D14.6 REVIEW OF EXISTING CITIZEN SCIENCE TOOLS

WORK PACKAGE 14 – CITIZEN OBSERVATORIES AND PARTICIPATIVE SCIENCE

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ABSTRACT

A necessary component of environmental RI's is and will increasingly become participative or "citizen" science. This is for two key reasons: 1) it raises societal awareness and engagement about environmental change and 2) provides data that is otherwise logistically inaccessible for monitoring change on our planet. This document provides a guide for Research Infrastructures who are considering citizen science programmes, or who wish to provide guidance to their community about entering the citizen science arena.

The components that need to be considered include:

- What can citizen science do for Science and Scientists?
- What can citizen science do for Society?
- How to effectively engage, train, and maintain Citizen Scientists.
- Data systems for acquisition, assessment, access, and analysis of distributed data sources.
- Community Online Platforms: websites, social networks, discussion forums.
- Crowdsourcing Tools: image acquisition, web and smartphone applications, surveys/questionnaires.
- Information and Training Resources: webinars, public lectures, websites, public/museum displays.
- Citizen Mobilization: rapid event response observations and human sensor networks.

While this document is not exhaustive, it provides links to many international citizen science associations, which in turn provide extensive resources.

Note on timing:

The initial due date in month 12 was postponed until month 15 caused by extended ill health of the task leader. The task leader is at the same time, WP and Theme leader - and these roles have taken more work than planned for ongoing progress in Theme 4. The delivery of D14.6 at month 15 then was in conflict with other deliverables which had more dependencies, and we're prioritized. All of these deliverables also suffered from higher than normal absences of the co-authors due to the combined impact of holidays/leaves/lengthy ocean research cruises. It has therefore taken this additional time to get input from any of the co-authors. As always planned, this document will continue to develop over the life of the project (see document plan).

The change does not affect the budget or other elements of the project.

DOCUMENT HISTORY AND PLAN

N.B. This document was always envisioned to evolve over the course of the project, with contributions not only from the immediate WP14 team, but from the broader ENVRIplus R.I. community. An updated version will be included in the final report for the WP.

Date	Version
18.08.2016	Draft for comments and contributions by citizen science WP Team
28.08.2016	Deadline for comments and contributions by Citizen science WP Team (not all contributions possible by this date due to leave/fieldwork/holidays)
28.08.2016	Deadline for comments and contributions by Reviewer
29.08.2016	Final working document submitted to ENVRIplus management office.
06.09.2016	Final working document submitted to EC by management office.
01.09.2016	Working document for comment and contributions by remaining WP members.
15.10.2016	Working document for comment and contributions by larger ENVRIplus community
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DOCUMENT AMENDMENT PROCEDURE

Amendments, comments and suggestions should be sent to the authors (Author Mairi Best, mmrbest@gmail.com)

TERMINOLOGY

A complete project glossary is provided online here: https://envriplus.manageprojects.com/s/text-documents/LFCMXHHCwS5hh

PROJECT SUMMARY

ENVRIplus is a Horizon 2020 project bringing together Environmental and Earth System Research Infrastructures, projects and networks together with technical specialist partners to create a more coherent, interdisciplinary and interoperable cluster of Environmental Research Infrastructures across Europe. It is driven by three overarching goals: 1) promoting cross-fertilization between infrastructures, 2) implementing innovative concepts and devices across RIs, and 3) facilitating research and innovation in the field of environment for an increasing number of users outside the RIs.

ENVRIplus aligns its activities to a core strategic plan where sharing multi-disciplinary expertise will be most effective. The project aims to improve Earth observation monitoring systems and strategies, including actions to improve harmonization and innovation, and generate common solutions to many shared information technology and data related challenges. It also seeks to harmonize policies for access and provide strategies for knowledge transfer amongst RIs. ENVRIplus develops guidelines to enhance transdisciplinary use of data and data-products supported by applied use-cases involving RIs from different domains. The project coordinates actions to improve communication and cooperation, addressing Environmental RIs at all levels, from management to end-users, implementing RI-staff exchange programs, generating material for RI personnel, and proposing common strategic developments and actions for enhancing services to users and evaluating the socio-economic impacts.

ENVRIplus is expected to facilitate structuration and improve quality of services offered both within single RIs and at the pan-RI level. It promotes efficient and multi-disciplinary research offering new opportunities to users, new tools to RI managers and new communication strategies for environmental RI communities. The resulting solutions, services and other project outcomes are made available to all environmental RI initiatives, thus contributing to the development of a coherent European RI ecosystem.

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REVIEW OF EXISTING CITIZEN SCIENCE TOOLS

A necessary component of environmental RI's is and will increasingly become participative or "citizen" science. This is for two key reasons: 1) it raises societal awareness and engagement about environmental change and 2) provides data that is otherwise logistically inaccessible for monitoring change on our planet.

Even if all existing data from environmental monitoring and research programs would be accessible to scientists today, there would still be large gaps in the spatial and temporal coverage across the globe. This creates a principal problem that obstructs our understanding of the processes and changes in the environment. Therefore, new and cost-effective approaches need to be developed, including those based on human resources, to increase the quality and amount of data for the assessment of the environment. Here, society members in general, "citizen scientists", have the potential to become valuable assets in gathering and processing large amounts of relevant research data. In the context of cost-effective monitoring systems, a citizen system is an especially helpful addition where other methods (e.g. sensor-based observation systems, scientist-based monitoring programs) cannot be used, or where they are too expensive (e.g. Silvertown, 2009). Citizen science projects have expanded in number and scope over the past decade as a cost-effective way to undertake large-scale and/or high- resolution surveys and to connect scientific research to public outreach and education (e.g. Dickinson et al., 2010, Dickinson et al., 2012, Bonney et al., 2014). Access to the Internet and advances in information technologies have also made citizen science projects more visible and accessible, allowing interested citizens to participate in data collection, analysis, and application (e.g. Silvertown, 2009, Hochachka et al., 2012, Bonney et al., 2014).

Work package 14 develops and summarizes resources for environmental R.I.'s to engage with the public in citizen science, an area providing innovative solutions for data or sample collection, management, processing, curation, annotation, and deposition. In particular it will move beyond a review of status quo to targeted test cases in leading areas of citizen science to develop:

1. resources and best practices for public contributions to the annotation of imagery (a charismatic form of scientific information with which to engage the public, while also being a resource-intensive information source for RI's) and

2. a framework for distributed networks of observers and sensors who collect data and can perform response actions.

This deliverable is a working document[1] to provide a framework for WP 14-Citizen Observatories and Participative Science members in developing their cutting edge test cases above. It is within Theme 4 - Societal Relevance and Communication, part of Task: 14.4. RI Citizen Science Toolkit – Best Practices augmented by Leading Area test cases (Task leader is Mairi Best (INGV-EMSO), but with the support of all other task leaders of WP14) including a review of:

- how to effectively engage, train, and maintain Citizen Scientists

[1] "Working document" here means that the document provides background to other WP14 work and it will be further developed during project time – see document history and plans.

- data systems for acquisition, assessment, access, and analysis of distributed data sources

These include:

- Community Online Platforms: websites, social networks, discussion forums
- Crowdsourcing Tools: image acquisition, web and smartphone applications, surveys/questionnaires
- Information and Training Resources: webinars, public lectures, websites, public/museum displays
- Citizen Mobilization: rapid response observations of events (e.g. earthquakes, oil spills)

A useful classification of citizen science was described by Bonney et al 2009. Three main approaches were recognized:

- Contributory projects – designed entirely by scientists where participants collect data to a protocol and in the case of crowdsourcing analyse the data.
- Collaborative projects – designed by scientists but where participants are involved in one stage of the scientific process perhaps in the analysis of data; changes or communicating the science
- Co-created projects – designed in partnership between scientists and communities.

It is important to understand citizens can be involved in a broad range of activities, including:

- Instrument manufacture and maintenance
- Instrument deployment/sample collection
- Data collection and transmission
- Data analysis
- Data validation/verification
- Proposals of new topics to research (what it is known as extreme citizen science)

Table 1 provides a list of citizen science organisations and amalgamators which are excellent sources of further information and linkages.

TABLE 1 CITIZEN SCIENCE ORGANISATIONS AND AMALGAMATORS WHICH ARE EXCELLENT SOURCES OF FURTHER INFORMATION AND LINKAGES.

Organisation	**Website**	**Country(ies)**
Citizen Science Association	citizenscience.org	U.S.A.
European Citizen Science Association	ecsa.citizen-science.net/	E.U.
Australian Citizen Science Association	csna.gaiaresources.com.au/WordPress/	Australia
Canadian Network for Ocean Education: CaNOE	oceanliteracy.ca/	Canada
Wikipedia List of citizen science projects	en.wikipedia.org/wiki/List_of_citizen_science_projects	International

Scientific American listing of Citizen Science projects	www.scientificamerican.com/citizen-science/	International
Citizen Science Alliance	www.citizensciencealliance.org/	International
UK Earth Observation Framework (UK-EOF)	www.ukeof.org.uk/our-work/citizen-science	UK

What can Citizen Science do for Science and Scientists?

Citizen science is often presented as a means for increasing scientific literacy and engagement within the general public. However, particularly for environmental science, it is important to note that there are certain aspects of citizen science that can overcome limitations of standard sampling/monitoring the Earth. Firstly, we seldom have adequate **spatial coverage** for many key Earth observations. Engaging citizen scientists around the globe can help address this problem, particularly in remote, and often sensitive regions, such as the polar environments. A related issue is not only spatial coverage, but the **density of observations**, particularly in areas of rapid transition such as the coastal interface between land and sea – where remote sensing techniques perform poorly because of lack of resolution. T**emporal resolution** is equally important to spatial resolution when trying to understand evolving processes over time. Even when spatial sampling is reasonable, it is rarely carried out during the same time period, so patterns in space become confounded with patterns over time, without the resolution in the dataset to resolve either. Finally, citizens can help in what humans do best, which is using their for example their "superior spatial awareness" as is being more deeply developed by Task 14.1. This is part of the concept of "distributed thinking" (e.g. Hand et al. 2010).

For example, in seismology, citizens help:

- *to monitor urban areas where the seismic risk is very heterogeneous*
- *to better understand the earthquake phenomena (site effects, etc.)*
- *to improve spatial coverage in region where it is difficult to install sensors*
- *to improve regularity of the observations (not only during scientific campaigns but all through the year)*

Given these benefits to science, citizen science does require different approaches to project design than in traditional scientific disciplines, so requires some rethinking on the part of scientists. As with any approach, citizen science has limitations, in this case including access to data and the ability of citizen scientists to provide accurate and required data as usually collected by scientists. Many of the barriers relating to data quality control (e.g. sampling bias and measurement errors) during the compilation and analysis of large complex data sets can be handled through novel statistical and computational solutions (Hochachka et al., 2012, Bird et al., 2013). As long as these limitations are understood and the science scheme developed accordingly then citizen science remains a powerful tool.

What can Citizen Science do for Society?

Science has a long tradition within society in various forms (Noble 1992, Ralston Saul 1992, Wright 2004). That said, many would call this the scientific age. Therefore, there is not necessarily a long term disconnect between science and society, as is sometimes suggested. What did happen during the 20th century was the rise of the Expert, the Professional, where a culture of exclusion grew (e.g. Ralston Saul 1992). This was also in part because much of the

advances in certain areas of science were driven by larger societal pressures such as war (e.g. Wright 2004). Science has increasingly become seen as a tool of power and politicians. Many scientists don't see it this way, because they by and large are not actually included in this power. However, the specialization and jargon that has grown over the 20th century has served to cut out citizens from the discussion. Some of this is insurmountable, but the basic concerns of society continue to be addressed by many scientists.

The challenge therefore is to communicate how science is done, the constraints on scientific progress, and in fact harness societies concerns to focus scientific research. For example, many scientists have been concerned about climate change for decades, bit by bit they communicated this complex concern to members of society, but in many countries progress towards addressing climate change has been hampered by politics.

Citizen science has traction for many because it provides a means for citizens to have a voice within science, to engage in how it is done, but also to have influence on what is done. For example, considered studies of potential pollutants may not be in the political interest, and may not be rewarding theoretically or politically to the scientists, but may be essential to the health of society. Citizen science is also recognized as a positive in promotion of health and wellbeing of citizens; offering engagement with the natural world and contribution to society. Similarly, improved citizen understanding of natural phenomenon and natural disasters may in some cases make them less afraid.

How to effectively engage, train, and maintain Citizen Scientists

People's reasons for engaging in citizen science may vary from interest in a particular area, concern (e.g. loss of habitat), to social activity. A useful report on citizen science motivation was undertaken by the UK Earth Observation Framework (UK-EOF) (see Table 1) in May 2016 using survey techniques to consider citizen engagement reasons (Geoghan et al 2016). Projects need to understand the reasons for engagement to maximize benefit from citizen input and target effort accordingly. Some examples of effective engagement, training and maintenance are given in Table 2.

The use of citizen science as a data collation methodology needs to be considered before the scheme is set up. Just as any science project, clear methodological planning needs to be present from the start, a citizen science component cannot be added as an afterthought. Some schemes do not last because they do not effectively engage; train or maintain interest from participants. Equally there are established long term schemes which have maintained interest and levels of commitment form participants. For event led/rapid engagement, necessary training should be kept at a minimum. An example is the earthquake response work using images to collect data and not requiring training to get maximum data returned. Experience from development of LastQuake (http://www.emsc-csem.org/) reiterates recommendations seen in many fields:

- Develop simple and user-friendly web interfaces to show and play with the data
- Develop simple games
- The tools/devices/interface must be free of charge and easy to install/use
- Target schools as teachers may be keen on such projects and more available
- Reward the best or most frequent users in some way

TABLE 2 SOME EXAMPLES OF EFFECTIVE ENGAGEMENT, TRAINING AND MAINTENANCE.

Engagement type	Example	Comment
Long term engagement – society activity	British Trust Ornithology (BTO) Breeding Bird Survey – member surveys going back to 1994	Learned societies and local/regional groups often provide stable long term engagement
Event driven	Harlequin ladybird survey www.harlequin-survey.org www.bwars.com www.emsc-csem.org	Reacting to an event – climatic/earthquake or invasive species. Able to mobilize participants quickly with clear purpose
Scientific question	Endangered species surveys and biogeographic hypotheses testing horseshoecrabs.myspecies.info	Through ENVRIplus we are developing formats and training to allow scientists to consider citizen science and provide routes for engagement.
General public interest	Sealife survey – online recording open to all for observations www.sealifesurvey.org	Usually simple format schemes to allow engagement without much or any training
One off event driven	Bioblitz surveys – undertaking surveys with experts and the public	Raising awareness is key element with less emphasis on data but event has purpose and public feedback mechanism
Target groups	For example divers www.seasearch.org.uk, www.seasearch.org.uk www.comber.hcmr.gr ReefWatch, ReefCheck… www.reefcheck.org	Often linked to schemes and societies; can access different areas and usually open to training
School groups	Shorething www.mba.ac.uk/shorething www.virtuedata.se	Engagement and training in techniques but often only one survey round completed
Data processing	Gaming fold.it/portal/info/about www.oceannetworks.ca/learning/get-involved/citizen-science/digital-fishers	Generates data that supports research on protein folding
Data generation	Annotations www.oldweather.org	transcribe old hand-written weather records to support research in climate modelling

Maintaining contributions depends very much on the type of engagement (one off event or long term monitoring), the groups/individuals involved, and the structure of the engagement including progression. Engagement in a one off event (e.g. Bioblitz survey) does not require maintenance of volunteers, but it should be considered an effective route into other longer term activities. (see Table 2) Where training is required and provided, it is of interest for financial reasons alone to maintain the engagement. Societies where a common interest is shared are the best place for longer term commitment as the citizen survey is one element of the interest.

Data systems for acquisition, assessment, access, and analysis of distributed data sources

Successful citizen-science programs use appropriate cyberinfrastructure (Bonney et al. 2009), providing well-structured and easy-to-use reporting templates (e.g. Fig. 1) as well as resources for data storage and visualization. As these tools often have similar functionality, shared open source resources are available through many of the citizen science amalgamators (see Table 1; e.g. Citizen Science Alliance – see also description under "Community Platforms" below). Given the potential for a large amount of data, from many contributors, it is particularly important to have a well-structured data capture and storage process.

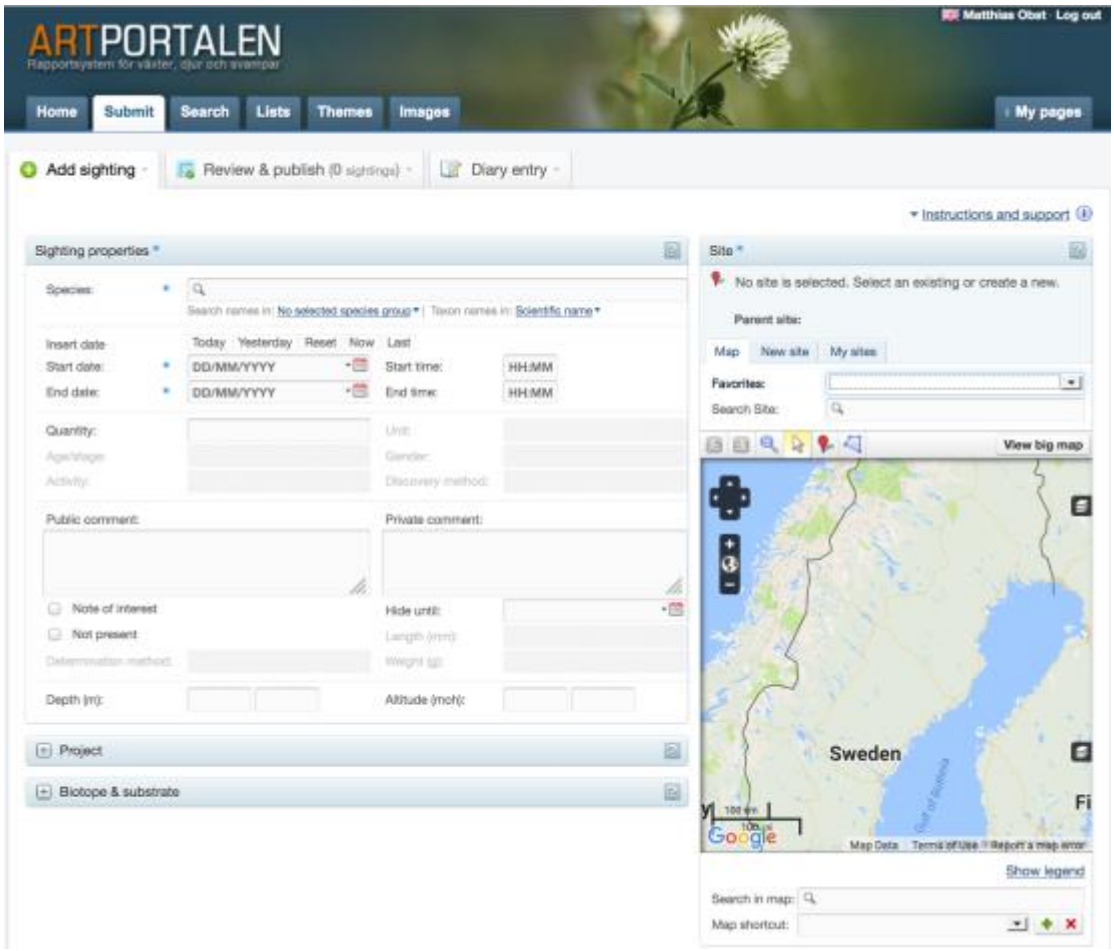

Fig 1. Reporting scheme of the Swedish Species Observation System (Gärdenfors et al., 2014)

Through ENVRIplus, Task 14.3 is further developing access templates and tools for scientists and citizen scientists. We are testing the use of Indicia (open source data capture, reporting and

mapping software) and iRecord to allow data validation. The product will be tested between UGot and EMBRC.

Another key element of such a data system is an integrated data annotation/flagging element, which allows for multiple levels of QA/QC, and from a range of sources (which can be ranked for reliability for example). This also allows for implementation of peer ranking of observations, which then can engage citizen scientists in the vetting of the collected data as they gain more experience with the process.

Automated analysis tools can be provided as a part of citizen observatory platforms (Fig. 2), and are essential components in citizen processing platforms (e.g. https://fold.it/portal/). These tools are critical to keep the users involved and return value for the delivered citizen data. For example, platforms that include visualization and analysis tools are more appropriate for use in schools, and are more likely to keep users engaged over the long-term.

Fig 2. Automated calculation of Extent of Occurrence (EOO) and Area of Occupancy (AOO) as a part of citizen observatory for endangered horseshoe crabs (http://horseshoecrabs.myspecies.info).

Any data gathering system should have a clear data policy, including clear discussion of privacy provisions, intellectual property, and expectations in terms of acknowledgement and/or co-authorship in publications and other dissemination

Community Online Platforms: websites, social networks, discussion forums

The growth of social media has been a great boon for citizen science. It has fostered the development of large scale groups with common interests, even when broadly distributed. This then allows for sharing of discoveries and sharing of tools. For example the Argo adopt a float program includes an interactive element similar to "following" a float, so that you then keep returning to see what the latest profiles are. An example of a community fostered by a common web-based environment is the Citizen Science Alliance, described as follows on their website (www.citizensciencealliance.org):

"The CSA is a collaboration of scientists, software developers and educators who collectively develop, manage and utilise internet-based citizen science projects in order to further science

itself, and the public understanding of both science and of the scientific process. These projects use the time, abilities and energies of a distributed community of citizen scientists who are our collaborators. Our projects live within the 'Zooniverse', the home of Citizen Science on the web. Each is inspired by a science team who provide the initial ideas, the reassurance that what we're doing can make a real contribution and an audience who are willing to use the end result. We are working with a wide variety of partners, from classicists to climate scientists and ecologists to planetary scientists."

"The Zooniverse is a collection of web-based citizen science projects that use the efforts of volunteers to help researchers deal with the flood of data that confronts them."

Crowdsourcing Tools: image acquisition, web and smartphone applications, surveys/questionnaires

The core power of citizen science is crowdsourcing – many hands make light work. In fact, many discussions use "crowdsourcing" and "citizen science" as interchangeable. As a result, tools that have served crowdsourcing inform the approach to citizen science. Tools that are therefore associated with crowdsourcing, are by definition citizen science tools. For example, citizens can share testimonies and pictures with smartphone apps.

Information and Training Resources: webinars, public lectures, websites, public/museum displays

Citizen science requires attracting citizen participation; maintaining involvement and providing results. Effective dissemination is key to participation and results. With co-created activities and surveys undertaken by societies, resources are developed with feedback from participants. One reason for participation is to make a difference and it is important to recognize contributions from participants.

Type of interaction	**Comment**	**Example**	**Effectiveness**
On line Training resources	Effective method of reaching widespread community. Very effective for Crowdsourcing activities	Zooinverse Seabed recording	High
Hardcopy training and information resources	Required for more involved participation and face to face interaction. Electronic formats (e.g. keys becoming more popular)	Shore thing resources	Electronic format e.g. apps may have connection problems in remote or no network coverage area.
Webinars	Strong method of interaction but requires citizen participants to	NOAA Ocean Explorer oceanexplorer.noaa.gov/edu/developme	Reaches wide group but requires buy in from participants ahead of 'broadcast' i.e. sign in.

	already be aware	nt/online_development.html	
Public Lectures	Includes novel areas such as Scibar; fishermans café		Effective locally and very strong for local/regional interaction and recruitment.
Websites	Provides portals for multiple recording schemes	iRecord nbn.org.uk/tools-and-resources/useful-websites/database-of-wildlife-surveys-and-recording-schemes/	Effectiveness is based on usability. Use of template format with backend data warehouse will allow quicker development.
Public displays	Can be linked to science centres and museums or in public space	Escite – utilizing citizen science activities of Sea Change and ENVRIplus projects Brittany Ferries working with ORCA recording marine mammals on Ferry routes	Way to reach the public and seek engagement.

Citizen Mobilization: rapid event response observations and human sensor networks

The tradition of Natural History has been to make observations, not to steer directly towards a specific scientific enquiry, but rather to observe opportunistically. This has been a success factor when engaging citizen scientists and generating large amounts of data (e.g., http://ebird.org, http://artportalen.se). Such liberty however can result in less structured and less representative data that pose some challenges when it comes to specific analyses, particularly when the standardisation assumes standard education of the observers – which tends to be less uniform among citizen scientists. In the future it is likely that many systems will initiate more structured citizen-based reporting schemes and projects, to generate data in response to specific events or to evaluate specific scientific hypotheses. Such event- or hypothesis-driven projects will benefit from implementing well-designed and standardized collection methods (Kopf et al, 2015). With appropriate guidelines and existing promotion channels, amateurs can indeed collect data of high quality equal to those collected by experts (Crall et al., 2011, Danielsen et al., 2014).

NOAA's Skywarn citizen reporting system is an example of citizen based event response systems (www.nws.noaa.gov/skywarn/). Here, the United States National Weather Service (NWS) has

built up a network consisting of 350.000 – 400.000 specially trained volunteers from across the country to report on severe thunderstorms, floods, tornadoes, snow and ice storms in their country. The work of these volunteers improves NWS's ability to forecast dangerous weather conditions

Likewise invasive species observation networks are becoming more and more popular. These citizen reporting networks provide effective means to detect alien species at an early stage of a potential invasion, when eradicative measures are still possible (Maistrello et al., 2016).

Research infrastructures should increase connectivity to support citizen science across the different domains of environmental research and leverage promising approaches to improve data collection with the help of the public, such as human sensor networks and event-response actions to collect scientific data.

CONCLUSIONS

This document provides a roadmap to guide users into the world of citizen science. It will evolve over time with the growing input of other RI's and disciplines. It is designed to provide the citizen science neophyte or sceptic some resources and tools to actually try this approach…it is rewarding in many ways.

IMPACT ON PROJECT

This overview of the scope of citizen science provides the framework within which other tasks in WP14 will be understood as they expand current frontiers in citizen science. The document will be updated through the course of the project and the final version will be included with the final report, thus providing all RI's with a primer on citizen science.

IMPACT ON STAKEHOLDERS

This document provides a framework for consultation with those not directly involved in WP14, to contribute their experience and concerns around citizen science. Based on this shared experience, it will serve as a primer on citizen science for those RI's that have not developed much experience in this area, or have considered citizen science only in subsets of the full range of activity.

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APPENDIX

List of Citizen Science Projects

This table lists some national to international level citizen science projects, which are provided as examples of different aspects of implementation.

Project	**Website**
Argo adopt a float	argofloats.wikispaces.com/Adopt+an+Argo+Float
Atlas of Living Australia	www.csiro.au/en/Research/Collections/ALA
B.C. Cetacean Sightings Network	wildwhales.org/sightings-network/about-wild-whales/
Beachwatch (UK beach litter survey)	www.mcsuk.org/beachwatch/
Bioblitz	www.bnhc.org.uk/bioblitz/free-downloadable-resources/guide-running-bioblitz
British Breeding Birds survey	www.bto.org/volunteer-surveys/bbs
Citizen Scientists	www.citizenscientists.ca/Citizen_Scientists.html
Coastbuster	www.oceannetworks.ca/learning/citizen-science/coastbuster
Cyril Diver Project	www.nationaltrust.org.uk/studland-beach/features/the-cyril-diver-project
Digital Fishers	www.oceannetworks.ca/learning/citizen-science/digital-fishers
Earthquake game, Taiwan (Their system is focused on Taiwan territory and for schools. EMSC are in discussion with them to translate it in English and to adapt it to a worldwide context and to a general adult public.	katepil6.wixsite.com/earthquake-school/slideshow qcntw.earth.sinica.edu.tw/games/competitionV3/index.php
EMSC QCN project	www.emsc-csem.org/service/QCN/
eOceans	www.eoceans.org/
eShark	www.eshark.org/
Explore the Seafloor	www.exploretheseafloor.net.au/
Galaxy Zoo	www.galaxyzoo.org
Harlequin ladybird survey	www.harlequin-survey.org

iNaturalist	www.inaturalist.org/home
iSeahorse	www.iseahorse.org/
ISPOT	www.ispotnature.org
Manta Matcher - The Wildbook for Manta Rays	mantamatcher.org/
Marine Metres Squared	www.mm2.net.nz/home
Mitten crab (invasive/ non native species)	www.mittencrabs.org.uk
Mosquito Alert: a citizen platform for studying and control mosquitoes which transmit global diseases	www.mosquitoalert.com/en/
My Soil mySoil gives you access to a comprehensive European soil properties map within a single app. Discover what lies beneath your feet and help us to build a community dataset by submitting your own soil information.	www.bgs.ac.uk/mysoil/
National Biodiversity Network (data compilation from UK citizen science with links to schemes).	nbn.org.uk/record-share-explore-data/start-recording-wildlife/
Natusfera: a variant of iNaturalist that is promoted by the Spanish node of GBIF	natusfera.gbif.es
Orca Game	orchive.net/games/1
Plankton Project	www.planktonportal.org/
Quakecatcher (QCN project developed by Stanford Univ.)	quakecatcher.net
Reef Environmental Education Foundation (REEF)	www.reef.org/
Reef Life Survey (RLS)	www.reeflifesurvey.com/

Sealife survey	www.sealifesurvey.org.uk
Secchi Disk	www.secchidisk.org/
Seismographs at school, developed by IRIS	www.iris.edu/hq/sis
Seismology at school developed within NERA FP7 project	www.bgs.ac.uk/schoolseismology/schoolSeismology.cfc?method=viewLatestQuake Example of a course program: www.nera-eu.org/content/mm_files/do_798/2011_12_Training%20Course%20June2012.pdf Final report: ftp://www.orfeus-eu.org/pub/NERA/Deliverables/NERA_D8.4.pdf
The Shore Thing	www.mba.ac.uk/shorething
The Shore Thing Project	www.mba.ac.uk/shore_thing/
Wakame Watch	wakamewatch.org.uk/