**Title : Participatory science : encouraging public engagement in ONEM**

**Abstract**

This article provides a case study of a participatory science project that involved collecting observations of a giant grasshopper and registering them online. Our objective is to reflect on conditions for meaningful amateur engagement on Web 2.0 science platforms. Our overall approach is qualitative and ethnographically informed and draws on multiple data sources collected over a period of 18 months: semi-structured interviews, observations, statistical analysis of online activity, and document analysis. We identify a number of factors that enable widespread participation in this naturalist inquiry, organized by Observatoire Naturaliste des Écosystèmes Méditerranéens (ONEM). Our findings illustrate how the association’s double goals of stimulating an appreciation for nature and increasing scientific knowledge of the species under investigation are articulated as both naturalists and the general public participate. This double objective and the inquiry’s locus of control - neither scientist-driven nor grassroots-based - leads us to call for a refinement of existing typologies of participatory science projects. This case illustrates how even low-level participation (crowdsourcing type) can produce significant results – not only in terms of generating scientific knowledge, but also in increasing public engagement with science

**Key words:** participatory science, citizen science, Web 2.0, crowdsourcing, commons, Saga pedo, engagement

**1. Introduction**

Sharing research resources of different kinds, in new ways, and on an increasing scale, is a central element of the new scientific landscape. In participatory Web (Web 2.0) environments, users are invited, not only to consume, but also to produce a large variety of content, tools and applications (Millerand et al 2010). The development of the participatory Web and the ubiquity of digital tools and media make the involvement of amateurs and the general public in scientific research a viable research strategy for some research problems. Over the past decade, the number of scientific projects that invite the participation of amateurs has exploded.

 The objective of this article is to reflect on conditions for meaningful amateur engagement in this type of science. To do so, we provide a detailed description of one participatory science project organized by the Observatoire Naturaliste des Écosystèmes Méditerranéens (ONEM), a non-profit association based on the principles of open access and collective action. The project was highly successful both in terms of encouraging widespread participation and in generating scientific knowledge. We illustrate how the association’s goals of increasing environmental knowledge of the Mediterranean region, engaging ordinary individuals in naturalist practices and providing accessible scientific information are articulated as both naturalists and the general public participate in the inquiry.

 This article makes two contributions to the literature on online participatory science. Firstly, in some respects, our case does not fit well within existing typologies of citizen science. While it exhibits some of the characteristics of a top-down, contributory model of citizen science, its origins in a political stance and a commitment to ideals of openly accessible and free access to data, a “data commons”, also produce a situation that has many of the “bottom-up” characteristics of collaborative or co-created projects. This suggests the need to refine existing typologies or to rethink the way they are mobilized to enable projects to simultaneously occupy multiple locales. Rather than distinguishing between scientific knowledge production and public engagement goals, we suggest that it may be more profitable to examine the ways in which participatory science projects may be multivalent. Our findings support much of what we already know about “best practices” for encouraging widespread participation and engagement in a naturalist inquiry. These best practices concern both the architecture of the online platform and how it was integrated within the community. They may provide guidance as to how to design other online participatory science projects that target BOTH knowledge production and increasing public engagement with science.

 Secondly, by examining the “crowdsourcing model” of Web 2.0 participatory science projects in another light, we provide evidence that small, relatively insignificant contributions are making a difference in science, not only in supplying information or data processing capabilities but also in orienting the type of questions asked. Our research positions amateurs’ contributions using digital devices such as collaborative platforms and databases as an integral part of the scientific knowledge production process. In terms of public understanding of and engagement with science, this emergent reality lends increased importance to a perspective in which amateurs or the general public are not merely recipients of knowledge that is generated elsewhere. The case of ONEM’s *Saga pedo* inquiry provides an empirical illustration that even “low-level” participation can produce significant results in terms of increasing scientific knowledge, appreciation for and engagement with science.

**2. Literature review**

*Participation of amateurs and non-scientists in science*

Projects which invite members of the public to participate in producing scientific knowledge are often classed under the rubric of citizen science. For some scholars (Irwin, 1995; Feynman, 1998; Pion & Piron, 2009; Piron, 2010), citizen science also includes activities as varied as scientific popularisation and public participation in debates on issues such as nuclear power, environmental issues or biotechnologies.[[1]](#footnote-1) In the interests of clarity and for the purposes of this article, we will use the expression “participatory science” defined as the engagement of non-professionals in scientific investigation, whether by contributing resources, asking questions, collecting data, or interpreting results.

The participation of amateurs in producing scientific knowledge is not a new phenomenon, particularly in the field sciences (Charvolin et al., 2007; Miller-Rushing, Primack and Bonney, 2012), where collections (of data or specimens) play an important role. In botany, as in astronomy, regular amateur contribution dates back to the 19th century (Secord, 1994; Goodchild, 2007). What is new, however, is how the development of information technologies and the ubiquity of digital tools and media make the involvement of amateurs and the general public in scientific research a viable research strategy for some research problems.

Digital technologies are playing a pivotal role in the emergence of a structured amateur practice. On the one hand, by creating spaces that facilitate communication between professionals and amateurs, social media and Web 2.0 platforms provide opportunities for large-scale participation (Lievrouw, 2010). This multiplication of arenas for informal knowledge sharing can transform amateurs and the general public into the “invisible workers” of science (Barley and Bechky, 1994). On the other, the emergence of these new practices is directly related to the use of new observation technologies (such as personal GPS systems) and tools which enable the production, aggregation and sharing of data. These technologies stabilize knowledge by standardizing it as data stored in interoperable databases (Hanseth et al., 1996).

Faced with the rapid development of participatory science projects, a number of authors have developed typologies with a view to better understanding and differentiating between projects. Wilderman (2007) proposes a distinction between citizen science and community science based on the locus of control of the inquiry. Her typology differentiates between scientist-driven situations in which the community either plays a consultative role or acts as workers, (“science for the people”) on the one hand, and community-based participatory research, characterized as “science by the people” on the other. Along similar lines, Bonney, Ballard, Jordan, McCallie, Philips, Shirk and Wilderman (2009) propose distinguishing between three types of public participation based on the degree and type of involvement: contribution, collaboration or full participant (co-creation). These typologies tend to focus on who designs or controls projects, and, by extension, on the types of activities citizens perform. Trying to integrate uses of technology and project goals into the equation, Wiggins and Crowston (2012) empirically identified differences between projects focusing on education and outreach, and those focusing on conservation and action (often regional and local in scope). The underlying assumption of these typologies is that a given citizen science project will fit nicely in one space or another. More recently, Prainsack (2013) has proposed a series of criteria to enable the classification of projects: how coordination is organised (locus of control) and agency distributed, participant and participation characteristics (degree and type of involvement), degree of project “openness”, evaluation of outcomes, and entrepreneurial model.

At its most basic, public participation may involve simply supplying resources, such as unused computing power, to a project that is managed by scientists. The best-known example is likely *SETI@home* (Search for Extra Terrestrial Intelligence), which installs a screensaver on volunteer computers to analyze radio signals from space.

The vast majority of projects that invite amateur participation rely on large numbers of contributors to provide small contributions that are more or less independent, allowing them to be treated separately and then integrated into a coherent whole, with a variety of mechanisms to ensure the quality of results (Kelling et al, 2011; Wiggins et al, 2011)[[2]](#footnote-2). In this the scientific equivalent of crowdsourcing, amateurs work actively to gather and contribute data (usually observations) or to code or classify existing data (often specimens). For example, the *Herbaria@home* project, hosted by the U.K. Botanical Society, invites volunteers to document and classify plant specimens from collections throughout the United Kingdom. In the ecological sciences, amateur participation using digital platforms tends to focus on observation of ecosystems and wildlife populations, where volunteers monitor natural resources or form a human sensor network for data collection, often at larger temporal and geographic scales than would otherwise be possible (Cornwell and Campbell, 2012). This can represent a significant contribution, since the quality of a data set is closely related to its size. What is more, a distributed network of amateurs can track the progression of phenomena in quasi-real time. In other fields, data processing projects leverage perceptual capacities and problem-solving skills, spanning a wide variety of task types, from data reduction of images of galaxies (*Galaxy Zoo,* Cho and Clery, 2009 ) to solving protein folding puzzles (*Foldit,* Cooper et al, 2010).)

Amateurs are seldom involved in the definition of research questions or the interpretation of results (Wiggins and Crowston, 2011; Lievrouw, 2010; Nielsen, 2012). Although their contributions are generally restricted and channelled by projects defined and managed by researchers, their work may lead to the actual production of scientific knowledge in the form of *discoveries* (ex. new galaxies), *techniques,* (ex. algorithms for protein folding), or *research directions* (ex. new questions about the impact of climate change on species distribution (Lemonnier-Darcemont, Bernier and Darcemont, 2009; Davis and Howard, 2005). Heaton, Millerand, Crespel and Proulx’s (2011) study of amateur practices in an online botanical network, *TelaBotanica*, suggests something like a paradigm shift in the production of botanical knowledge. By providing order and organization - two “markers” of science identified by Henke and Gieryn (2008), digital tools and platforms developed by *TelaBotanica* facilitate the production of legitimate botanical knowledge by non-scientists. In particular, Heaton et al. identify: a) new forms of division of labour between amateur and scientific activities, b) the pivotal role of amateurs in updating botanical knowledge through the aggregation of new content in a database, and c) the production of innovative resources (tools, databases) through the mobilization of the “many.” These findings extend Hine’s (2008) argument that databases have revolutionized practices in the systematic sciences. Along similar lines, Kelling et al (2009) suggest that the need to compile, organize and document large and complex data sets creates an opportunity to engage a larger number and wider scope of people in producing biodiversity data collections.

Bos and his colleagues (2007) contend that a major issue for online systems that support collaboration between distributed scientists and volunteers is the need to motivate contributors while ensuring the credibility and scientific validity of the data. Indeed, one of the biggest challenges for such “community contribution systems” is to allow participants at all levels to feel like full members. Previous studies of motivations, values and trust among participants in online science projects suggest primarily relational motivations: a desire to work cooperatively, to share skills and knowledge, as well as to belong to a community (Raddick et al, 2010; Brossard et al, 2005). Enjoyment and identification with the project goals are also prime motivations (Nov, Arazy and Anderson, 2011; Raddick et al, 2010). Many participatory science projects also incorporate mechanisms for recognizing their most active or productive participants, and often provide lists of publications produced by the project (some of which include amateur co-authors) (Lievrouw, 2010).

Fewer studies have looked at learning and educational outcomes of participatory science projects. Philips, Bonney and Shirk (2012) qualify our understanding of engagement in citizen science and other public research initiatives as “incomplete.” In addition to increasing their subject knowledge, there is evidence that amateurs develop scientific thinking skills, such as increased concern for data quality and method (Trumbull et al, 2000; McCaffrey, 2005; Krasny and Bonney, 2005). However, Brossard et al.’s (2005) study of Cornell's Birdhouse Network project found increased subject knowledge, but no significant developments in terms of understanding of the scientific process, and attitude towards science Crall et al.’s (2012) study of a citizen science project on invasive plants essentially replicated these findings, although they did find modest change in self-reported intention to engage in pro-environmental activities. Finally, Evans et al. (2005) identified an increase in what they term participants’ “sense of place,” that is, their awareness of and relationship to the local environment.

**3. Method**

The study reported here was part of a four-year multi-sited research project exploring the use of several online platforms by amateurs and professionals in natural history and the environmental sciences in France. In addition to exploring each site individually, we examined relationships between them to build up a portrait of naturalist activities in the area. The larger study that informs this paper drew on data from a variety of sources, including over fifty semi-structured interviews, observations, activity on online platforms, and documents. Our overall approach was qualitative and ethnographically informed.

In the case of the Observatoire Naturaliste des Écosystèmes Méditerranéens (ONEM) platform that is the subject of this article, we analyzed the composition, structure and contributions in thirteen of ONEM’s fourteen species-based inquiries.[[3]](#footnote-3) For each, we compiled information on the number of contributions and their distribution over time. We also documented the different types of contributions on the platform. In addition to field observations, the online platform accepts other types of contribution, such as historical data or data harvested from naturalist databases in order to enrich understanding, or track the evolution of geographical distribution over time. Finally, since each contribution remains associated with the individual or group of individuals who produced it, we were able to determine how many times an individual contributed to a given inquiry, who and how many people participated in multiple inquiries, and the evolution of their participation over time. This quantitative treatment highlighted different dynamics at work in different inquiries. It also enabled us to choose people to interview in order to deepen our understanding of a certain number of inquiries. We conducted semi-structured interviews with the association’s founders and with the coordinators of five species-specific inquiries – all of whom are also contributors to other inquiries. Data was collected over a period of eighteen months (March 2010 to August 2011). Interviews (in French) were taped, and transcribed. Quotes presented here have been translated and are referenced by a number given each respondent.

Our analysis was based on a grounded theory approach (Strauss and Corbin, 1998). We used qualitative data analysis software, NVivo, to support coding as well as to manage and query our data (Bazeley, 2007). Each interview was coded according to a set of categories that evolved during coding. Our team held regular joint data analysis sessions. Each team member then wrote a memo of salient points. Memos were shared and served as the starting point for the next data session.

4. **Description of ONEM and the *Saga pedo* inquiry**

The Observatoire Naturaliste des Écosystèmes Méditerranéens (ONEM) is a non-profit association based on the principles of open access and collective action. Its mission is to increase naturalistic and environmental knowledge in the Mediterranean region, to serve as a point of reference for naturalists, researchers and managers of environmental services in the region, and to provide accessible scientific information to the general public. It was founded in 2004 by a small group of friends and colleagues (primarily naturalists and environmental educators[[4]](#footnote-4)) in reaction to the scientific, institutional and territorial fragmentation of environmental studies in the region. The group proposed a more ecological approach to examine the Mediterranean region as a whole, to fill in the spaces between existing pockets of information, and to encourage its circulation between actors in the field and with the general public. It positioned itself as a complement to existing initiatives and more traditional naturalist associations. A nonprofit associative model was deemed most likely to enable such interconnections and the most compatible with the group’s underlying philosophy of social responsibility, of “stimulating responsible reflection on the impact of human activities on ecosystemic evolution.”[[5]](#footnote-5)

ONEM is thus strongly anchored in a territory, the Mediterranean region, but paradoxically it coordinates its activities exclusively over the Internet and has no physical location or paid staff. Hierarchy is kept to a minimum: everyone is a volunteer, and participation is based on giving freely of one’s time and abilities. The annual general assembly is sovereign, and a coordinating committee, the Scientific and Technical Council (CST), composed of a president, secretary and treasurer plus the coordinator of each inquiry, ensures the association’s scientific and administrative governance. The web site is based on an open-source Wiki and integrates a cartography module. ONEM also uses a database manager and a system for managing the photo gallery, email and Yahoo discussion lists for certain inquiries. All data are published under a Creative Commons licence.

ONEM’s principal activity is conducting species-specific “inquiries”.[[6]](#footnote-6) Anyone can propose or participate in an inquiry on a Mediterranean species. Subjects are typically chosen with a view to enhancing the visibility of little known species and/or to increasing knowledge of poorly understood or poorly documented species.[[7]](#footnote-7)

One of the important elements is the scientific interest and also to what extent the inquiry will lead the general public to better appropriate knowledge about nature in the Mediterranean region. … Most of the inquiries are on species that are relatively easy to identify. On very, very specific things, we’ve tended to respond negatively because we think that the [specialists] who want to conduct such specific inquiries … have other means to conduct their inquiry. We’re using tools for the general public that aren’t really adapted for ultra-specialized things. That’s not where we’ve put our energy. (R2)

 Once approved by the CST, a sub-site is created for the collection of data and relevant documentation. Each inquiry is autonomous and is run by a volunteer coordinator, who may not be a scientist or the most knowledgeable person on the species in question. The coordinator’s primary role is to manage the inquiry, which involves both managing the collected observations and encouraging participation. Participants report observations by completing an online form with details such as the date, exact location, the number of specimens, as well as their names and contact information. They can also attach photographs to their observations.

ONEM’s first, and largest, inquiry targeted the *Saga pedo,* a very large, carnivorous cricket, also known as the predatory bush cricket*.* With a body length of 10 cm and a total length that can reach 17 cm from antennae to tail, this insect is spectacular and highly recognizable, but rare. Present on the French, European and IUCN lists of threatened species, it was largely unknown in France (a 2003 atlas edited by the French National Natural History Museum (MNHN) had reported only 72 sightings in France). By all accounts, 2004 was a “good year” for crickets, and thus propitious for launching the inquiry. ONEM printed 4,000 paper copies of a flyer,[[8]](#footnote-8) calling for people to record their observations of the *Saga pedo* and established an Internet site for collecting and sharing observations.[[9]](#footnote-9) Amply illustrated and written in simple language, the flyer was distributed in places such as local community centres, town halls and environmental associations. It described the *Saga*’s distinguishing characteristics and behaviour, as well as its preferred habitats and proposed a simple, innovative observation protocol.[[10]](#footnote-10) It also contained a “beware of look-alikes” section. As a summary of existing knowledge about the species, the flyer itself was a valuable reference tool for naturalists and environmental educators.

The inquiry was a resounding success. In just a year, the number of observations recorded increased fivefold. The inquiry was most active in its first two years, with the total number of observations passing 1,000 in 2007 (see Figure 1). By the end of 2012, it had gathered over 1,200 observations. Given its low level of recent activity, the inquiry will wrap up in 2013 after ten years.

Figure 1.

As is usual on collaborative sites[[11]](#footnote-11), a small number of individuals were responsible for the majority of contributions[[12]](#footnote-12). Six percent (n=40) were responsible for half of the contributions to the *Saga* inquiry, including data entry of observations from other sources (pre-existing compilations and databases). 542 different individuals or groups (470 individual and 72 group observations) made actual field observations. Groups of two or three people, typically including at least one member who also “hunted” the *Saga* individually, were responsible for 72 observations. The groups were often friends, sometimes family units. Table 1 show the number of observations per person. Observations made in groups have not been included, since the composition of groups was almost never the same. According to the inquiry’s coordinator, over half of participants were from the general public.[[13]](#footnote-13) Forty percent of participants went on to participate in other ONEM inquiries.

|  |  |
| --- | --- |
| Number of observations | Number of participants |
| 1 | 217 |
| 2 | 143 |
| 3-4 | 51 |
| 5-9 | 36 |
| 10-19 | 14 |
| 20 or more | 9 |
| **Total 1261** | **470** |

Table 1. Field observations of *Saga pedo* per participant (excluding group observations), 2004-2010

In the first years of the inquiry, about a third of all observations were accompanied by one or more photos, but this proportion declined after a stock of photos had been constituted and seeing the insect became less of a novelty. In keeping with naturalist practices,[[14]](#footnote-14) observations were attributed to those present at the sighting, not the person or persons who entered them on the website. This transposition of the “ownership” principle is a clear indication of the role of the platform for contributors: the website and the form are situated downstream from the activity of observation. What is more, in the days, weeks or months between the date of an observation and its entry into the ONEM database, it is typically consigned in a notebook, another common naturalist practice.

The success of the *Saga* inquiry in terms of participation, led the coordinator and close collaborators to compile two syntheses to present the advancement of the project in 2004 and 2005 respectively. The online syntheses contain bibliographic references on *Saga pedo*, all contributors’ names and the location of observations on a dynamic map, statistical treatment, as well as information on new knowledge about the species. A coffee table book about the *Saga* is also being prepared as both a synthesis of the inquiry results and a further effort at increasing public appreciation of science and promoting cooperative action in the naturalist world.

**5. Analysis and discussion**

We organize our discussion in three parts. First, we highlight how the *Saga* inquiry implemented a number of strategies that have been mentioned in the literature as conducive for engaging participants. We then consider what made this inquiry different, by focusing on the association’s stance regarding data and public participation and showing how this permeated the organisation of the inquiry. Finally, we illustrate how this model, based on small contributions, nonetheless produced significant scientific results, both in developing new scientific knowledge and increasing public engagement and appreciation of nature.[[15]](#footnote-15)

*Implementing best practices in online participatory science*

ONEM’s *Saga pedo* inquiry generated widespread interest and participation. To this end, in organizing the inquiry, the ONEM team made a number of judicious choices that correspond to elements already identified in the literature (see for example Bonney et al 2009; Charvolin, 2011). Firstly, they engaged their participants. By choosing a spectacular species and by seizing an opportunity – the contingencies of nature made 2004 a good year for crickets – the inquiry built on the natural curiosity of individuals. If they didn’t already know of the ONEM inquiry, they would often do an Internet search for “giant grasshopper”, and be pointed to the site.[[16]](#footnote-16) Targeting a species in particular also enabled ONEM to solicit the participation of experienced naturalists who may have been more interested in plants or birds than an insect. In the words of one of ONEM’s founders, focusing on one species is “good for [involving naturalists] because as soon as you tell them what to look for, they can find it.”(R1) The paper flyers were also an important strategy for engaging participants. Their distribution in local town halls and meeting places helped situate the inquiry as a regional activity, as well as to reassure potential contributors as to the level of skill required.

Secondly, ONEM insisted on making participation in the inquiry easy. “In a lot of participatory science programs, you have to register, have an access code, use long forms. We didn't follow that route… We really try to lower the threshold for participation, to keep it as simple as possible.”(R1) Contributors need only type textual information into a simple form. One coordinator interviewed referred to the goal of “making it so simple that even a child can participate without risk of confusion” (R6). This accent on simplicity is consistent with the findings of previous research. For instance, Bonney, Cooper et al (2009) recommend keeping projects simple in order to reach large audiences, arguing that “even simple projects can address complicated questions by recruiting a subset of participants into more complex tasks” (p. 979). While participant segregation has not been ONEM’s strategy, in each inquiry individuals who are more knowledgeable about the species typically volunteer to take on additional tasks, such as data validation, or developing materials such as observation protocols, information leaflets or syntheses.

Despite the simplicity of its website, ONEM makes good use of the interactive possibilities of Web 2.0, particularly to provide immediate, personalized feedback. One of ONEM’s founders explains how the Web has transformed the way naturalist observations are treated:

Typically, when someone wanted to report a sighting, he would communicate with a museum, which meant he had to already have a contact there. And then there was no feedback, until maybe 10 or15 years later when a scientist might publish something. But now, with websites where the contribution is immediately visible and feedback on observations is also immediate, there’s a dynamic, a network of observers that has developed and a sort of friendly competition among them to get as much data as possible. (R2)

The inquiry’s website includes a dynamic map and lists the details of every participant’s contributions. These features provide recognition mechanisms that emphasize the value of participation. One coordinator affirms that people take part in the inquiries precisely because of the visibility of their individual contributions.

That’s what people tell us … In ONEM feedback is immediate. You enter an observation on the map and the next second you see your point on the map. Your name and your observation are shown in a [popup] extension. And that’s totally innovative, because in most participatory science programs, the general public contributes observations, but these observations are usually transformed [aggregated]. Whereas, in ONEM *every* contribution is put online and is accessible to everyone – as is. It’s the result of someone’s work and it is preserved on the site in the same way it was entered. (R1)

Another interviewee told us that it would have been possible, but more difficult, to conduct the *Saga* inquiry without interactive mapping, which reinforced participation (R2). This is consistent with Sullivan et al’s (2009) finding that the number of individuals submitting data nearly tripled when eBird’s website was upgraded with new features that allowed personalized views of their own observations and comparison with those of others (reported in Bonney, Cooper et al (2009 : 981). Being able to see one’s own observation recorded on the map also incited people to revisit the site, either to confirm its presence or to compare with other observations (R2).

Finally, participation in the *Saga* inquiry (and all others) was conceived of as a both an online and offline activity. Observing nature is, by definition, a local activity. In their choice of species and in their approach, the ONEM coordinators consciously ascribe value to local, situated knowledge and experience. Publishing advertisements in local newspapers and distributing paper flyers in local town halls and meeting places enabled ONEM to reach a large, local public. The interactive maps on the platform are regional in scale, although it is possible to zoom out. ONEM thus proposed an activity in which the “field” component was primordial, and for which the platform was a complement. They were drawing on a “sense of place” (Evans et al 2005) that has proven extremely significant in non-Internet based participatory science programs (Miller-Rushing et al, 2012).

The combination of these elements: an attractive object, ease of participation and minimal requirements in terms of technical skill and engagement, judicious use of elements of the platform to the extent of downplaying the importance of the site, and links with the local community made widespread participation possible, but were not in and of themselves sufficient to produce a successful inquiry. These strategies should be interpreted in the context of ONEM’s goal of increasing public engagement with the natural environment.

*Neither top-down not bottom-up: recognition, coordination and facilitation*

The *Saga* and other ONEM inquiries follow a model of participatory science anchored in a commitment to ideals of data commons and individual worth.

We support the creation of common goods. That’s something that… seduces the general public. The data that they supply don’t go into some database where you don’t know what will happen to them or whose interests they will serve. [In ONEM] they’re immediately available and reusable and in the public domain. … For us, that’s essential. (R2)

Participants are not viewed as “data providers” for scientific projects. Their contributions are valued as coming from individuals. Indeed, in some parts of the site, observations are referred to as “témoignages” (testimonials or evidence) rather than data. “Contributors are not considered simple observers, inventors, or anonymous data contributors, but as eye witnesses to the history of our natural heritage.”[[17]](#footnote-17) This ideological stance translates into an insistence on acknowledging all contributions as significant.

People need to be recognized for their actions, that’s normal. And when you contribute even the smallest brick, the tiniest bit of evidence about a species, you should be recognized for that because you made an effort to participate. And it’s very important for us to provide people with that recognition. (R4)

ONEM’s founders insist strongly that participants should receive something in return. The *Saga* inquiry’s annual syntheses were a means of providing regular feedback on the progress of the inquiry. The book project is another way of giving back to the community. The importance of educational materials in providing information and proposing observational protocols has been discussed by Bonney, Cooper et al (2009). For ONEM, the flyers and syntheses are also a way of sharing interest for nature, and of “giving back.” The association also organizes periodic workshops and an annual weekend get-together, with no other goal than to enhance community and enjoy each other.

This “commons-based” stance makes it impossible to conceive of the *Saga* inquiry as a data-driven project. However, the inquiry would not have happened were it not for the organization provided by ONEM in general and the inquiry coordinator in particular. ONEM’s dual concern for the community (facilitation) and for advancing science (through coordinating data and ensuring its validation) is reflected in the role the coordinator played in both coordinating and facilitating the *Saga* inquiry. In fact, it is for this reason that ONEM generally prefers inquiry coordinators that are not experts on the species, simply people who are interested and competent enough to ensure their smooth progression. While other citizen science projects may be established with multiple goals,[[18]](#footnote-18) we suggest that this dual preoccupation is the key to ONEM’s success.

In our view, a key element for transcending the dichotomous perception of approaches to citizen participation as either top-down or bottom-up is to examine the role of what LaessØe (2008) has conceptualised as “mediators.” In the context of implementing participative processes for sustainable development, LaessØe describes how mediators may play several roles: bringing people together (networking), transferring ideas and practices from one place to another (interpreting), and organizing communicative or action-oriented processes in order to promote learning (facilitating the process). According to the situation, one aspect or another may come to the fore. In the case of ONEM, the online platform helps accomplish the networking role, while the coordinator assumes responsibility for facilitation. Wilderman et al.’s (2004) discussion of mentoring in a community science context appears to us to come close to this facilitation role. The coordinator and others with more domain knowledge also have a role to play in establishing the observation protocol and mentoring less experienced participants. The importance of this type of guidance or interpretation has been discussed by Trautmann, Shirk, Fee and Krasny (2012) and Trumbull, Bonney and Grudens-Schuck (2005) in collaborations between scientists and teachers in formal education settings.

As in LaessØe’s (2008) case, participation in an ONEM inquiry is a tool for promoting both individual engagement and learning and collective awareness of the local environment. Animation and facilitation play an important role in whetting the appetite of potential contributors. A coordinator will “transmit the desire to look for things and accompany them *live* as they find them” (R3), as well as encourage participation and publish regular syntheses (R5). The *Saga* inquiry was exemplary in this regard. Its coordinator “was a good facilitator who called on people often, who used a little pressure: ‘no *Saga* observed in this area, maybe you could add something…’ And so, even with just a discussion list and a website, before the mapping tool, we accumulated a lot of data.” (R2)

As noted in the literature review, participants are typically seen as a source of error in participatory science, and the data they provide as requiring some type of validation. Wiggins et al (2011) provide a list of data validation and quality control mechanisms used in participatory science projects. Data quality is also a concern for ONEM inquiries, particularly given the simplicity of its online form. In ONEM, however, there are two types of data validation. Since participants see their contributions immediately and raw data is always available on the site, “if someone notices something that seems wrong, he can [bring it up]. So validity is ensured by a permanent collective monitoring.”(R4) This ongoing validation is complemented by a second, more classic type, performed on data that has often already been identified as questionable by other participants. The coordinator and a small number of knowledgeable volunteers use a variety of measures, among them digital vouchers, such as asking the observer if they can provide a photo of the species, personal knowledge of participant skills/expertise and contacting participants about unusual reports. Wiggins et al (2011) suggest that contacting participants for verification may alienate them and discourage participation. However, none of the ONEM coordinators interviewed mentioned this. They typically viewed such contacts as a positive experience that allowed exchange beyond simple data validation.

*Minimal engagement but significant contribution*

At first glance, the *Saga* inquiry resembles a crowdsourcing project in which large numbers of non-specialists contribute basic information about their observations using a simple online form. It is tempting to underestimate the significance of this type of engagement, possibly because each contribution is so small and because data analysis typically remains in the hands of scientists. However, widespread participation produces larger data sets, with wider geographic (and sometimes temporal) distribution. The advantages for natural scientists are related to the fact that data quality goes with quantity – a larger dataset will be more robust. The *Saga* inquiry produced an explosion in the number of observations, coverage that would have otherwise been impossible, and a correspondingly dramatic increase in dataset quality. The coordinator notes that, while the top contributors who all work in entomology may be responsible for the most data, “that’s quantitative, not qualitative. The quality comes from the general public. They are really the ones who made the difference.” (R1)[[19]](#footnote-19) He further explains: “if you are working from a few observations, the margin of error is large. But if you work on thousands of data, the margin of error is below the threshold that would invalidate the work, taking into account that the data are still validated by specialists.” (R1) Thus, the significance of the *Saga i*nquiry’s data stems from the scope and range of data generated by field observations, not from a compilation of “previous knowledge.”

The *Saga* inquiry also led to the emergence of new questions. After reconstructing the species’ geographical range, the inquiry turned its attention to generating knowledge about the ecology of the species, such as its reproductive habitat, or the impact of climatic variations on hatching, size and periodicity of observation. Questions of this type arose through the natural curiosity of those interested in the *Saga,* who either talked to the coordinator or posted them on the site*.* Although he was not the source of the new questions, the coordinator, an ecologist and environmental educator, was instrumental in mobilizing active “*Saga* seekers” to further document poorly understood aspects of the insect’s life and habitat.

And then there are elements that were completely unknown before we launched the inquiry that we were able to document and, in doing so, make a scientific contribution to biology and the ecology of the species. For example, we demonstrated that the *Saga* is active in early evening but [not late at night][[20]](#footnote-20). (R1)

This echoes Davis and Howard (2005) who illustrated both the value of data contributed online by the general public on monarch butterfly movement, and the emergence of new questions.

The *Saga* inquiry also differs from much scientific crowdsourcing in that it was not established in order to obtain data for a specific scientist-driven project, although its data has been used in at least one scientific paper. Rather, its goal was to generate a dataset that could be used by any number of people to answer questions that were not specified in advance. To this end, ONEM’s online infrastructure plays a vital role. “The website helped us organize things, structure them, make them durable.” (R2) In addition to collecting observations, it acted as a clearinghouse by centralizing information on the *Saga*. ONEM organizers insist strongly that access to this information be open to all under the Creative Commons licence. In this, ONEM’s position is much more radical than that of most participatory science platforms.[[21]](#footnote-21) Bonney, Cooper et al (2009) are among the few who recommend allowing and encouraging participants to manipulate and study project data as one of the most educational features of participatory science. However, their proposition is limited to allowing “participants to view a diverse set of graphs, maps, histograms, and other visualizations that immediately show how their data are being used” (p. 981), and does not appear to encourage actual use of data by ordinary participants. Similiarly, while Jordan et al (2012: 176) suggest that citizen science projects provide an excellent opportunity to broaden volunteers’ understanding of science by involving them in “authentic science”, they interpret engagement as a graduated set of steps in which volunteers would progress gradually to more complex tasks, always determined by someone else.

Miller-Rushing et al (2012: 289) note that “citizen science is also increasingly seen as a way to engage the public in science, improve scientific literacy and interest in science, and inform participants about particular topics.” With its double goal of increasing scientific knowledge and promoting appreciation of the natural world, ONEM shares this emerging perspective. The scientific interest of an ONEM inquiry is just one facet. “The other – because our goal is better knowledge of the Mediterranean region – is the creation of a network of observers, a network of people interested in nature, who observe. Not necessarily with a view to scientific education, but of developing an interest in nature.”(R2) This dual concern is reflected in the inquiry coordinator’s double role of data management and facilitation. It is also present in ONEM’s marriage of online and offline activities and strategies. Thus, “even if participants don’t record their observations on the website, it’s not too serious. Their participation is also important. It’s not just gathering data that is important.”(R2)

ONEM situates its inquiries within a perspective of continuity, in terms of both content and durability. The *Saga* inquiry took an historical approach in retracing and compiling historical observations. This echoes Miller-Rushing et al’s (2012) suggestion that historical citizen-science datasets may enrich understandings of long-term changes in the environment and their causes and consequences. The *Saga* inquiry was conceived of as an ongoing, open-ended activity. “The idea is not necessarily that it continue forever. Once an inquiry has gathered sufficient information to answers all the questions that were asked, it could be closed. … On the other hand, it’s too bad in a way because it has gotten people involved.” (R3) The fact that the Saga inquiry will be the first inquiry to close in 2013 after ten years reflects this ambivalence.

ONEM seeks to foster an ongoing interest in nature, far beyond participation in a single inquiry. To what extent have they succeeded in this aspect of their mission? All our respondents mentioned that participants tend to become interested in other species and to get involved in other inquiries. The fact that forty percent (n=220) of those who took part in the *Saga* inquiry went on to participate in other ONEM inquiries, and that many ONEM contributors do in fact contribute to multiple inquiries confirm this perception. We do not know what other kinds of naturalist activities participants engage in outside of participating online in ONEM, although our respondents observe that people are motivated to participate in other naturalist activities[[22]](#footnote-22). One person we interviewed reported that he has sometimes been sometimes contacted by people who saw a notice or article about the inquiry two or more years earlier and who now want to participate. “And you say to yourself ‘that person kept that newspaper clipping because he or she was interested but didn’t participate at the time for whatever reason. But the interest was there.’”(R3) He goes on to suggest that the significance of outreach activities such as distributing flyers and other documentation can only be evaluated in the long term. By all accounts, in terms of public understanding of and appreciation for nature, ONEM is indeed building its “network of observers” – one inquiry at a time.

**6. Conclusions**

The *Saga pedo* inquiry provokes us to question the adequacy of existing typologies of citizen science. Bonney, Ballard et al. (2009) propose distinguishing between three types of public participation based on degree and type of involvement, while Wiggins and Crowston (2012) propose distinctions based on project goals, either educational and outreach, or focused on science. The underlying assumption is that a given citizen science project will fit nicely in one space or another. Our case does not fit well within these typologies, however. In ONEM inquiries, control is in the hands of a small group, the project’s designers, and the level of participant investment and engagement required from participants is minimal (although more is encouraged). This would appear to put it in the top-down, “contributory” category. However, the group’s serious political commitment to ideals of openly accessible and free access to data also produces a situation that has many of the “bottom-up” characteristics of collaborative or co-created projects. By explicitly recognizing the contributions of all participants and paying attention to them, not only the data they provide, the ONEM model encourages meaningful participation and empowerment. We argue that it has been successful at least partially because it brings together individuals of different backgrounds and expertise, all of whose contributions are recognized as important. Everyone gives freely of his or her time and knowledge to enrich the common good. This stance of “co-ownership” of both the inquiry and the data allows the coexistence of different registers of knowledge (amateur, professional and general public), different disciplines (for example entomology, ecology and botany) and different projects: the data compiled are available for use in multiple projects. Similarly, the *Saga* inquiry successfully produced both public engagement and an increase in scientific knowledge. We suggest that it may be more profitable to examine the ways in which participatory science projects may be multivalent than to suggest that they prioritize one goal over another.

The emergent reality of amateurs using digital devices such as collaborative platforms and databases to contribute to the production of scientific knowledge lends increased importance to a perspective in which amateurs or the general public are not merely recipients of knowledge that is generated elsewhere. Our example provides evidence that small, relatively insignificant contributions can make a difference in Web 2.0 participatory science projects, both in terms of knowledge generation and public understanding and appreciation of the natural world.

 Our findings are limited by the specificity of our case. Our choice to focus on one inquiry within one organisation allows for a depth of description and understanding of contextual factors, but does not permit generalization. In this emerging field, research to date has focused on individual cases, and few cross-case comparisons or syntheses have been attempted. More research is needed to clarify the relations between various factors contributing to engagement with a view to identifying emergent patterns across cases and contexts. In particular, we observe a lack of attention in previous studies to the relationship between online and off-line activities, and to the importance of facilitation and mediation on online participatory science platforms. Future research in participatory science must also continue to explore models that provide an alternative to large-scale, data-driven projects and anonymous participation that are becoming the norm. As is common with many studies of Internet communities and activities, our study also suffers from limited access to “ordinary” contributors, which makes evaluation of changes in awareness, knowledge and understanding impossible to evaluate. While participation and short-term results within ONEM (the number of observations and participants) provide evidence of engagement, it is impossible for us to draw any conclusions as to the long-term impacts of participation in the *Saga* inquiry.

 Participatory science initiatives open new possibilities for engaging the public with science. Long before the advent of Web 2.0, in his seminal 1996 article, Bucchi argued against “reducing the public to an external, monolithic, and taken-for-granted source of support,” (which we argue a crowdsourcing approach to science tends to do). He further suggested that

communication of science at the popular level may influence core scientific practice … It can foster the inclusion or the exclusion of actors or theories from the specialists’ discourse, and it can make room for new interpretations or confer a different status on existing models by linking them to other public issues and themes. The popular stage can in this sense provide an open space where stimuli, ideas and information may be merged and exchanged among different actors and across disciplinary fields, in the absence of the constraints and conventions which bind scientific work and communication at the specialist level.(Bucchi. 1996: 386)

 Using its platform as a space for exchange and interaction among different actors in the absence of the constraints and conventions that bind scientific work and communication at the specialist level, ONEM’s *Saga pedo* inquiry communicates science by encouraging participating in it. This is precisely the ideological, and naturalist, mission of ONEM.

REFERENCES

Akrich, M. et Méadel, C. (2009). Les échanges entre patients sur l’Internet. *La Presse Médicale*, *38*(10), 1484‑1490.

Allen, D.E. (1976). *The Naturalist in Britain.* London: Allen Lane.

Barley, S. R. & Bechky, B. A., (1994). In the Backrooms of Science: The Work of Technicians in Science Labs. *Work and Occupations: An International Sociological Journal*, *21* (1), 85-126.

Bazeley, P. (2007). *Qualitative data analysis with NVivo*. Los Angeles, CA: Sage.

Benkler, Y. (2007). *The wealth of networks: How social production transforms markets and freedom.* New Haven, CT: Yale University Press.

Bonney, R., Ballard, H., R., Jordan, E. McCallie, Phillips, T., Shirk, J. and Wilderman, C. (2009). *Public Participation in Scientific Research: Defining the Field and Assessing Its Potential for Informal Science Education. A CAISE Inquiry Group Report,* Center for Advancement of Informal Science Education (CAISE), Washington, DC, Tech. Rep. Retrieved from http://www.eric.ed.gov/ERICWebPortal/detail?accno=ED519688

Bonney, R., Cooper, C. B., Dickinson, J., Kelling, S., Phillips, T., Rosenberg, K. V., & Shirk, J. (2009). Citizen science: a developing tool for expanding science knowledge and scientific literacy. *BioScience, 59*(11), 977-984. http://dx.doi.org/10.1525/bio.2009.59.11.9

Bos, N., Zimmerman, A., Olson, J., Yew, J., Yerkie, J., Dahl, E. and Olson, G. (2007). From shared databases to communities of practice: A taxonomy of collaboratories. *Journal of Computer Mediated Communication*, *12*(2), 652-672. <http://dx.doi.org/10.1111/j.1083-6101.2007.00343.x>

Boullier, D., Le Bayon, S. et Philip, F. (2010). *Format techniques, format communautaires, formats d’engagement - Le cas d’une communauté diasporique.* Montréal : Presses de l’Université du Québec.

Brossard, D., Lewenstein, B., & Bonney, R. (2005). Scientific knowledge and attitude change: The impact of a citizen science project. *International Journal of Science Education*, *27*(9), 1099-1121. http://dx.doi.org/10.1080/09500690500069483

Brown, S., Gay, P. L., & Daus, C. S. (2011). Motivation of Citizen Scientists Participating in Moon Zoo. *Bulletin of the American Astronomical Society*, *43*. Retrieved from http://adsabs.harvard.edu/abs/2011AAS...21715814B ( June 27, 2012)

Bucchi, M. (1996). When scientists turn to the public: alternative routes in science communication. *Public Understanding of Science*, *5*(4), 375‑394. http://dx.doi.org/10.1088/0963-6625/5/4/005

Charvolin, F., Micoud, A. & Nyhart, L.K. eds., (2007). *Des sciences citoyennes ? : La question de lʼamateur dans les sciences naturalistes*. Paris: Editions de lʼAube.

Charvolin, F. (2011). La « cause » des sciences citoennes , *Alliage*, n°69, 90-99. Consulted Oct. 14, 2013, URL : http://revel.unice.fr/alliage/index.html?id=3260.

Charvolin, F. (2004). Le programme Feederwatch et la politique des grands nombres, *Développement* *durable et territoires* [En ligne], Consulted Oct 14, 2013. URL : http://developpementdurable.revues.org/687 ; DOI : 10.4000/developpementdurable.687

Cho, A., & Clery, D. (2009). Astronomy Hits the Big Time. *Science*, *323*(5912), 332‑335. http://dx.doi.org/10.1126/science.323.5912.332

Cooper, S., Khatib, F., Treuille, A., Barbero, J., Lee, J., Beenen, M., … Players, F. (2010). Predicting protein structures with a multiplayer online game. *Nature*, *466*(7307), 756‑760. http://dx.doi.org/10.1038/nature09304

Cornwell, M. L., & Campbell, L. M. (2012). Co-producing conservation and knowledge: Citizen-based sea turtle monitoring in North Carolina, USA. *Social Studies of Science, 42*(1), 101 -120.

Crall, A.W., Jordan, R., Holfelder, K., Newman, G.J., Graham, J. & Waller, D.W. (2013). The impacts of an invasive species citizen science training program on participant attitudes, behavior, and science literacy. Public Understanding of Science *22*(6), 745-764. doi:[10.1177/0963662511434894](http://opurl.bib.umontreal.ca:9003/sfx_local?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&__char_set=utf8&rft_id=info:doi/10.1177/0963662511434894&rfr_id=info:sid/libx&rft.genre=article)

Davis, A. K. & Howard, E. (2005). Spring recolonization rate of monarch butterflies in eastern North America: new estimates from citizen-science data. *Journal of the Lepidopterists’ Society, 59*(1), 1-5.

Evans, C., Abrams, E., Reitsma, R., Roux, K., Salmonsen, R.,& Marra, P.P. (2005). The Neighborhood Nestwatch Program: Participant outcomes of a citizen-science ecological research project*. Conservation Biology, 19*(3), 589-594*.* http://dx.doi.org/10.1111/j.1523-1739.2005.00s01.x

Feynman, R. P. (1998). *The Meaning of it All: Thoughts of a Citizen Scientist.* Reading, MA: Addison-Wesley.

Goodchild, M. F. (2007). Citizens as sensors: the world of volunteered geography. *GeoJournal, 69*(4), 211‑221. <http://dx.doi.org/10.1007/s10708-007-9111-y>

Hanseth, O., Monteiro, E., & Hatling, M. (1996). Developing Information Infrastructure: The Tension between Standardization and Flexibility*. Science, Technology, & Human Values, 21*(4), 407-426*.*

Hargittai, E. & Welejko G. (2007). The participation divide: content creation and sharing in the digital age. *Information, Communication and Society, 11*(2), 239–256.

Heaton, L., Millerand, F., Crespel, E. & Proulx, S. (2011). La réactualisation de la contribution amateure à la botanique: le collectif en ligne Tela Botanica*. Terrains et Travaux, 1*(18), 155-173*.*

Henke, C. R. & Gieryn, T. F. (2008). Sites of Scientific Practice: The Enduring Importance of Place. In E. J. Hackett, O. Amsterdamska, M. Lynch & J. Wajcman (Eds.), *The Handbook of Science and Technology Studies*. Third Edition. Cambridge, MA: MIT Press.

Hine, C. (2008)*. Systematics as Cyberscience. Computers, Change, and Continuity in Science.* Cambridge, MA: MIT Press.

Irwin, A. (1995). *Citizen Science: A Study of People, Expertise, and Sustainable Development.* London: Routledge.

Jordan, R. C., Ehrenfeld, J. G., Gray, S. A, Brooks, W. R., Howe, David V., & Hmelo-Silver, C. E. (2012). Cognitive Considerations in the Developmnet of Citizen Science Projects. In J.L. Dickinson & R. Bonney, eds. *Citizen Science : Public Participation in Environmental Research.* Ithaca, N.Y. : Cornell University Press. p. 167-178.

Kanefsky, B., N. G. Barlow, & V. C. Gulick. 2001. Can distributed volunteers accomplish massive data analysis tasks? *32nd Annual Lunar and Planetary Science Conference,* 12–16 March, Houston, TX, abstract no. 1272 [June 27 2012].

Keeney, E. (1992). *The Botanizers: Amateur Scientists in Nineteenth-Century America.* Chapel Hill: University of North Carolina Press.

Kelling, S., Yu, J., Gerbracht, J., & Wong, W.-K. (2011). Emergent Filters: Automated Data Verification in a Large-Scale Citizen Science Project. *In 2011 IEEE Seventh International Conference on e-Science Workshops (eScienceW*) (p. 20 ‑27).Presented at 2011 IEEE Seventh International Conference on e-Science Workshops (eScienceW). *http://dx.doi.org/10.1109/eScienceW.2011.13*

Krasny, M., & Bonney, R. (2005). Environmental education through citizen science and paticipatory action research. In E. A. Johnson and M. J. Mappin (Eds.), *Environmental education or advocacy: perspectives of ecology and education in environmental education*. Cambridge, UK : Cambridge University Press. p. 292-319.

LaessØe, J. (2008). Participation and Sustainable Development: The Role and Challenges of Mediating Agents. In A. Reid, B. Bruun Jensen, J. Nikel, V. Simovska, eds. *Participation and Learning: Perspectives on Education and the Environment, Health and Sustainability.* Berlin: Springer. p. 144-158.

Lemonnier-Darcemont, M., Bernier, C., & Darcemont, C. (2009). Field and breeding data on the European species of the genus Saga (Orthoptera: Tettigoniidae). *Articulata, 24*, 1‑14.

Lievrouw, L. A. (2010). Social Media and the Production of Knowledge: A Return to Little Science? *Social Epistemology, 24*(3), 219-237. http://dx.doi.org/10.1080/02691728.2010.499177

McCaffrey, R. E. (2005). Using citizen science in urban bird studies. *Urban Habitats, 3*(1), 70-86.Retrieved from http://www.urbanhabitats.org/v03n01/citizenscience\_full.html

Miller-Rushing, A., Primack, R. & Bonney, R. (2012). The history of public participation in ecological research. *Frontiers in Ecology and the Environment, 10*(6): 285–290. [http://dx.doi.org/:10.1890/110278](http://dx.doi.org/%3A10.1890/110278)

Millerand, F., Proulx, S. & Rueff, J. (eds) (2010). *Web social. Mutation de la communication.* Québec, Québec: Presses de l’Université du Québec.

Neilsen, M. (2012). *Reinventing discovery: The new era of networked science*. Princeton, N.J: Princeton University Press.

Nov, O., Arazy, O., & Anderson, D. (2011). Dusting for science: motivation and participation of digital citizen science volunteers. In *Proceedings of the 2011* *iConference* (p. 68–74). New York, NY: ACM. http://dx.doi.org/10.1145/1940761.1940771

Phillips, T., Bonney, R. & Shirk, J. L. (2012). What is our Impact ? Toward a Unified Framework for Evaluating Outcomes of Citizen Science Participation. In J.L. Dickinson & R. Bonney, eds. *Citizen Science : Public Participation in Environmental Research.* Ithaca, N.Y. : Cornell University Press. p. 82-95.

Piron, F. (2010). La citoyenneté scientifique contre l’économie marchande du savoir. Éthique publique, *12*(1), 79-104. consulté le 09 novembre 2013. URL : http://ethiquepublique.revues.org/240 ; DOI : [10.4000/ethiquepublique.240](http://opurl.bib.umontreal.ca:9003/sfx_local?url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&__char_set=utf8&rft_id=info:doi/10.4000/ethiquepublique.240&rfr_id=info:sid/libx&rft.genre=article)

Pion, L. & Piron, F. (2009) Aux sciences, citoyens ! Expériences et méthodes de participation autour des enjeux scientifiques de notre temps. Montréal : Les Presses de l’Université de Montréal et Institut du Nouveau Monde.

Raddick, M. J., Bracey, G., Gay, P. L., Lintott, C. J., Murray, P., Schawinski, K., … Vandenberg, J. (2010). Galaxy Zoo: Exploring the Motivations of Citizen Science Volunteers. *Astronomy Education Review, 9*(1), 010103. <http://dx.doi.org/10.3847/AER2009036>

Roth, W-M. & Lee, S. H. (2004). Science education as/for participation in the community. *Science Education 24*, 76-89.

Secord, A. (1994). Science in the pub: artisan botanists in early nineteenth-century Lancashire. *History of science, 32*(97), 269‑315.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: techniques and procedures for developing grounded theory* (2nd ed.). Thousand Oaks: Sage Publications.

Trautmann, N. M., Shirk, J. L., Fee, J. & Krasny, M. E. (2012). Who Poses the Question? In J.L. Dickinson & R. Bonney, eds. *Citizen Science : Public Participation in Environmental Research.* Ithaca, N.Y. : Cornell University Press. p. 179-190.

Trumbull, D. J., Bonney, R., Bascom, D., & Cabral, A. (2000). Thinking scientifically during participation in a citizen-science project. *Science Education, 84*(2), 265–275. [http://dx.doi.org/10.1002/(SICI)1098-237X(200003)84:2<265::AID-SCE7>3.3.CO;2-X](http://dx.doi.org/10.1002/%28SICI%291098-237X%28200003%2984%3A2%3C265%3A%3AAID-SCE7%3E3.3.CO;2-X)

Trumbull, D. J., Bonney, R., & Grudens-Schuck, N. (2005). Developing materials to promote inquiry: Lessons learned. *Science Education, 89*(6), 879-900. http://dx.doi.org/10.1002/sce.20081

Wiggins, A., & Crowston, K. (2011). From Conservation to Crowdsourcing: A Typology of Citizen Science. In 2011 44th Hawaii International Conference on System Sciences (HICSS) (p. 1 ‑10). Paper presented at 2011 44th Hawaii International Conference on System Sciences (HICSS). http://dx.doi.org/10.1109/HICSS.2011.207

Wiggins, A., & Crowston, K. (2012). Goals and Tasks: Two Typologies of Citizen Science Projects. In *2012 45th Hawaii International Conference on System Science (HICSS)* (p. 3426 ‑3435). Paper presented at 2012 45th Hawaii International Conference on System Science (HICSS). http://dx.doi.org/10.1109/HICSS.2012.295

Wiggins, A., Newman, G., Stevenson, R. D., & Crowston, K. (2011). Mechanisms for Data Quality and Validation in Citizen Science. In *2011 IEEE Seventh International Conference on e-Science Workshops (eScienceW)* (p. 14 ‑19). Paper presented at 2011 IEEE Seventh International Conference on e-Science Workshops (eScienceW). <http://dx.doi.org/10.1109/eScienceW.2011.27>

Wilderman, C. C. (2007). Models of community science: design lessons from the field, in *Citizen Science Toolkit Conference*, C. McEver, R. Bonney, J. Dickinson, S. Kelling, K. Rosenberg, and J. L. Shirk, Eds., Cornell Laboratory of Ornithology, Ithaca, NY. (available online at http://birds.cornell.edu/citscitoolkit/conference/proceeding-pdfs/Wilderman%202007%20CS%20Conference.pdf)

Wilderman, C. C., Barron, A & Imgrund, L. (2004). Top-Down or Bottom-Up? ALLARM’s Experience with Two Operational Models of Community Science. Paper presented at the 2004 *National Monitoring Conference* (available online at http: //acwi.gov/monitoring/conference/2004/proceedings\_contents/13\_titlepages/posters/poster\_235.pdf)

1. We note that older references tend to refer to a variety of practices as citizen science. In the English-speaking world, as the participation of citizen in gathering data has exploded, there may be a tendency to CONTRAST this definition of citizen science with other practices focused on public discussion and debate. [↑](#footnote-ref-1)
2. The development of this model is closely associated with the open–source software community. It is usually referred to as “commons-based peer production.”  See Benkler (2007). [↑](#footnote-ref-2)
3. ONEM organizes participation and data collection around a limited number of species as “inquiries” (described in detail in the next section). One inquiry was just beginning and had few contributions. [↑](#footnote-ref-3)
4. The founding group is best characterized as “passionate amateurs.” While a number work in the field of environmental studies: as outdoor educators, nature reserve manager and guard, technician in environmental management, consultant for environmental impact assessments, others have occupations that are completely unrelated: public works engineer, computer scientist, sociologist. Only one of the founding members is a scientist. [↑](#footnote-ref-4)
5. In keeping with the association’s philosophy of open access and transparency, the minutes of the 2002 meeting that led to ONEM’s creation are published on the website : http://www.onem-france.org/wakka.php?wiki=AvantProjet [↑](#footnote-ref-5)
6. The species-specific model wasn’t a specific choice at the outset. ONEM initially wanted also to produce a newsletter and to organize field outings. Lack of financial resources and other possibilities for outings caused ONEM to “specialize” in what was unique and possible to accomplish with virtually no money. [↑](#footnote-ref-6)
7. The choice of species is strongly conditioned by a number of factors, including the desire to serve as large a public as possible. Thus, an easy to identify, or impressive species may be more attractive to users than a more common species, such as snails. Species that are vulnerable, endangered or “collectible” are typically avoided, unless the potential benefits in terms of increased knowledge are thought to outweigh potential harm. [↑](#footnote-ref-7)
8. Funded by a grant from the Fondation Nature & Découvertes, whose mission is to help fund local initiatives that seek to protect biodiversity http://www.fondation-natureetdecouvertes.com [↑](#footnote-ref-8)
9. <http://saga.onem-france.org/> The Saga inquiry was launched using a provisional website before ONEM was officially constituted as an association. [↑](#footnote-ref-9)
10. to go out at night with a flashlight or in a vehicle and look for the eyes that would reflect the light [↑](#footnote-ref-10)
11. Popular wisdom has it that 90% of a site’s users typically limit their use to consulting its content, while only 10% contribute actively ([http://en.wikipedia.org/wiki/1%25\_rule\_(Internet\_culture)](http://en.wikipedia.org/wiki/1%25_rule_%28Internet_culture%29). While there is some evidence to support these figures in online discussion forums (see for example Akrich and Meadel 2009 and Boullier, Le Bayon and Phillip, 2010), quantitative studies are rare. We do not know of any studies that address content creation. What is more, the proportion must vary depending on population characteristics. For instance, Hargittai and Welejko (2007) found the percentage of young adults actively creating and posting content to be around 20%. [↑](#footnote-ref-11)
12. We have distinguished between observations made in the field and other types of contribution, such as entering historical data or harvesting data from other naturalist databases. Thus, when we compiled our statistics, we had 2,267 total contributions, only 1,261 of which were field observations made by the person who entered them. [↑](#footnote-ref-12)
13. The proportion of general public vs. more knowledgeable naturalists varies according to the nature of each inquiry. While the *Saga pedo* was already a *cas célèbre* and has a naturalist “following,” other inquiries that do not build on an installed base of naturalists draw an even larger part of their participation from the general public (R5). [↑](#footnote-ref-13)
14. See for example Keeney, 1992 and Allen, 1976 for descriptions of naturalist practices. One component of our current research project involves documenting the historical evolution of these practices, with a view to establishing parallels with online participatory science projects. [↑](#footnote-ref-14)
15. In this discussion, we will sometimes refer specifically to the *Saga* inquiry. and sometimes to ONEM in general, since *Saga* served as a model for subsequent inquiries. If generalizations are made, the statements apply not only to the particular inquiry, but to all others as well. [↑](#footnote-ref-15)
16. In fact, ONEM asked early contributors what key words had brought them to the *Saga* inquiry, and used this information to improve the referencing to the site. [↑](#footnote-ref-16)
17. http://www.onem-france.org/saga/wakka.php?wiki=LivreArgumentaire  [↑](#footnote-ref-17)
18. See in particular the work of Wilderman et al (2004) or Roth and Lee (2004) in off-line contexts. [↑](#footnote-ref-18)
19. 5 of the top 12 contributors (in terms of number of contributions) made no actual field observations but contributed data from existing sources such as databases or print sources. [↑](#footnote-ref-19)
20. Despite having observers at all times of night, there are no observations after 3 a.m. [↑](#footnote-ref-20)
21. ONEM allows acces to « raw data », i.e. individual observations without the obligation to register or submit a request for access [↑](#footnote-ref-21)
22. The minimal time and effort required for participation in ONEM inquiries makes it simple for people to integrate this activity in their daily lives, but also seems to lead them to underestimate its importance. Occasional contributors often report that they have “nothing interesting to say,” particularly since registering observations on the Website is, for them, secondary to the actual fact of observing the species in question. [↑](#footnote-ref-22)