based on the use of a water mark on pictures as a distinctive symbol approved by the JRC SM Team:

Figure 6. (A) image, watermark and (B) banners adopted on EASIN social media and implemented in 2021.



3.3 The “Invasive Alien Species in Europe” Smart app

Technology has greatly helped in documenting biodiversity in recent years, thanks to development of many applications for mobile phones. Apps have an important role in educating and engaging the public and to raise awareness on biodiversity and environmental issues.

The development by a JRC Team of the “Invasive Alien Species in Europe” app,, allows users the reporting of species of Union concern under EU Regulation 1143/2014 (Tsiamis et al., 2017). Its development carefully considers the needs to improve usability and users’ experience, to foster its use across Europe. Principles for developing mobile apps and platforms for Citizen Science were discussed in two European workshops (Sturm et al. 2018).

Further developments following an open and participatory approach that allowed people to share their experiences regarding IAS are considered for upgrading the app (Schade et al., 2019).

Analysis of needs, comparison with similar initiatives, and new features and technologies are continuously considered for embedding in the IAS app. Issues related to the quality of data and validation of reports were considered by another report developed in the context of this PoC (Adriaens et al., 2021).

Volunteers help generate data through the app records on the presence of regulated species. These records are important as they supplement the data acquired through official surveillance performed by the Competent Authorities of the EU Member States, thus contributing to the implementation of the EU Regulation 1143/2014.

The IAS in Europe app was translated in 13 languages, in addition to English: Bulgarian, Bosnian, Deutsch, Greek, Spanish, French, Hungarian, Italian, Maltese, Portuguese, Romanian, Serbian, and Turkish. This choice responded to the problem mentioned in section 3.1.1. about English being the only language for the EASIN website hosting news and social media posts dedicated to Citizen Science and the IAS in

Europe app. This development was done thanks to a network of volunteers created within the EASIN social media followers (call for contribution launched on EASIN social media on 27.03.2020, new call for further updates foreseen in 2022).

Extending the number of available languages to 14 reflects the effort towards increasing people awareness, improves their understanding of IAS issues and makes their contribution easier, addressing issues such as personal motivation, satisfaction and engagement, as well as the possibility to signify specific local conditions in the local language.

Ownership was addressed through the customization of the app and the creation of national or regional catalogues of IAS and the branding, with the acknowledgement of the partnership and active role of organizations working at national and regional level (LIFE Invasaqua (Oliva-Paterna et al. 2022), Sava Ties, Danube River basin (Trichkova et al. 2021), Malta ERA).

While motivations of participants may vary, it is generally acknowledged that the use of prompt feedbacks as well as of data visualization can keep users motivated and engaged with the technology (August et al, 2015). On this line, the app features were modified to give an automatic feedback to users when submitting a report, graphic visualization by means of observations maps, and allowing EASIN data validators to send direct messages to users.

The same principle inspired the idea of allowing expert validators outside the JRC to access the validation console. With it, citizens' reports in defined geographical areas can be validated and verified.. This increase the sense of ownership and trust in the project.

Further developments are envisaged as follows:

linking experts to species' taxa in the data validation console, similarly to what happens in the EASIN Editorial Board working procedures.;

- development of an EASIN web application to allow reporting of IAS of Union concern, as an alternative to the use of the JRC app. This will allow users to report sightings and pictures taken with cameras and not just from cameras embedded in mobile devices. The first steps towards designing the web app were undertaken.

Table 4. Statistics on users' observations (December 2021)

Validation status	Nº observations
Discarded	431
Pre-validated	6
Submitted	85
Unclear	118
Validated	743
Total	1,383

Table 4. IAS observations by local catalogues

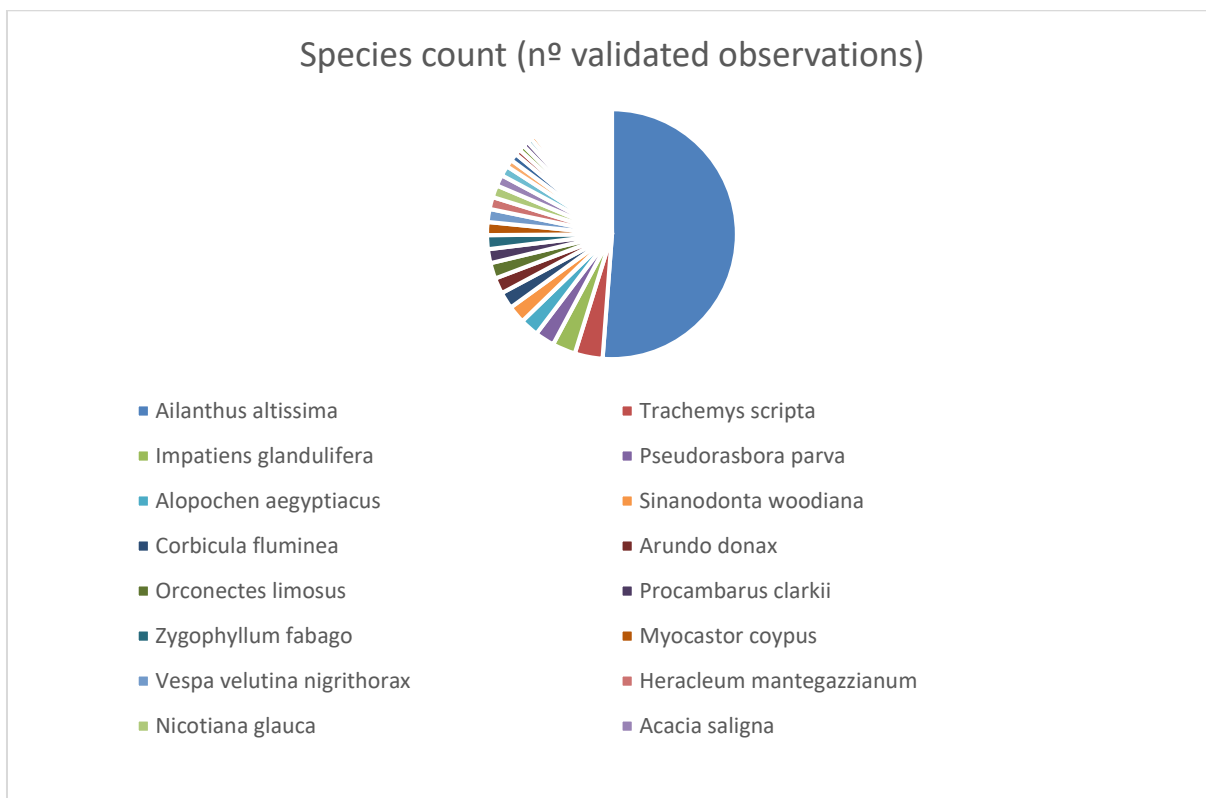
IAS app catalogues	Nº of observations by catalogue (not including discarded and unclear observations)
Total (all catalogues)	834
General catalogue (IAS of Union concern)	665
DANUBE basin catalogue	61
SAVA_Ties catalogue	19
Iberian catalogue (LIFE INVASAQUA project)	90

Table 5. Species count (n° of validated observations)

<i>Species</i>	<i>Species count (validated observations)</i>
<i>Ailanthus altissima</i>	426
<i>Trachemys scripta</i>	30
<i>Impatiens glandulifera</i>	25
<i>Pseudorasbora parva</i>	21
<i>Alopochen aegyptiacus</i>	20
<i>Sinanodonta woodiana</i>	19
<i>Corbicula fluminea</i>	18
<i>Arundo donax</i>	17
<i>Orconectes limosus</i>	17
<i>Procambarus clarkii</i>	15
<i>Zygophyllum fabago</i>	15
<i>Myocastor coypus</i>	14
<i>Vespa velutina nigrithorax</i>	14
<i>Heracleum mantegazzianum</i>	13
<i>Nicotiana glauca</i>	13
<i>Acacia saligna</i>	12
<i>Alburnus albidus</i>	11
<i>Myiopsitta monachus</i>	8
<i>Sciurus carolinensis</i>	8
<i>Asclepias syriaca</i>	6
<i>Elodea nuttallii</i>	6
<i>Gambusia holbrooki</i>	6
<i>Lepomis gibbosus</i>	5
<i>Salix babylonica</i>	5
<i>Ambrosia artemisiifolia</i>	4
<i>Eichhornia crassipes</i>	4
<i>Eucalyptus globulus</i>	4
<i>Myriophyllum aquaticum</i>	4
<i>Opuntia ficus-indica</i>	4
<i>Carassius auratus</i>	3
<i>Dreissena polymorpha</i>	3
<i>Lagarosiphon major</i>	3
<i>Ludwigia grandiflora</i>	3
<i>Phytolacca americana</i>	3
<i>Bidens frondosa</i>	2
<i>Cairina moschata</i>	2
<i>Callinectes sapidus</i>	2
<i>Carassius gibelio</i>	2
<i>Cyprinus carpio</i>	2
<i>Dreissena rostriformis bugensis</i>	2
<i>Echinocystis lobata</i>	2
<i>Eriocheir sinensis</i>	2

<i>Fraxinus pennsylvanica</i>	2
<i>Myriophyllum heterophyllum</i>	2
<i>Pacifastacus leniusculus</i>	2
<i>Pectinatella magnifica</i>	2
<i>Pennisetum setaceum</i>	2
<i>Perca fluviatilis</i>	2
<i>Aesculus hippocastanum</i>	1
<i>Agave americana</i>	1
<i>Ameiurus melas</i>	1
<i>Amorpha fruticosa</i>	1
<i>Crangonyx pseudogracilis</i>	1
<i>Ctenopharyngodon idella</i>	1
<i>Cylindropuntia imbricata</i>	1
<i>Estrilda astrild</i>	1
<i>Eucalyptus camaldulensis</i>	1
<i>Gunnera tinctoria</i>	1
<i>Gymnocoronis spilanthoides</i>	1
<i>Hydrocotyle ranunculoides</i>	1
<i>Hypophthalmichthys molitrix</i>	1
<i>Ipomoea purpurea</i>	1
<i>Ludwigia peploides</i>	1
<i>Muntingia calabura</i>	1
<i>Nyctereutes procyonoides</i>	1
<i>Orconectes virilis</i>	1
<i>Perccottus glenii</i>	1
<i>Procyon lotor</i>	1
<i>Pueraria montana var. lobata = Pueraria lobata</i>	1
<i>Rhynchophorus ferrugineus</i>	1
<i>Solidago gigantea</i>	1
<i>Symphotrichum lanceolatum</i>	1
<i>Vitis riparia</i>	1

Figure 7. Number of validated observations per species of all species catalogues. *Ailanthus altissima* represents more than 50% of the total amount of observations.



Citizen Science validated data can be mapped using EASIN web tools or visualized through a specific map viewer.

Figure 8. Integration of the validated IAS app observations into the EASIN geodatabase. Darker colours indicate a higher number of citizens' observations in a country.

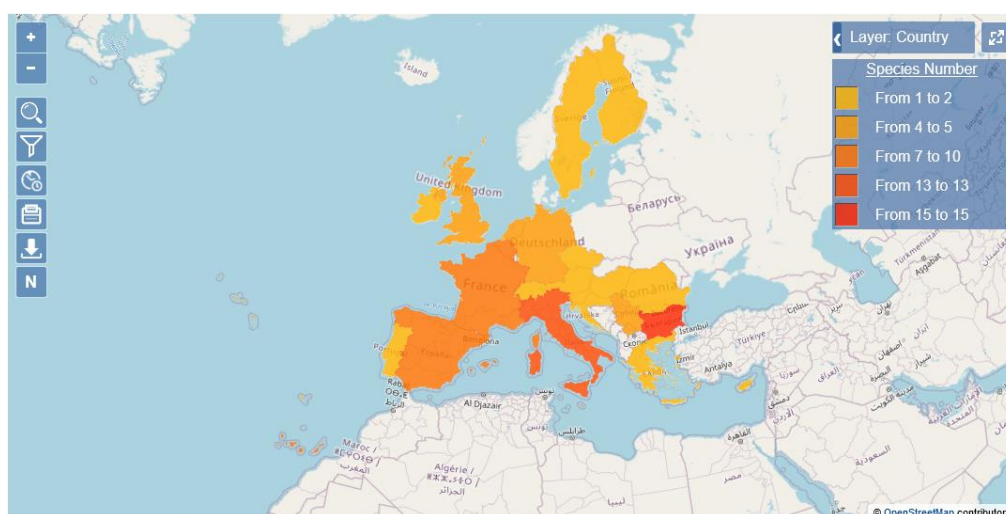


Figure 9. EASIN Citizen Science reports viewer allows users the navigation of CS validated reports app



3.4 Education: the Massive Open Online Course (MOOC) “Have you seen an alien?”

In the current PoC project, education was identified as key to the creation of a community of trainers for a wider use and promotion of the app. This will lead ultimately to an increased engagement of citizens in the monitoring of IAS and will allow the acquisition of high data quality, benefiting the research and the management of IAS.

The online course, was conceived and developed under the frame of the JRC School Programme <https://ec.europa.eu/jrc/en/eu-science-outreach-programme/school-visit-programme>, and is hosted on the [EU Academy platform](#). The course targets primarily teachers of secondary schools who seek expert support on biodiversity and want to give their students the opportunity to experiment Citizen Science activities.

The course is free, open and accessible to teachers, trainers, students and all people interested in IAS issues.

The course objectives are :

- raise public awareness about biodiversity, and the need of its protection through monitoring and management of alien and invasive alien species (IAS) occurring in Europe
- increase knowledge on IAS and their relationship with nature conservation, and human well-being
- inform on the need for updated and timely availability of data on IAS, and on the role of the EASIN platform as crossing point for information on IAS in Europe
- promote people’s long term engagement in the monitoring and management of IAS through dedicated tools and projects, contributing to the EU policy on biodiversity and supporting the implementation of the EU Regulation 1143/2014 on IAS
- create a community of trainers on the “IAS in Europe” app
- create a European-wide community of interest on AS and IAS.

Meetings were held with a group of Italian teachers and European school teachers to gather their feedback and suggestions on the course content, addressing the set learning objectives.

The course is composed of 5 modules :

- introduction to biodiversity

- Alien and Invasive Alien Species
- Invasive Alien Species at national and European levels
- data collection: Citizen Science and the EASIN platform
- the JRC "Invasive Alien Species in Europe" app

Each module is composed of short videos in English, with subtitles in 7 EU languages (DE, EN, ES, FR, IT, NL, PT), customizable classes and outdoor activities, and tests for teachers and students. It is planned to add further languages aiming at widening participation throughout Europe.

The users can take tests along the course to evaluate their level of learning and obtain a certificate once the course and tests are completed.

Feedback sections are available in the course such as : « Share your work » and « How did you experience Module X ? ». In addition, a forum was activated where teachers and users can post questions, suggestions and availability or requests for collaboration.

The course was launched in February 2021 and is available at : <https://academy.europa.eu/courses/have-you-seen-an-alien>

Direct communication between MOOC authors and students enrolled is essential to provide feedback, follow up on students' questions and share additional recommendations and materials.

By December 2021, 307 people enrolled in the MOOC.

Teachers, even outside Europe, welcomed and appreciated the course, expressing their opinion:

« I still have not used for my students but I will do soon. And indeed the course information will be of much help for me as a teacher and for my students to learn »

« I liked it very much. The videos were very clear and informative »

« Module 5 was very helpful to understand the app of Invasive Alien Species in Europe. The app is very intuitive and easy to work with. I plan to publicize the application around my family and friends »

"Great learning experience."

JRC and EASIN social media channels were the main tools of promotion of the MOOC, one of the most successful topics.

Figure 10. EASIN top tweet December 2021 : promotion of the new MOOC languages, EU Commissioner @GabrielMariya launch of the official promotion campaign (May-June 2021).

Dec 2021 · 12 days so far...

TWEET HIGHLIGHTS

Top Tweet earned 4,446 impressions

Have you checked the "HAVE YOU SEEN AN ALIEN?" MOOC on [#biodiversity](#) [#alienspecies](#) [#CitizenScience](#) at [#EUAcademy](#)? 🤔 It is now available in 7 LANGUAGES! 🇪🇺 EN, ES, PT, IT, DE, FR, DL 🤔🤔 Don't miss it! Learn, enjoy and get your certificate 📄📄 +INFO 📄📄 easin.jrc.ec.europa.eu/easin/News/Det... pic.twitter.com/FqBhMZJWzh



13 22

Mariya Gabriel @GabrielMariya · 1h

Are you a teacher? ✓
Do you want your #students to know more about 🇪🇺's #biodiversity? ✓🐝

Check out the [#EUAcademy](#) e-course! 📖
Participants can learn, discover, explore & engage in [#CitizenScience](#) activities & earn a participation certificate! 📄

europa.eu/lyJ66Mn



Frans Timmermans y 5 más

13 31

Figure 11. JRC Twitter account stats (August 2021). JRC EASIN MOOC among the top tweets.



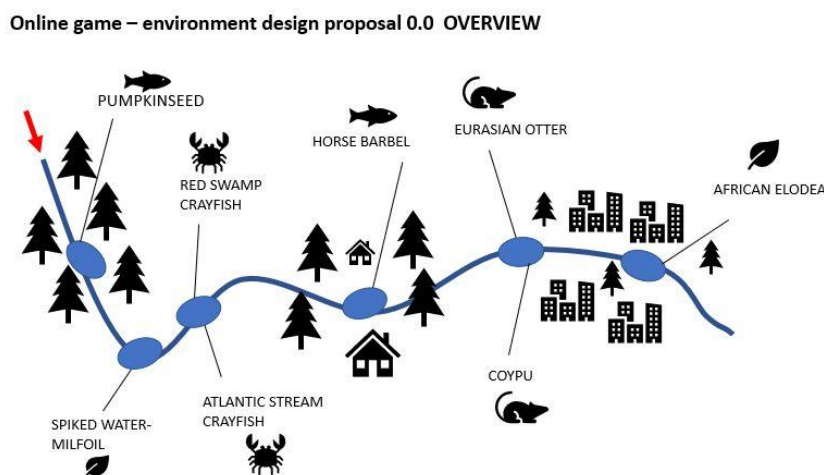
3.5 Augmented reality game

A new activity is ongoing aimed at developing a virtual environment where the user can visit a freshwater environment and find native and invasive alien species, explore and learn about their features and biology, understand the impact that invasive species may have on native species and ecosystem services.

The overall aim is to stimulate curiosity, educate, and foster engagement in the monitoring and management of invasive alien species and protection of biodiversity and a behavioural change.

When finalized, the game will be hosted on the EASIN website. Estimated time of delivery: end of 2022.

Figure 12. Outline of the augmented reality experience on IAS in a freshwater environment



3.6 Board game on IAS

A downloadable and printable board game «Have you seen an alien?» first presented as a pilot experience in 2019 at the World Water Day in Mantua (Italy) was further developed for playing online. The board game aims at raising awareness on IAS appearance, area of origin and pathways of introduction in Europe. The game also helps distinguish native species, which need to be protected from IAS, and stimulates action to protect biodiversity.

The board game was digitalized, introducing two levels of difficulty, and is hosted on the EASIN website at: <https://easin.jrc.ec.europa.eu/easin/CitizenScience/Haveyouseenanalien>.

Figure 13 pilot version of the IAS game (printed cards) at the European Researchers Night 2019 in Milan (left), and at the World water Day 2019 in Mantua (right)



4 Promotion of the IAS app

The promotion of the app was done in several events, by physical attendance, but mostly online due to the COVID pandemic. The promotion of the app was performed within conferences or training events on biodiversity and invasive alien species, and in the context of EU led initiatives.

4.1 Participation to science events

Participation to conferences, webinars and science popularization events are summarized in the box below.

Box 1. List of scientific events and science popularization events attended by EASIN in 2020-2021

- 22.04.2020 participation with a speech to the GLOBE webinar on the 50th Earth Day, <https://www.globeitalia.it/index.php/2015-11-12-17-18-33/rassegna-stampa/news/472-tre-presentazioni-per-la-didattica-scientifica-webinar-l-uomo-la-terra-e-il-covid-19> (followed by 300 people via Zoom and 200 via Youtube).
- Online presentation to secondary school students Suzzara (MN) 27.11.2020, GLOBE Italia
- Daylighting Rivers Final Conference 01.12.2020 <https://www.daylightingrivers.com/final-conference-2/>
- EFSA Virtual School 04.03.2021: presentation to secondary school students
- World water Day 2021 – Fiumi di primavera <https://www.globeitalia.it/index.php/gma2021>
- European Week of Regions and Cities 2020
- ECSA Conference 2020 https://www.ecsa-conference.eu/Conference_programme.pdf
- Citizen Engagement Festival 2019 and 2020 <https://ec.europa.eu/jrc/en/event/conference/3rd-annual-citizen-engagement-and-deliberative-democracy-festival>
- European Researchers Night 2021, EASIN presentation 24.09.2021 to secondary school students in Lombardy
- Knowledge for Change: a decade of Citizen Science (2020-2030) in support of the SDGs 14.-15. October 2020 <https://www.cs-sdg-conference.berlin/en/>
- Panel discussion in the Education for Climate Coalition 25.11.2021
- European School Varese management visit to JRC in Ispra 09.12.2021
- LIFE INVASAQUA contest for anglers 24.05-24.06.2022 in the context of the “Week of Invasive Species Spain & Portugal”.
- Coming events: European Week of Regions and Cities 2022

4.2 Set-up of a network of trainers

The EASIN integrated approach towards citizens’ engagement, coordinating CS initiatives, science communication and social media aims, amongst other, to create volunteers ambassadors on biodiversity and IAS issues, promoting the use of the IAS app for reporting observations of species of Union concern.

The support provided by the EASIN Team to more qualified users enriched their experience , in using the app. This allows them to further promote the use of the IAS app, acting as “trainers” of volunteers.

It is foreseen that videos hosted in the MOOC on how to use the IAS app and how CS generated data are processed and integrated in the EASIN geodatabase will be used to further promote the use of the app and increase trust in science.

5 Conclusions

The experience gained in the implementation of the PoC 2020-21 on public engagement in the monitoring of invasive alien species in Europe allows us to make some conclusions :

- expectations, feelings, cultural context must always be considered and addressed when developing Citizen Science activities, verifying and adapting activities following participants' feedback
- language barriers can be overcome by making available the app, IAS factsheets, training, and tools in the EASIN website in all EU languages
- a properly planned communication strategy, also making use of social media, stimulates motivation, long term engagement and helps building a European-wide community of interest on IAS
- technical and scientific support and feedback to volunteers involved in biodiversity monitoring are key to motivate participation and sustain people's long term engagement
- local species catalogues and the translation of the app content in all EU languages enhances participation in biodiversity monitoring programmes
- education addressing secondary students and teachers via online courses is a dynamic and powerful tool to increase scientific knowledge, stimulate action and behavioural change
- the development of networks of trainers on the IAS app increases its use, and opens to the exchange of experiences and development of collaborations.

To further improve people's involvement and long-term engagement we would advise the following:

- improve and upgrade available technologies for biological recording (e.g. incorporating artificial intelligence), to broaden their use and improve users' experience and the acquisition of high quality data
- outcomes, data and researches generated using CS inputs must be clearly and duly acknowledged and properly communicated, including appealing visualizations, to increase trust and ownership
- results of IAS management, which benefited from citizens' contribution and involvement should be correctly referenced, presented and widely communicated, including through social media.

EASIN will continue working towards addressing the highlighted needs, extending the network of collaborations within the JRC-wide community of practice on citizens' engagement and within the JRC School Programme initiative, seeking collaboration also amongst external partners.

Follow up will be given to recommendations drawn by Adriaens et. Al (2021) to increase people's long term engagement in IAS recording.

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List of abbreviations and definitions

AS	Alien Species
CS	Citizen Science
DG ENV	European Commission Directorate General for Environment
EASIN	European Alien Species Information Network
IAS	Invasive Alien Species
JRC	Joint Research Centre of the European Commission
MOOC	Massive Open Online Course
PoC	JRC Proof of Concept project
SM	Social media

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