

Citizen-generated Data on Invasive Alien Species in Romania: Trends and Challenges

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Abstract: Raising public awareness about invasive alien species (IAS) is essential and one step in citizen assumed responsibility is represented by their willingness to cooperate and help the scientists. Recent citizen science initiatives all around the world are bringing promising results, but in Romania almost no citizen-generated data (CGD) projects on IAS were initiated. Mobile agriculture applications (apps) started to develop in Romania and to be used by farmers, but not the IAS apps. The present article analyses the Romanian CGD activities on IAS on EASIN, GBIF and iNaturalist web platforms and the citizen feedback on *Halyomorpha halys* alert leaflets and public presentations. In the same direction, we initiated a questionnaire for reporting on IAS, addressed to students and teachers of the University of Agronomic Sciences and Veterinary Medicine in Bucharest. Report rates varied from 0.79% to 0.38% for web platforms, to 0.14% for e-mail and phones, while the IAS survey received 21.2% answers from teachers and colleagues and 10.5% from students. Face-to-face communication seemed to improve the participatory rate, but only when personal commitment and passion of the researcher is shown.

Key words: Invasive alien species, *Halyomorpha halys*, smartphone applications, citizen-science

Introduction

The monetary impacts of invasive alien species (IAS) in Europe amount to a total of 12.5 billion EUR/year (KETTUNEN et al. 2009). Because IAS were acknowledged as a growing threat to economy and biodiversity in Europe, the European Commission had financed almost 300 IAS projects, with a total budget exceeding 132 million Euro until 2009 (SCALERA 2009). As the pressure of IAS has an exponential growth, we can only presume that the monetary impacts of IAS will have an exponential growth as well. A recent estimation of BRADSHAW et al. (2016) indicates that the costs generated by the invasive insects are minimum US\$70.0 billion

per year globally, plus US\$6.9 billion per year for the associated health costs. For effective prevention and management of IAS, accurate and detailed information about their occurrence and distribution is required. According to VAN VLIET & MOORE (2016), citizen-science projects facilitate extensive data collection all over the world with lower efforts, both on time and money. Citizen science has become nearly a concept as big as science itself and there is evidence that it can contribute positively to social well-being by giving people a voice and by empowering them to become active members of society (BONNEY et al. 2015). COHN (2008) and

GALLO & WAITT (2011) have demonstrated that trained people can supply valuable data which can support the efforts of professional scientist. Extensive and up-to-date databases can exist as long as citizen science is acknowledged as a missing link in today's reality and the people are educated to assume responsibility for the environment. In the last decade, citizen science initiatives have expanded world-wide as a result of the development of communication tools (CAPPA et al. 2016). Smartphone applications (apps) as the Invasive Alien Species in Europe app, IASTracker app, *That's Invasive* app, AGIIR-INRA app etc., are only a few European initiatives. The validated geo-referenced records help the researchers, speed up the early warnings and further the response programs and management schemes. Recently, at the EU level, the need to unify the collected data from such apps on a common platform was acknowledged to ease the use of web services (JRC-COST 2017). This action perfectly lines up with the Open Science Strategic Priority defined in June 2015 by the Commissioner for Research, Science and Innovation and the ambitious plan of the Commission to develop the European Open Science Cloud. As a sign of acknowledging the importance of citizen science and its increasing popularity, the European Citizen Science Association (ECSA) was founded in 2014. The 'First International ECSA Conference Citizen Science – Innovation in Open Science, Society and Policy' was organised in 2016. If today the aims of the EU joint efforts in the IAS field are focused on strategies for how to better make use of the citizen-generated data in order to support a European early warning and rapid control system for IAS, Romania's aim is how to induce a shift in people behaviour and make them more collaborative.

The aim of our study was to analyse the actual situation of Romanian citizen-generated data (CGD) on IAS and to assess the citizen response to different approaches for raising awareness about harmful alien species recently introduced in Romania.

Materials and Methods

The existing Romanian citizen science activities on the web platforms were identified by an online survey related to data about the best known ten invasive alien insect species: *Leptinotarsa decemlineata* (Say, 1824), *Diabrotica virgifera virgifera* LeConte, 1868, *Cameraria ohridella* Deschka & Dimić, 1986, *Hyphantria cunea* (Drury, 1773), *Metcalfa pruinosa* Say, 1830, *Harmonia axyridis* (Pallas, 1773), *Nezara viridula* (Linnaeus, 1758), *Cydalima perspectalis* (Walker, 1859), *Halyomorpha halys* (Stål, 1855), and

Drosophila suzukii (Matsumura, 1931). The survey was performed on the following web platforms: the European Alien Species Information Network (EASIN, <https://easin.jrc.ec.europa.eu/>), Global Biodiversity Information Facility (GBIF, <http://www.gbif.org/>) and iNaturalist (<https://www.inaturalist.org/>), in the period June 2016 – March 2017.

The citizen responses to alerts for alien species were determined on the basis of responses to alerts for the sting bug *Halyomorpha halys* (Stål, 1855), recently introduced in Romania. The following approaches were applied:

1) An alert leaflet about *H. halys* was sent by email to 200 farmers by a consultancy company on 16 August 2016.

2) The same leaflet and information about *H. halys* were published in November and December 2016 in the national Plant Health Magazine (CICEOI 2016a, b), which has more than 4000 monthly subscribers.

3) Fifty alert leaflets were made available to visitors during the 'International trade fair for equipment and products in agriculture, horticulture, viticulture, and animal husbandry (INDAGRA)' on 02-06 November 2016 (<http://www.indagra.ro/en/>).

4) Four oral presentations related to *H. halys* were delivered: one public presentation at the University of Agronomic Science and Veterinary Medicine of Bucharest (USAMV) Conference, 2-4 November 2016 (students and visitors of the INDAGRA Fair as audience); and three scientific presentations at: the XXV Conference of the National Society of Plant Protection, 27-28 October 2016 (plant protection researchers and stakeholders as audience); the Annual Session of Scientific Communication of the Research and Development Institute for Plant Protection, Bucharest, 4 November 2016 (plant protection researchers and stakeholders as audience); and the International Symposium 'Young researchers in Horticulture, Forestry and Biotechnology', Timișoara, 25 November 2016 (students and professors as audience).

The most attractive ways of stimulating citizens to report alien pests were determined by a Google questionnaire related to invasive alien species, which was sent to 447 students, researchers and teachers of USAMV. The questionnaire had 12 questions about reporting of invasive alien species and four demographic questions. In four of the questions the respondents were asked to rank on a scale from 1 to 10 their preference of using a telephone line, Facebook, WhatsApp or a dedicated smartphone application to report IAS. The questionnaire results were interpreted with Excel Software.

Results and Discussion

Already existing citizen science actions related to reporting of invasive alien species

On the European Alien Species Information Network (EASIN), out of the ten species surveyed in our study, only *C. ohridella*, *H. cunea* and *H. axyridis* were mentioned as existing in Romania, although all of them are present. According to TSIAMIS et al. (2017), EASIN aims to facilitate easier access to data of alien species occurring in Europe and 'provide a one-stop shop to access all the information necessary to underpin alien species related policy and management decisions', being the main tool developed by the European Commission's Joint Research Centre (KATSANEVAKIS et al. 2012) and formally recognised as the information system supporting European Member States in the implementation of the IAS Regulation EU 1143/2014. Having an updated status for each invasive alien species on the platform should be considered as one of the priorities of Romanian biologists. On the other hand, the lack of seven out of ten invasive alien species for Romania in the database is an illustration of the flaws in the European public databases managed by scientists. Therefore, we considered necessary to include here a remark on the absence of these main invasive alien species as an alarm sign, and we are waiting for the EASIN reaction following our notification.

The frequency of Romanian citizen generated data on the Global Biodiversity Information Facility and iNaturalist platforms is presented in Table 1. On the GBIF, there were only few data about invasive alien species in Romania and even fewer were

coming from citizens' reports. More exactly, for the ten invasive alien species that we chose as examples, of a total of 31,350 records, only 25, representing 0.079%, were from Romania. Out of these 25, eleven records (0.035%) were generated by three citizens (by integration of the iNaturalist data) and 14 records were extracted from scientific publications or museum collections. On the iNaturalist, a platform specially designed for general public to upload what they observe in nature, of a total of 5,536 records, 21 were from Romania, representing 0.38%, and those were uploaded by two citizens. No CGD projects on IAS were identified in Romania, although many personal blogs of people posting different nature pictures, including insects could be found on the Internet.

BECK et al. (2014) states that GBIF is the largest online platform that integrates digitised collection and survey data about species distribution, but warns that the distributional data are spatially biased given to the nation-wide differences in funding and data sharing. GBIF platform provides less information regarding different ecological parameters, such as range filling, range extent or climatic niches of the species. As a consequence, it should be considered as a useful tool in mapping the invasive alien species, especially because GBIF integrates the georeferenced data uploaded in other different platforms opened to everyone. One example is the iNaturalist platform, a website where anyone can record their observations from nature, either for their participation in citizen science projects, class projects or personal fulfilment (GBIF 2017). As our results show, reports of only two citizens were presented on the GBIF platform for Romania and their content represented only 0.38%

Table 1. Records of ten invasive alien species on the Global Biodiversity Information Facility (GBIF, <http://www.gbif.org/>) and iNaturalist (<https://www.inaturalist.org/>) platforms. TNR – total number of records; TNCGD – Total number of Citizen Generated Data; * – the same person that uploaded data about the specified invasive alien species

Invasive species	TNR GBIF	TNR Romania GBIF	TNCGD Romania GBIF	TNR iNaturalist	TNR Romania iNaturalist	TNCGD Romania iNaturalist
<i>Leptinotarsa decemlineata</i>	2122	1	1*	105	2	1*
<i>Diabrotica virgifera virgifera</i>	462	0	0	4	0	0
<i>Cameraria ohridella</i>	1802	4	0	7	0	0
<i>Hyphantria cunea</i>	1095	11	1	471	0	0
<i>Metcalfa pruinosa</i>	577	0	0	224	1	1
<i>Harmonia axyridis</i>	21713	2	1*	3746	6	1*
<i>Nezara viridula</i>	2632	5	1*	343	7	1*
<i>Cydalima perspectalis</i>	504	2	1+1*	67	2	1+1*
<i>Halyomorpha halys</i>	405	0	0	561	3	1*
<i>Drosophila sukuzii</i>	38	0	0	8	0	0
TOTAL	31350	25	3	5536	21	2

Table 2. Means of asking citizens to report invasive alien species. * – the real number is higher due to the unknown number of people that have seen the leaflet on LinkedIn

Means of asking citizens to report <i>Halyomorpha halys</i> in 2016	Targeted	Answers
Email messages sent directly to farmers	200	0
Publication in Plant Health Magazine	4000	1
Alert leaflets offered directly to visitors during INDAGRA Fair	50	1
Public presentation	100	2
Alert leaflet posted on LinkedIn platform, reposted by 1 person	?	1
On the filed conversation (direct show and explanations)	1	2
TOTAL	4351*	7

of the total number of records for the considered ten invasive alien species.

The citizens' willingness to report *Halyomorpha halys*

Out of the total of 4,351 possible respondents, only seven answers were obtained, representing 0.16% (Table 2). There was one report out of the 50 leaflet offered at INDAGRA Fair, one call after the public presentation, two reports after one personal conversation, and there was no any answer from the 200 farmers contacted by email. In 2016, only five persons came to the Plant Protection Department at the USAMV to ask for an advice about *H. halys*, although Bucharest was really invaded by this pest.

A positive experience regarding the citizens' willingness to report new pests was represented by one face-to-face conversation, directly in the field, an event which led to an active involvement in the project. That person sent samples, spoke with friends, sent pictures. As DELLINGER et al. (2016) and CAPPÀ et al. (2016) proved, the participant motivation can be significantly improved by the face-to-face interaction. Communicating the project's mission and achievements to the volunteers increase their commitment to the project and its goals (Nov et al. 2014).

SCYPHERS et al. (2015) demonstrated that citizens' observations document one marine invasive alien species one-two years earlier and more frequently than traditional monitoring programs. CRALL et al. (2010) showed that in the USA citizens collect data on invasive alien species within many programs and are willing to contribute to public databases. LEPCZYK (2005) stated that citizen scientists have access to areas that may not be accessible to professional scientists, allowing them to discover invasive alien species not yet detected. MAISTRELLO et al. (2016) highlighted the importance of citizen science in early detection of *H. halys*. The authors initiated citizen science surveys by encouraging students of entomology classes and school personnel to search for *H. halys*; by alerting professional and amateur entomologists/ naturalists or phytosanitary services, using social networks and

web forums; by alerting general public and farmers through the university and Phytosanitary Services websites and extension magazines; by issuing press releases and extension flyers; and by organising public conferences. Based on the experience of MAISTRELLO et al. (2016), we also organised a simple citizen science project to collect data with the help of citizens, integrating several of the above mentioned approaches. However, our first results were unsatisfactory, as the response rate was only 0.14%. In MAISTRELLO et al. (2016) approach, the public was invited to collect or take high quality photographs and send them to the authors, together with details on the collection. In our project, only one citizen answered to our request, which was disappointing. Considering the fact that limited resources at hand of researchers make difficult to document and monitor IAS across large areas and that the early detection and spread track of these species is critical in taking appropriate management decisions, we undertake to improve our approaches towards citizens, in such a way to enhance their willingness to participate in invasive alien species monitoring programs. According to BOAKES et al. (2016), an increased understanding of volunteer behaviour could enhance the fit between volunteer interests and the needs of scientific projects.

Students and university staff experiences about reporting of invasive alien species in Romania and ways of stimulating them to report new IAS

Of a total of 447 targeted respondents (students, researchers and teachers) at the USAMV, 51 answers were obtained, of which 47 were complete and valid, representing 10.5% of the total. This percentage was very low, considering the background of the test – students were asked by their professors teaching their courses while professors and researchers were asked by their colleagues. Of the total number of respondents, 68.1% were students, representing 9.25% of the total number of students who received the questionnaire, while 31.9% of the respondents were researchers (17.0%) and teaching staff (14.9%) (colleagues), with an

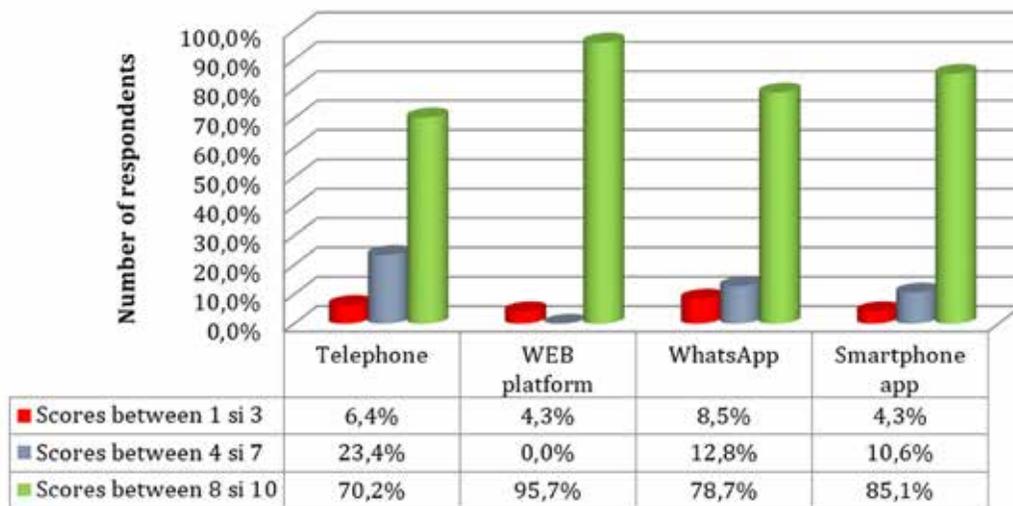


Fig. 1. Types of reporting services about invasive alien species preferred by the respondents from the University of Agronomic Science and Veterinary Medicine of Bucharest (USAMV)

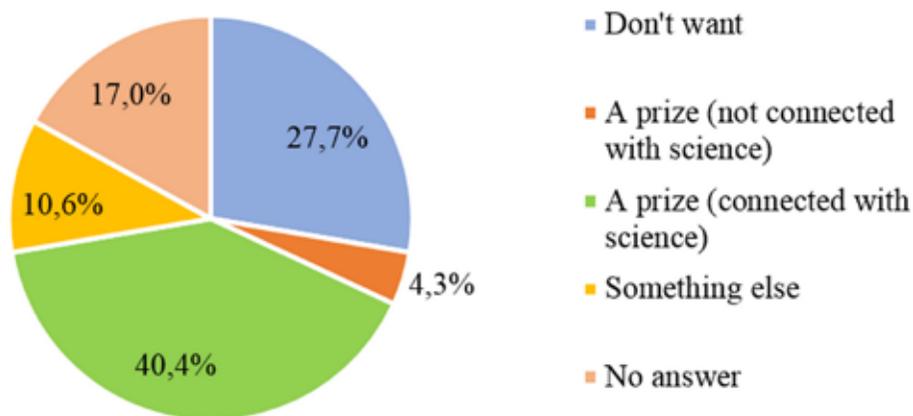


Fig. 2. Types of rewards for the invasive alien species reporting preferred by the respondents from the University of Agronomic Science and Veterinary Medicine of Bucharest (USAMV)

answer rate of 21.2% of the total number of colleagues asked to answer. This may suggest that personal relation and involvement may enhance the people willingness to answer, but still with a very low rate.

When respondents were asked if they had noticed invasive alien insects before, only 4.3% of them gave negative answers. The rest of the respondents had notices IAS, of them 8.3% gave more details and 61.7% took pictures of the disturbing pests.

A high percentage (70.3%) of the respondents wanted to make reports about the pests but did not find the necessary tools. Regarding the type of the reporting tools preferred by the respondents, the highest scores were obtained for the web platforms (95.7%) and smartphone apps (85.1%) (Fig. 1).

When asked if they would appreciate a reward

for their volunteer work, only 27.7% of respondents specified that they did not want anything, while 55.3% would appreciate/expect a reward (Fig. 2).

Following our unsatisfactory results after the first citizen science project, we decided to address the main issues in an online questionnaire, in order to find the best ways to empower citizens in being more open to the requests of scientists. According to AIGNER & KUCHAR (2014), citizen scientists gave valuable data for tracking the spread of *H. halys* into new regions, especially using reporting websites as those of Rutgers University (<http://njaes.rutgers.edu/stinkbug/>) and Pennsylvania State University (<http://www.Stinkbuginfo.org>). Our survey revealed similar results, as the web platforms received scores from eight to ten from 95.7% of the respondents, while telephone

or WhatsApp received the highest scores only from 70.2% and 78.7% of respondents, respectively (Fig. 1). In addition, it should be stated that citizen science projects enables people in materialising their ideas. AIGNER & KUCHAR (2014) gave an example of one homeowner from Pennsylvania who designed and patented his *H. halys* light trap and started a business (<http://www.stinkbugtrapsonline.com/>). As currently there is no any specific trap available on the Romanian market, we expect that our extension initiative regarding *H. halys* will stimulate some people in taking action on this matter.

Conclusions

Good communication skills, personal involvement, face-to-face discussions and explanations of goals and advantages seem to be the involvement triggers

for volunteers. The most appropriate tools should guarantee privacy – web platforms, smartphone apps and require no supplementary costs. The empowerment of Romanian citizens towards a responsible approach regarding the invasive alien species requires a changing mentality approach about the idea of cooperation. Our experience showed that in order to increase their willingness, people need to be talked to and trained. Given the Romanian background of the communism (cooperatives/ cooperation), citizen science can act as one shifting mentality tool, with unperceivable effects for the future generations. The citizen-researcher relationship creates an incredible synergy, which may finally ‘break the wall’ between scientists and the rest of the world. Active collaborative efforts that include scientists, stakeholders and citizens will allow us to develop and implement more effective solutions for invasive alien species at a national and European scale.

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