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Abstract

For landscape research to function in a democratic landscape governance, it must achieve two things. One, it must integrate stakeholder perspectives at multiple steps of the research process, and two it must effectively communicate its knowledge and insights. Citizen science can be described as the involvement of the public in the scientific process, through a range of different approaches. We ask what such approaches can bring landscape research and its stakeholders closer together. We survey the field of citizen science and present a number of typologies of approaches. Next, we introduce three applications of citizen science in the landscape context, and examine them under the lens of the typologies. We find that each employs citizen science to include stakeholders in different ways, but each limited to just one stage of the research process. Finally, we suggest ways forward for landscape research to achieve an integrative relationship between researchers and stakeholders.

Keywords:

Citizen Science, Landscape Democracy; Social-ecological systems; Landscape; Landscape Governance

Introduction

Questions of power, justice and democracy in landscapes have received increasing attention in recent times (Council of Europe, 2008; Jorgensen, 2016; Landscape Research Group, 2015). While changes in landscapes are generally observed at the local level, they are driven by interconnected dynamics at the regional and global scales such as urbanisation, agricultural intensification, land abandonment, nature conservation, globalisation and international commerce and trade (Plieninger & Bieling, 2012). Deriving from these processes of landscape change are ethical challenges of power imbalances, exclusion and disenfranchisement.

The European Landscape Convention (ELC) takes up this challenge, enshrining the values of democracy, justice and the rule of law in matters of landscape planning and management. Accordingly, the ELC has an inclusive definition of landscapes as 'an area, as perceived by people whose character is the result of the action and interaction of natural and/or human factors' (Council of Europe, 2008: Article 1a), and

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acknowledges the role landscape plays in the formation of culture and local identity (Council of Europe, 2008: Preamble). The ELC, addressing the governance challenges in applying its principles to landscapes and incorporating the myriad perceptions of them, requires participative processes of its signatories to include 'the general public, local and regional authorities, and other parties with an interest' (Council of Europe, 2008: Article 5c).

Participation brings people and groups who are outside the formal government and local authorities into decision-making; not to replace official processes but to complement them (Jones, 2007; Laird, 1993). Participation is a 'discursive and dialogic process', during which diverse values and meanings held by different groups are negotiated (Jones, 2011, p. 40). According to Laird (1993) public participation not only strengthens the democratic process of a community, it also makes people more aware of governance processes, gives people a sense of justice, and is critical in developing a feeling of community. In its Research Strategy of 2015, the Landscape Research Group focuses on themes of justice and democracy in landscapes, citing the growing emphasis on the 'problems of power, exclusion and inequity' in landscape issues, and wishes to see public participation firmly embedded in landscape governance processes (Landscape Research Group, 2015).

There has been much attention given to how public participation in landscape and environmental planning presents opportunities and challenges (Jones, 2007; Jones & Stenseke, 2011), and to examples and techniques for effective participation (Reed, 2008). Reflecting the emergence of pluralistic democratic values in environmental management, decision-making has shifted from being a top down government activity to a multi-layered dynamic governance process. In this context, participation is viewed as a process from which the substance of policy emerges, rather than a tool to provide accountability to governments needing to know that what they do is in the public interest (Beierle & Cayford, 2002).

The role of the scientist and knowledge in this nexus has also shifted. Where previously science provided objective knowledge to central planners, now the acceptance of complexity in society means that there is a growth of uncertainty in knowledge productions (Nowotny, Scott, & Gibbons, 2013). In this pluralistic environment actors both compete and collaborate to achieve outcomes in their interest, and knowledge is used to reinforce positions of power and to de-legitimize the positions and knowledge of competing organisations (Beunen & Opdam, 2011). Researchers are facing a challenge to communicate scientific knowledge effectively, to show its added value in the decision-making process, and to stand up to questions of its legitimacy in problem setting and solutions (Jackson, 2005). The scientific production of knowledge needs to be more context specific and reactive to public needs to achieve a continuous dialogue and exchange of knowledge between science and practice (Nassauer & Opdam, 2008; Tress, Tress, & Fry, 2005). Some landscape researchers are integrating these dynamics into their work in crossdisciplinarity (Wu, 2006), landscape sustainability (Musacchio, 2009; Wu, 2013), integrated landscape management (Scherr et al., 2015; Scherr, Buck, Willemen, & Milder, 2014), and collaborative research (van Paassen, Opdam, Steingröver, & van den Berg, 2007).

Citizen Science approaches have been welcomed as 'the future of genuine interactive and inclusive scientific engagement' (Riesch & Potter, 2014, p. 107). It has been heralded as a way to authentically engage the public in science projects with benefits of legitimisation and learning, for science and

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participants respectively (Dickinson et al., 2012), as well as offering a cost-effective data collection mechanism where the citizen represents cheap or free labour to the scientists (Silvertown, 2009). The term has multiple origins, being used to describe public involvement in data collection initiatives related to conservation science (Bonney et al., 2009), as well as more broadly to describe an opening up of science and science policy to the public (Irwin, 1995). For the purposes of this paper, we will use the term citizen science to refer to the involvement of the public in a scientific process, ranging from data collection to collaboration, co-design, and the consumption of scientific projects and results, in ways that in particular employ the use of web-based infrastructures to facilitate the engagement.

For landscape research to have a legitimate voice in a dynamic landscape governance, it must achieve two things: it must incorporate citizen knowledge in science and it must communicate scientific knowledge to citizens. This article asks the question of what contribution citizen science approaches can provide to this, and what a selection of existing applications of such approaches are achieving within landscape research. Are citizen science approaches in landscape sciences giving citizens a voice in research, and are they an effective means for communicating scientific knowledge to citizens? First, we delve deeper into citizen science and its emergence in the last decades. Then we will describe a number of citizen science and participation typologies. In the analysis, these typologies will each be used as a lens through which to consider three example projects with an explicit landscape focus which use citizen science approaches. Finally we propose ways forward for citizen science in the advancement of more democratic and inclusive processes in landscape research.

Developments in Citizen Science

Involvement of the public in scientific projects goes back at least as far as the American Audubon Society's annual Christmas bird count in 1900. However changes in the last decades have led to increasing participation in science in new and innovative ways. According to Silvertown (2009), this increase stems from developments in technology, research, and expectations of research funding bodies. The advent of the Internet, computers and smartphones in the last decade has offered new possibilities to enrich the scientific process. People are increasingly technology savvy, online and interconnected to communities of shared interest. This offers a powerful tool to scientists to access and motivate participants to collect and share data, and for scientists to communicate results and insights from their work (Silvertown, 2009).

Participants in citizen science projects are referred to as 'citizens' as a way to indicate that they participate in a personal capacity, rather than hired by an institution. They have also been called 'volunteers' (to reflect their informal involvement), 'censors', to highlight a focus in data collection (Goodchild, 2007), 'contributors', when following scientific protocols (Wiggins & Crowston, 2011), 'a crowd', when they perform crowdsourcing tasks (Lukyanenko, Parsons, & Wiersma, 2011) or 'collaborators', when they were involved in design of the scientific experiment (J. Reed, Raddick, & Lardner, 2013). We will use the terms 'citizen' to describe any participant from the general public, whether they are collecting and submitting data, or they are consumers of information and observers in the research process.

Data collection has always been a time and resource consuming aspect of science, and involvement of

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non-professionals as sensors, counters and collectors offers an alternative approach in many projects. Questions arise about validity and quality of data collected by non-professionals (Crall et al., 2011), while innovative procedures and analysis approaches are developed which seek to deliver bias-free data and a replicable research process (Dickinson, Zuckerberg, & Bonter, 2010). Scientists are also ever more interconnected with NGOs and other advocate groups in the governance process, and these channels are often utilised to motivate members to achieve what is perceived as a shared goal.

Funding organisations increasingly require researchers to reach out to the general public, both for involvement at various stages of the research and to effectively communicate findings to the appropriate audience (Soranno, Cheruvelil, Elliott, & Montgomery, 2015). The National Science Foundation in the United States and the European Commission's Directorate-General for Research expect scientists to share their data from publicly funded research projects. The Responsible Research and Innovation (RRI) approach, promoted by the European Commission in its Horizon 2020 program, calls for a closer involvement of researchers, citizens, policy makers, business and third sector organisations during the entire research process so that the process and the outcomes are in alignment with the values, needs and expectations of society (European Commission, 2016). This approach tends to be concerned less with furthering the advances of science, and more with collaboratively solving societal and environmental problems (Tress et al., 2005), and has also been facilitated by the growing number of grassroots movements, led by scientists and the public alike, toward greater public participation in environmental science and policy processes.

The possibility of public involvement in scientific projects has many direct and indirect benefits to society. At the societal level it contributes to education and empowerment, and can also often give participants something in return: people may find it interesting to be involved in a scientific process, they might consider it their civic duty to contribute to a better understanding of the world around them, or they may see participation as an opportunity to take part in something which fits and advances their values and world view (Lukyanenko et al., 2011). At the project level, it has been shown that projects that involve participants have a greater focus on societal innovation and social change (Hochgerner, 2013), making citizens active agents of change. The increasing participation of citizens in scientific projects has raised questions of data ownership (do collectors own the data?), data quality (can scientific tasks be performed by non-professionals at the same quality level as those done by professionals?), and citizen empowerment (do volunteers gain power by taking part in citizen science projects?).

Typologies of Approaches

Citizen science approaches have been used in projects ranging from ‘hard’ science such as folding proteins online (Cooper, Khatib, Treuille, Barbero, & Lee, 2010), nature conservation such as monitoring water quality (Fore, Paulsen, & O’Laughlin, 2001), to heritage conservation with collection and tagging of manuscripts (Causer, Tonra, & Wallace, 2012). Many attempts to draw typologies to describe and to qualify the diversity of projects have been made. Haklay (2013) differentiates between empowerment levels in citizen science (Table 1).

Projects with a relatively passive cognitive contribution are considered as crowdsourcing, where the citizens act as sensors reading data and reporting it to the scientists. Haklay argues that the more

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cognitive effort required of participants, the more empowerment they obtain. On the higher end, Haklay introduces 'extreme citizen science projects', which engage citizens from the start. These projects are initiated by the participants, who then request the help of scientists in order to help them framing their research. In this case, citizen scientists do the most of the intellectual work, assisted by scientists. The four levels of citizen science reflect the variety of contributions made by citizens and the role of the scientists. The degree of involvement in shaping the research questions, choice of methods, or simply participating in data collection has a corresponding level of empowerment for the citizen.

Haklay's typology is inspired by Arnstein's ladder (Arnstein, 1969), which is a seminal model of public participation and the underlying power dimensions at play (Figure 1). It describes how the involvement of the public in planning is often done in such as way as to exclude them from having any real effect on the outcomes, while at the same time satisfying the requirements of planners to have a participative process. The first two rungs describe a planner-public relationship based on the former using the participation to 'teach' the latter. The next rung is a participation process that is used by the planners to simply inform the public of the plans. The following two rungs show a gradient of increasing inclusion of public perspectives in the process, but still deny any obligation on the part of the planners to heed the public opinion. The final three rungs of the ladder relate to a gradient of decision-making power for the participants from negotiating outcomes to full control. The eight rungs are further placed in descriptive groups of nonparticipation, tokenism, and citizen power.

Shirk et al. (2012) build on participation and citizen science typologies to suggest five project models for public participation in science (Table 2). The authors describe the contractual model as an alternative to traditional scientific research where the interests are not solely those of the researchers furthering the field, while the collegial model relates to non-professional scientists making contributions to established fields. The contributory, collaboration, and co-creation models describe a gradient of involvement of the public, similar to those of Haklay (2013) and other typologies. They propose a framework to be used in conjunction with the models which breaks down the components of a project and examines the 'quality' of the interactions. The framework considers:

- input (aspirations of actors when setting the focus of the project),
- activities (design and management of the project, including communication, network building, training, meetings, and data collection),
- outputs (the initial results of activities),
- outcomes (tangible results derived from outputs, such as insights, knowledge, learning), and
- impacts (long term changes in terms of human or ecosystem wellbeing derived from the project).

The focus of the project and the producers of knowledge are considered by Schäfer and Kieslinger (2016) to be the most important aspects of differentiation between citizen science approaches. Arguing for an inclusive, flexible approach to describing citizen science, they consider both dimensions on a continuous spectrum which they summarise in the following matrix (Figure 2). They locate existing typologies and approaches on the matrix, which can then be examined relative to each other to show where improvements can be made towards having a more integrated participation of citizens in research, and

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for outcomes that are more society focused.

On the matrix the role and the flow of knowledge in a research project can also be considered. Traditional systems of knowledge production involved researchers producing knowledge to be used in research institutions (Hessels & van Lente, 2008). Knowledge was then part of academic cycles, and reached only a limited, specialised audience of those within the research and policy communities. As discussed, the expectation that research projects have an outreach component, more citizen participation, and the challenges scientists face competing with the multiple voices of NGOs, thinktanks and the media (Jackson, 2005, p. 1637) are reflected by an interest in producing knowledge that can be both concretely applied and is accessible to a wider audience. With citizen science processes and platforms there are opportunities for researchers to achieve these aims. Knowledge can flow then from citizens to science, from science to science, from science to citizens, and from citizens to citizens. A summary of the typologies and approaches can be found in Table 3.

Examples from the field – Citizen Science in a landscape context

This section introduces three initiatives that use citizen science approaches with an explicit landscape focus. The initiatives were chosen because they are diverse in their approaches, aims, and scales. They are not considered representative of citizen science approaches in landscape contexts, rather as three (non-exhaustive) examples from the field. The information about each project has been sourced either through websites, personal knowledge, or through communications with project members.

Wikipedra

The Landscape Observatory of Catalonia serves as an advisory body for the implementation of the European Landscape Convention in Catalonia, Spain, and is a collaboration between administration bodies, research centres, diverse associations and professionals. It aims to improve the knowledge and understanding of Catalonian landscapes, to raise awareness on landscape related issues, propose management strategies and to further develop landscape research theory and methods.

One component of the Observatory's work is the study and awareness raising of dry stone constructions as important landscape elements. The Observatory has developed a tool called Wikipedra, which is a mapping platform for locating dry stone constructions. It allows the public to see the location and characteristics of dry stone constructions, as well as contribute their own examples, indicating the exact coordinates and other information required such as contact details, a technical description of the construction (including conservation state) and photographs. After being reviewed, each element is displayed in the platform in the form of a marker which when clicked, displays the information contributed by the user (Figure 3). That way the users can see the results of their contribution and the researcher/administrator can assure the quality of the information displayed on the platform.

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Rate My View

A number of research projects at Plymouth University (UK) have explored introducing every day technology such as smartphone applications into landscape management as a means of increasing public participation. The "Rate my View" (RmV) application has been developed with South Devon Area of Outstanding Natural Beauty (AONB), and is now used by a number AONBs across the UK. It allows smartphone users to provide continuous landscape related feedback while in situ to the AONBs, which in turn assists the AONB authority in their management of the protected landscape. Users can automatically upload pictures taken on smartphones or tablets to the RmV website, and use GPS technology to pinpoint their location and detect the direction they are facing. Identifying the direction the user is facing is vital in understanding the view/area the user is assessing. Once the image has been collected the users are asked to rate their view by awarding a score of between 0 and 5 stars and submit three words or phrases that describe their view (Figure 4). How well the user knows the view and their age is also collected. Moreover, a comments box is available for further information. Images and text uploaded to the web page are displayed for public view and all data is stored within a database to allow the AONBs to use the results in management plans.

HERCULES Knowledge Hub

HERCULES (HERitage in CULtural landscapES) is a European research project which includes collaboration between researchers, practitioners and stakeholders across Europe. It has the overarching goal to increase understanding drivers, patterns, and values of European cultural landscapes and to use this knowledge to develop strategies for their protection, management and planning.

The Knowledge Hub (KH) is a web-based platform with geographic information systems (GIS) functionality, working as a repository for diverse types of data including spatially explicit information. It was developed as a tool for HERCULES researchers to connect to practitioners and other stakeholders through data collection, to showcase results and insights from completed and ongoing research, and to provide a platform with which the public creates their own spatial data. The KH has a simplified front end called Hercules Labs (Figure 5), which shows different data explorers according to theme and research application. On the main KH platform, users can create their own spatial data, import existing GIS data, and use a range of spatial processing tools to work with their and other's data. The KH also has a space where users can submit their examples of good landscape practices on a map, including photographs and a description, which after review, are visible to the general public.

Analysis

The three cases are each analysed according to typologies discussed in the section two. That of Haklay (2012) identifies the role of citizens in the projects; Shirk and colleagues (2012) describe the degree of participation, and consider the quality of participation at different phases of the project; while Arnstein's ladder allows them to be viewed through the lens of power distribution in a participatory process. Alongside these typologies citizen contributions and visitor data are described for each of the cases, and we interpret the main flows of knowledge through the platforms (Table 4). Finally, the cases

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are placed on the matrix of Schäfer and Kieslinger (2016), showing them relative to each other and within a broader context of citizen science approaches (Figure 3).

Applying the typology of Haklay (2012) to the three projects, the type of participation in RmV and the KH can be differentiated from that in Wikipedra because of the cognitive efforts required of participants. The KH asks the participant to suggest examples of good landscape practices, and RmV looks for how the participant 'rates' the landscape. Wikipedra on the other hand is crowdsourcing data in that it has a clear definition of what data it wants the participant to submit, and all they are required to do is to submit it. In considering how each project fits to Shirk and colleagues' (2012) models of public participation in science, we address the steps at which the participant is involved and the collaborative nature of the relationship between the researchers and the public. We see that essentially, in each example the public is invited to collect or contribute data to the project, and are then engaged as stakeholders for project outputs.

Viewing the cases through the lens of power in public participation, we see that the power to make decisions, to filter data from citizens and steer research outcomes lies without exception in all three cases with the researchers. Using Arnstein's terminology, RmV and Wikipedra give space for citizens to 'advise' (Arnstein, 1969), but retain nevertheless the right to include or heed this advice or not. While the KH has the functionality to receive input from citizens, and those citizens do have control over their information, considering that users exclusively use it as an information rather than a submission tool, it is clear that in practice the KH functions as a tool for informing visitors to the platform about work of the Hercules project, albeit some of which is derived through input from other channels such as interviews, surveys and workshops, which is then analysed and presented as research findings on the KH.

The flow of knowledge in each of the citizen science applications indicates within the context of the platforms who the main producers and consumers of knowledge are. Wikipedra receives citizen knowledge and presents it back to the public to increase public awareness of such landscape features. With RmV citizens submit their photographs and complimentary information, which although then publically accessible on the platform, is primarily intended for assisting in AONB management planning. As mentioned, the KH primarily functions as a repository of research information, some of which is based on citizen input through other channels. In this sense we consider the flow of knowledge to be (citizen)-science-citizen.

According to the matrix of Schäfer and Kieslinger (Figure 2), all cases tend towards researcher knowledge production when considered relative to co-created and action projects. In terms of project focus, the outcomes are orientated in RmV towards developing management plans for AONBs, and those for Wikipedra are aimed at building social awareness of landscape features. The KH is more complex in that the knowledge itself is presented on the platform as a means to reach out to both the public and the research community.

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Discussion

In this paper, we asked the question of what citizen science approaches can bring to participation and inclusion in landscape research. We have seen that on the surface, the application of such approaches in the case of RmV and Wikipedra do facilitate participation, but it is restricted to a very small part of the research process. Although power to frame research and make decisions lies with the researchers, participants are still empowered to contribute data. Participation here is not the discursive process that Jones (2011) describes, nor is it the co-creation or collaboration of Shirk (2012), rather it is closer to the cost effective data collection described by Silverton (2009). Such deployment of citizen science offers landscape scientists an effective and efficient conduit through which to collect spatial data from the public, and one that in the context of inclusion and landscape justice, offers participation to anyone with the requisite technology to hand. Furthermore, it could be said that both of these projects would not have been implementable without using citizen science, as a scientist-only approach for Wikipedra would have been prohibitively expensive and for RmV it would be redundant as it removes the collection of subjective, citizen data.

To approach a more cooperative or co-creative science-stakeholder relationship, the flow of knowledge is a crucial dynamic. The second question we posed was of how citizen science approaches help to communicate scientific knowledge, and we see steps being taken in each of the case examples to facilitate public access to projects, results and insights. This in itself does not make a research project collaborative, but it can facilitate dialogue and understanding between researchers and stakeholders that could lead to can lead to the discovery of topics and questions of shared interest, and more integrated research approaches in the future. Furthermore, making landscape knowledge available and accessible on platforms such as the KH in todays pluralistic, competitive governance context can foster understanding and engagement with landscape thinking, and its inclusive, multi-perspective cross-sectorial approach, reducing conflicts and promoting collaborative, synergist stakeholder relationships.

Such a dialogue process is also necessary as challenges and insights in landscape research are not necessarily transferrable. Although some landscape researchers may have the intention and the will to integrate stakeholder knowledge, as we have seen with the citizen input aspect of the KH, the implementation is difficult without first understanding the stakeholder needs and perspectives. These needs should be thought about specific to their context and with an appropriate scale to the challenge at hand.

Ways forward for landscape research and citizen science

Landscape research addresses coupled socio-ecological systems that include multiple perspectives and values. For this research to be consistent with the principles of justice and democracy, it needs to be a transdiciplinary collaborative process with a strong framework for the integration of stakeholder perspectives at multiple parts of the research process, as well as integrating landscape research into the broader landscape governance process. Citizen science has a particular utility in this regard. It can be at the centre of a researcher-stakeholder relationship, facilitating knowledge exchange and interactions, and can bring accessibility which otherwise might not have been possible. We have seen that there are myriad diverse citizen science approaches in action throughout the broader research

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community, and that there are already examples of such approaches being used in the landscape context. However, there is plenty of space in these examples for deeper integration and exchange between researchers and stakeholders. We believe that there is enthusiasm for these approaches in the landscape research community, but to move forward we needs capacity building with relevant stakeholders before the research process begins. This means more dialogue focused towards delivering research strategies that are at the appropriate scale, that are context specific, and which focus not on participation as the goal but rather on collaboration as the framework for conducting research that is more just, inclusive and reactive to public and stakeholder needs.

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Table 1: Empowerment levels of citizen science (from Haklay, 2013)

Level	Participant type	Example project
Crowdsourcing	Citizens as sensors (participants carry a sensor with them)	Old Weather: participants digitize ship logs (Eveleigh, Jennett, Lynn, & Cox, 2013)
Distributed intelligence	Citizens as basic interpreters, volunteered thinking	Galaxy Zoo: participants classify galaxies (Raddick et al., 2007)
Participatory science	Participation in problem definition and collection	FoldIt: participants suggest potentially interesting proteins to be synthesized into the University of Washington biochemistry lab (Khatib et al., 2011)
Extreme citizen science	Collaborative science – joint problem definition, data collection and analysis	Congo basin poachers: equipped with GPS trackers, rangers can monitor animal and poacher presence (Vitos, Lewis, Stevens, & Haklay, 2013)

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Table 2 : Types of public participation in science (from Shirk et al., 2012, p. 5)

Public action in each model:	Members of the public…
Contract	… ask scientists to conduct an investigation and report the results
Contribute	… are asked by scientists to collect and contribute data and/or samples
Collaborate	… assists scientists in developing a study and collecting and analysing data for shared goals
Co-create	… develop a study and work with input from scientists to address a question of interest or area of concern
Colleagues	… independently conduct research that advances knowledge in a scientific discipline

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Table 3: Summary of typologies and approaches

Typology	Description
Citizen participation (Haklay 2012)	Empowerment levels in a citizen science project based on the role of the participant in the project.
Public participation in science (Shirk et al. 2012)	Project models according to the interaction of participants and scientists.
Ladder of participation (Arnstein, 1969)	Describes the power distribution in a participatory process, from nonparticipation (of citizens) to tokenism to citizen power.
Matrix of approaches (Schäfer and Kieslinger 2016)	Two-dimensional matrix describing projects according to the producers of knowledge (scientists or public) and focus of the project (advancement of science or system intervention).
Flow of knowledge	Describes the main direction in which knowledge is communicated on the platform.

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Table 4: Case examples according to typologies and flow and visitor data

	Wikipedra	Rate my View	Knowledge Hub
Typology of citizen participation (Haklay 2012)	crowdsourcing	distributed intelligence	distributed intelligence
Models of public participation in science (Shirk et al. 2012)	contribute	contribute	contribute
Arnstein's ladder of participation (Arnstein 1969)	placation	placation	informing
Flow of knowledge	citizen-science-citizen	citizen-science	(citizen)-science-citizen
Visitor data (monthly)	(no data available)	110	180
Citizen contributions	12,473	437	0

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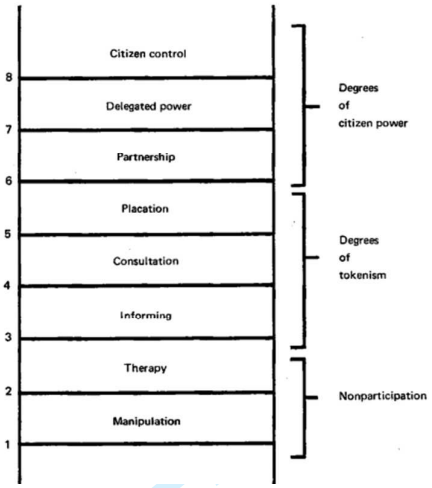

Figure 1 Arnstein's ladder of participation (from Arnstein, 1969)

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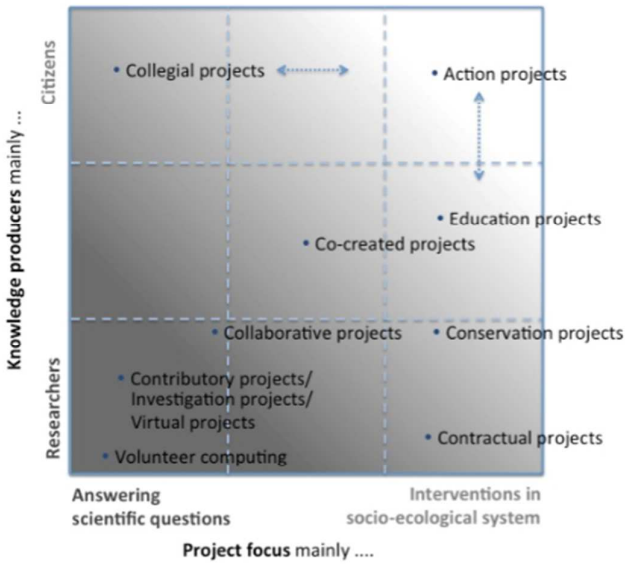

Figure 2: Citizen science approaches (from Schäfer and Kieslinger 2016)

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Figure 3: Wikipedra showing region of Catalonia and numbers of identified stone features (from wikipedra.catpaisatge.net/#)

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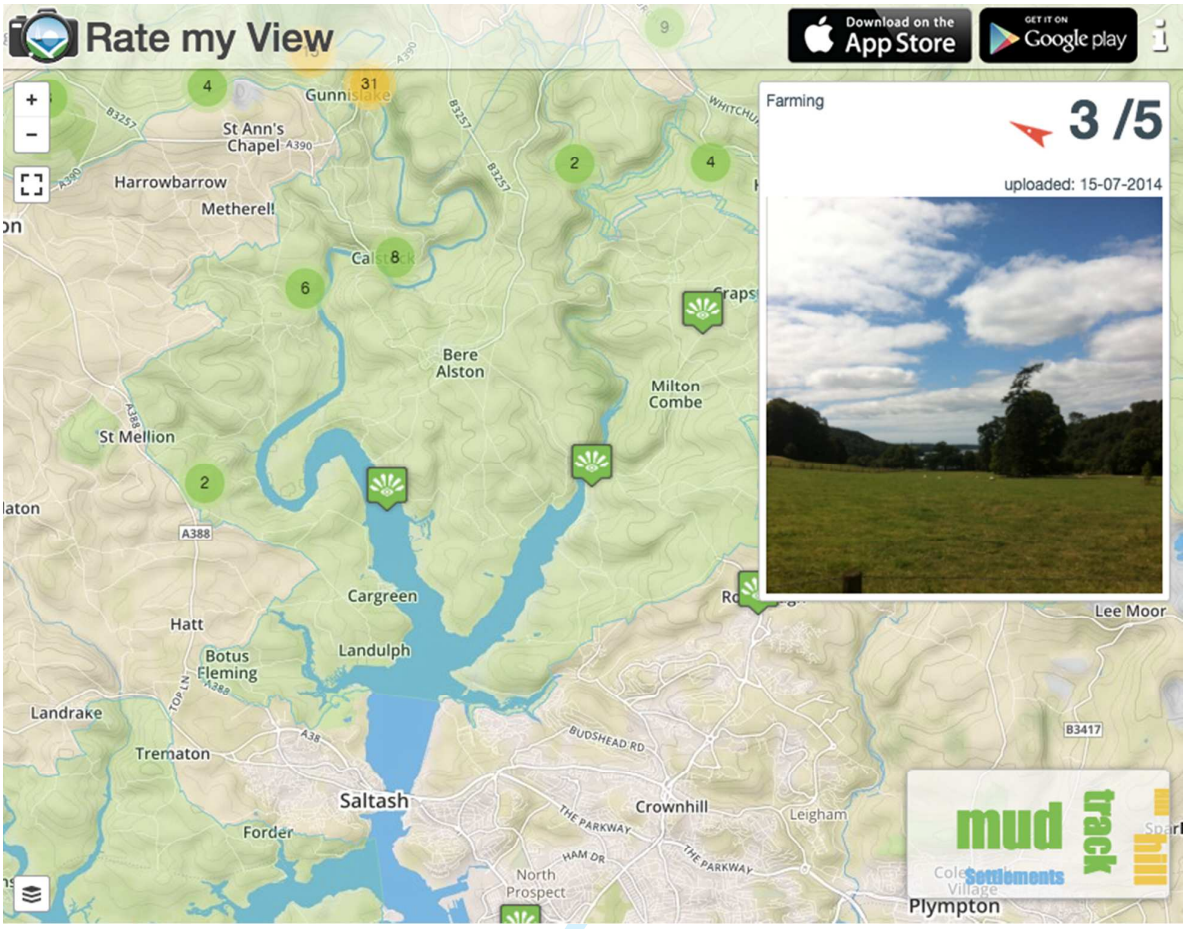

Figure 4: Rate my View showing user-submitted photograph with rating (3/5) and key word "farming" (from http://www.ratemyview.co.uk/)

View Only

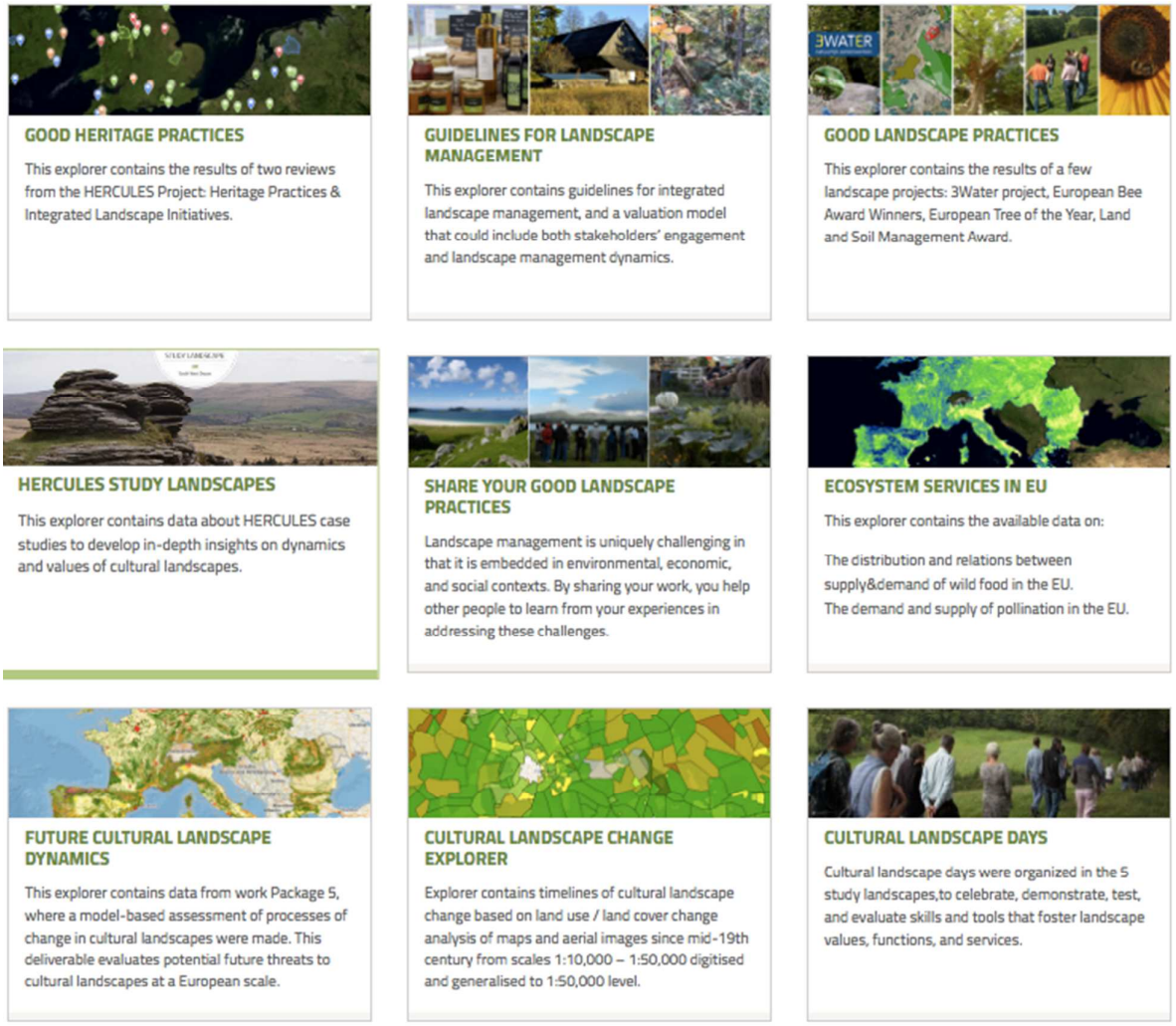

Figure 5: Knowledge Hub Labs with selection of data explorers (from http://labs.kh.hercules-landscapes.eu/)

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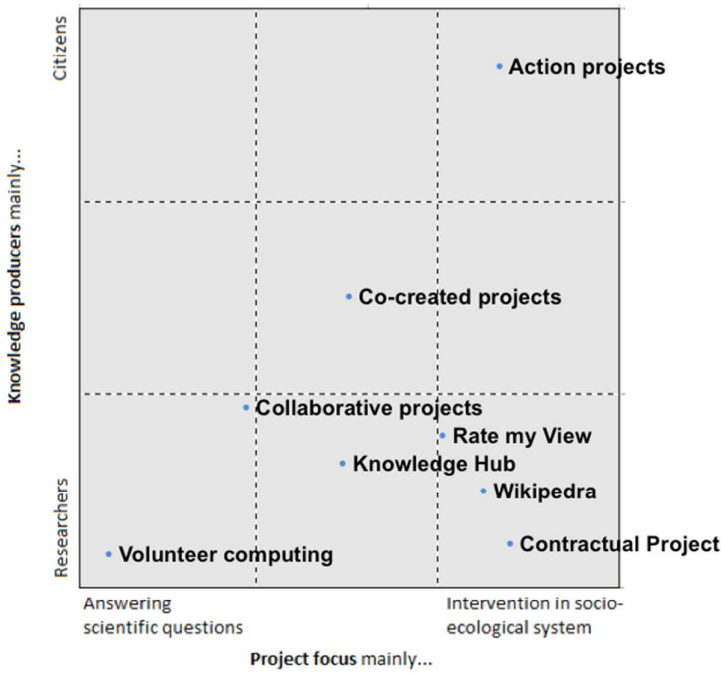

Figure 6: Relative position of projects (adapted from Schäfer and Kieslinger 2016)

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