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Science for everybody? Bridging the socio-economic gap in urban biodiversity monitoring

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Highlights

- Citizen science has the potential to bring societal benefits, but inclusivity is not an automatic outcome.
- The degree of inclusivity varies depending on the techniques used to involve citizens.
- Affective techniques can involve less experienced and less privileged participants.
- Addressing participants as individuals, with different learning abilities and skills, and the collective dynamics of learning are key to increased inclusivity.
- Successful techniques broaden the role of participants, address their concerns and support ownership of the learning process.

Introduction

In addition to scientific outcomes, citizen science often aims to achieve broader societal relevance and benefits, such as science education, empowerment or enhanced environmental citizenship (Edwards et al. in this volume). Citizen science is commonly presented as a way of opening science to everybody. The ECSA Ten Principles of Citizen Science also emphasise inclusiveness and societal benefits. However, the majority of participants

in citizen science are well educated (Haklay in this volume). Many citizen science projects involve, for example, skilled amateur naturalists. Participation may also be biased towards the more affluent or powerful, leaving aside those whose lives could benefit most from the activities (Buytaert et al. 2014). Finding ways of engaging less educated and less privileged participants with less specialist backgrounds is thus an important goal if citizen science genuinely wants to move towards involving everybody.

This chapter explores the capacity of citizen science to foster responsive and inclusive science (see also Smallman in this volume) by drawing on a case study in the city of Grenoble, France. The Propage programme (Fontaine & Renard 2010) is a citizen science project about butterflies. It was implemented in Grenoble to make urban biodiversity more visible and meaningful for those who manage public urban green spaces. An in-depth investigation of motivations for, and modalities of, involvement enabled us to identify the conditions which facilitated the implementation of Propage (Arpin, Mounet & Geoffroy 2015). In 2014, we carried out 20 interviews with volunteer gardeners and their trainers, and observed their training sessions.

Insights from this study demonstrate that citizen science has the potential to provide a forum for social learning and the development of collective capacities among less privileged participants, provided specific conditions are met. Understanding these conditions requires the identification and evaluation of broader transformative outcomes of citizen science, which is often difficult. One reason for this is that the social and cultural benefits may be diverse, discrete and delayed. They are not limited to individual learning outcomes, but include social, cultural and institutional transformations (see Kieslinger et al. in this volume). These transformations are often much harder to document than instrumental outcomes, such as new knowledge and skills (Bela et al. 2016). This chapter starts by briefly discussing what kind of outcomes are relevant when evaluating the potential of citizen science to target groups with less scientific training or fewer skills. We then move to lessons from the implementation of the Propage programme and demonstrate the importance of specific affective techniques in involving participants.

Social learning and transformative outcomes in citizen science

In its simplest form, participants in citizen science are considered as the 'crowd' or mere 'data-drones' (Ellis & Waterton 2004) who have the time,

equipment and skills to provide good-quality data (but see especially Ballard, Phillips & Robinson; Haklay; Mahr et al., all in this volume). Other outcomes, such as learning or empowerment, are not always goals for data-driven projects (see Keislinger et al. in this volume). Instead, learning-oriented projects may aim to improve participants' knowledge or enhance their scientific literacy and skills (e.g., Makuch & Aczel; Harlin et al., both in this volume). A French community biodiversity project, for example, is tellingly named 'ABC' (*Atlas de la Biodiversité Communale*). Socially and politically oriented citizen science projects, in turn, may focus on transforming participants' personal and collective identities and capacities. They aim to change participants' lives and careers, and even promote the knowledge of citizens, seldom taken into account in decision-making.

This multiplicity of participatory imaginations implies that learning may have a different role in different types of citizen science projects. Learning outcomes can also be diverse. In addition to the acquisition of new knowledge and skills, learning can be understood in terms of shared perspectives, clarification of arguments, enhanced dialogue, development of social capital (e.g., trust and partnerships) or adaptive capacities (Buytaert et al. 2014). According to Bull, Petts & Evans (2008) the notion of social learning also broadens understanding of learning processes as a whole. Social learning not only means that individuals adopt new knowledge or skills through social interaction, but also that learners become members of a community of practice who learn to collaborate, reflect on what they are doing and make collective judgements. Outcomes of social learning include understanding motivations for knowledge acquisition and moral development.

From the social learning perspective, the societal relevance of citizen science is linked to its ability to support problem-solving and the generation of actionable knowledge (Franzoni & Sauermann 2014). Collaborative research should generate new knowledge that matters not only scientifically but to all participants. Ideally, it opens up new roles and identities for the participants and even triggers new concerns or questions (Hinchliffe, Levidow & Oreszczyn 2014). Learning to approach problematic situations and the development of collective problem-solving capacities are key elements in evaluating the societal relevance of citizen science. From the social learning perspective, citizen science not only involves a generic crowd, but also deals with the public – citizens who have concerns of their own or adopt an active role concerning their living environments (see, e.g., Marres 2007).

The following section highlights how capacity for social learning can be developed among a less-educated group of citizen scientists (see also

Richter et al. in this volume). In particular, we demonstrate how collective reflection, new roles and identities have been built, and participants' concerns and questions met, in a project that seeks to make biodiversity visible and meaningful for green space workers. We focus on techniques of affecting the participants in ways that enable them to develop individual and collective capacities.

Propage: Biodiversity for green space workers

The city of Grenoble employs some 140 green space workers, predominantly male, of various age groups and with various educational levels. Some qualification is required to work at the city's green space department. Most workers hold a professional certificate (mainly a CAP, *certificat d'aptitude professionnelle*, or BEP, *brevet d'études professionnelles*, less often a *baccalauréat professionnel*), and only few have a higher degree (BTS, *brevet de technicien supérieur*). Eleven informants in our research had a BEP, whereas one had a *baccalauréat professionnel*. They were significantly younger (from 30 to 45 years old) than the green space workers' average.

All the city's green space workers are familiar with cultivated flowers but, until recently, knew little about insects except those well known to be useful (e.g., ladybirds) or harmful (e.g., aphids) to cultivated flowers and plants:

> I remember having bought a booklet during my initial training, which presented the main useful insects, such as ladybirds, hoverflies, green lacewings. So there was already some vague interest in integrated pest management at that time. But we spent 95% of the time learning how to use chemicals and which product to use against harmful insects or fungus diseases rather than when to release ladybirds or green lacewings (green space worker, 45 years old).

Neither biodiversity in general nor butterflies in particular were addressed in the workers' initial training. Their approach to butterflies was restricted to some leaf-eating caterpillars, which they had learned to fight. In 2014, 12 workers agreed to participate in the Propage programme, which aims to collect data about common butterfly species. These are relatively easy to detect and identify, so participation in the project does not require high naturalist skills.

Launched in 2010, Propage is one of the three butterfly monitoring programmes developed by the French National Museum of Natural His-

tory (MNHN). Propage targets the staff of the park and garden departments of cities and transport institutions while the two other projects are aimed at the general public or skilled naturalists. Propage was designed to respond to concerns about the impact of city management practices on biodiversity. The idea was to create a cost-effective and easy way to implement a protocol initially developed by an MNHN PhD student studying butterflies in urban parks and gardens. Propage resulted from close collaboration between the MNHN and an environmental non-governmental organisation (NGO), Noé Conservation. The MNHN is responsible for the data and website management, while Noé trains participants, communicates with them and disseminates written instructions. Before Propage was implemented in Grenoble, the MNHN and Noé made no particular effort to recruit participants as they were encountering serious technical problems with the programme website. At the time, Propage had two main contributors, the city of Nantes and the *département* of Seine-Saint-Denis (Paris), and a set of minor contributors. In Grenoble, the vice-head of the service responsible for the city's park management, David, knew about Propage and informed the MNHN that the city was willing to participate.

Addressing participants' concerns

Like many other cities (see Ernwein 2015 about Geneva), Grenoble had decided some years previously to move from lawn-oriented and pesticide-based management of its parks and gardens to biodiversity-oriented and insect-based management (see Tollis 2012). This shift changed the outlook of urban parks and triggered some criticism among the inhabitants who felt 'abandoned', especially in disadvantaged areas (see also Menozzi 2007). The green space workers, in turn, found that they had to work harder, for instance, to remove weeds by hand, while the result was less satisfactory and socially contested. The workers also suspected that this shift had hidden economic grounds beyond the official ecological reasons. At the time of our survey, the department was indeed being reorganised with a substantial decrease in the number of teams (from 19 to 13). David wanted to demonstrate to his staff that the new management practices did have positive effects on biodiversity. Therefore, contributing to citizen science was not the main objective of encouraging the green space workers to become involved in Propage or the main motivation for workers to participate. Instead, participation in Propage was a means to address David's concerns – showing his staff that the new management practices had positive effects on biodiversity – and the concerns of the workers – how to answer residents' questions and responses.

Affective techniques of educating attention

In the post-pesticide era, the green space workers saw weeds thriving in the city but not necessarily all the life, and in particular, all the insects that were thriving, too. Seeing is neither obvious nor spontaneous (see also Peltola & Tuomisaari 2016) but requires 'education of attention' (Ingold 2001), resting on specific techniques aiming to conduct the conducts of individuals. In Grenoble, several techniques were simultaneously adopted to teach the green space workers to become sensitive to insects in general and butterflies in particular. They were given the leaflets prepared by Noé Conservation explaining the Propage protocol and showing the butterfly species they were expected to recognise (figure 25.1). In addition, they were given nets to catch butterflies. 'Referent' workers for biodiversity were designated among the participants and training sessions were organised.

Training was carried out by staff of local environmental NGOs specialised in entomology and by the local museum of natural history. Before Propage, David had invited an entomologist, Édith, to come to Grenoble once or twice a year to teach the green space workers to detect and identify useful and harmful insects. This proved to be a major factor in the success of Propage. Édith had studied entomology first at university and then in a public research institute. In 1997, she founded a small company to develop integrated pest management in French cities and was later hired by a gardening company. She also writes articles for gardening journals and disseminates information about integrated pest management on the website of her company.

> Basically, my job consists of monitoring urban cultures. I work a bit like a doctor: I go to places, I observe plants and their health and we decide to manage the parks so as to facilitate the arrival of auxiliary insects, or to release insects, or possibly to use chemical treatments, when there is no other option. But I also have a pedagogical approach: I train the staff, which is not so good for my job, because then I don't come so often as they can cope by themselves.

David and Édith had met in the mid-2000s in the glasshouses of a city where she had been called to implement integrated pest management. David invited Édith to audit the gardens and gardening practices in Grenoble, and then to train the staff in integrated pest management. Since 2006, she has facilitated collective outdoor sessions, gradually showing the green space workers how to identify the insects likely to be

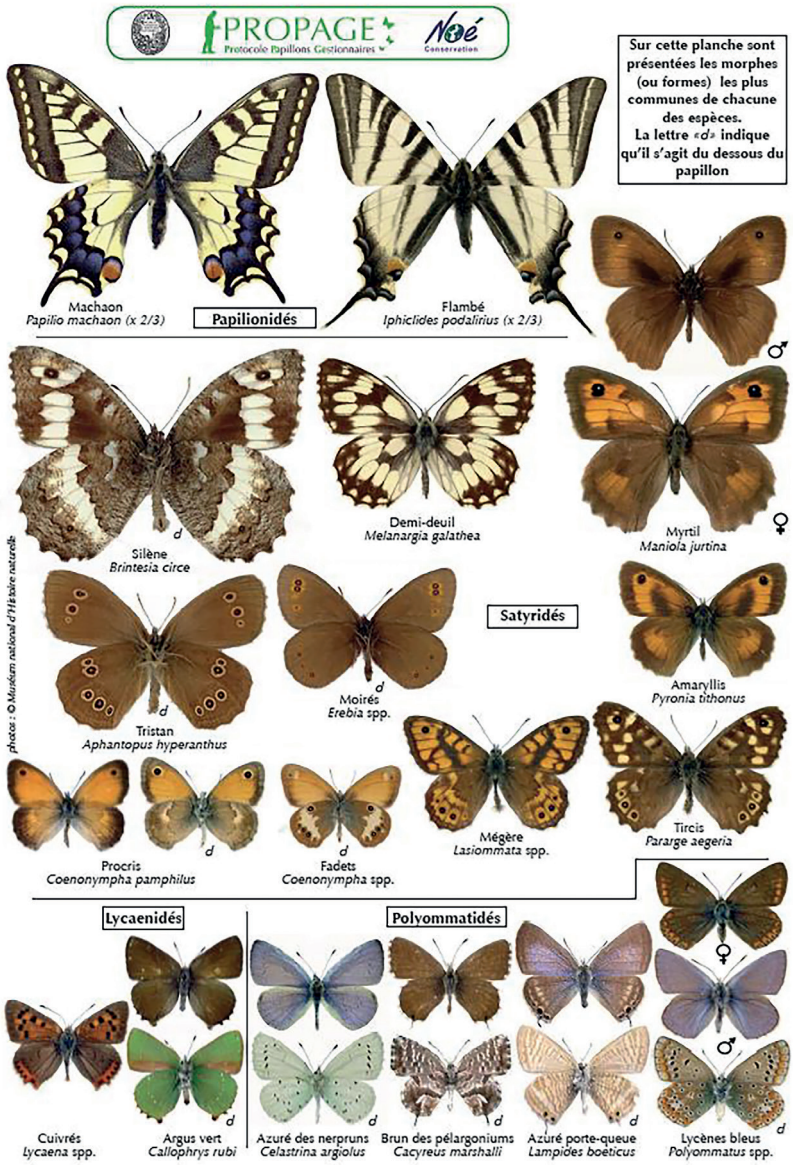

Fig. 25.1 Propage butterfly protocol. Instructions and leaflets were a technique for educating attention, but to become effective, they required other techniques helping the participants attune to insects. (Source: MNHN and Noé Conservation)

found in the parks. This work was ongoing when Propage was implemented in 2014.

David participated in the training sessions whenever he could and the workers could email Édith questions and send her insect photographs. Édith and David's enduring commitment played an important role in establishing trust with the green space workers. During the training sessions, Édith introduced short, varied games and used humour:

> They collect specimens, we usually look at a specimen together, normally I find out quite quickly what it is and then I ask them to identify. I help them to implement an identification method by giving them some clues and advice in a humorous tone. This helps them to memorise. Generally it's quite interactive, we play and have fun. I start with a few jokes and then we have a sort of contest, or a vote, regarding a specimen: who sees legs? Who doesn't?

This quotation demonstrates that educating attention can operate through affects and emotions. The bodily capacities of individuals, including their feelings, become 'object-targets' for action (Anderson 2014). Édith, for example, used humour and playfulness to influence the green space workers' sensitivity to particular elements of their environment. Gamification is a popular technique in citizen science (Bowser, Hansen & Preece 2013; Eveleigh et al. 2013) and is often discussed as a means to motivate citizens who might not be interested in science otherwise. In the current case, games played a crucial role in making the green space workers 'see' and relate to the insects. The playful atmosphere they helped create (see Anderson 2014 for a discussion on affective atmospheres) increased the participants' ability to become attuned to the presence of insects, enabling them to 'think as insects' (see Lorimer 2008).

Another technique facilitating learning was the feedback given to the gardeners. After each session, Édith sent a detailed, positive and reassuring progress report. Her attitude helped the green space workers to overcome their initial anxiety and doubts about their capacity to navigate the huge and creepy world of insects. The reassuring atmosphere was fundamental to the ability of the workers to use the Propage guides and leaflets. They gradually overcame their fear of being unable to identify the butterflies in flight and became more confident in their learning capacities.

Édith also carefully observed the conditions under which the green space workers were willing to learn. For instance, during the first train-

ing sessions, she observed how long the participants would stay indoors listening to theoretical explanations before showing signs of boredom or annoyance. The fact that most training sessions took place outdoors and were collective was very important for their learning. Sharing experiences with colleagues gave the workers a feeling of togetherness and of being on a fairly equal footing.

The green space workers' involvement in Propage was therefore supported by a long phase of collective education of attention using various techniques: humour and playfulness, reassurance, symbolic rewards and training based on long-term relationships with instructors. These techniques targeted creating a learning collective. However, this was complemented by an individualised approach. Distancing themselves from the conception of participants as a crowd, David and Édith paid close attention to the participants as individuals, called them by their first names and expressed genuine interest in them. They also identified a range of attitudes, knowledge and skills among the green space workers. For example, some were good at finding insects and catching butterflies during the training sessions but would not suggest names or respond to questions, while others were eager to offer suggestions and participate actively in the games. One participant, Christophe, had already acquired knowledge of butterflies before Propage started, so he was encouraged to take an active role in the learning process. Some participants were motivated from the beginning of the process, whereas it took some time before others started showing signs of deeper interest. David and Édith were patient and accepted the diversity in the rhythm and extent of the green space workers' involvement. Engaging them in Propage was thus based on seeing them not as a homogenous group of undifferentiated participants but as a complex, dynamic set of individuals endowed with diverse skills and characteristics that could all contribute to the collective learning process, albeit in different ways and at different paces.

Involving the green space workers also required learning by the instructors. David and Édith paid attention to the participants' social characteristics and the influence of these characteristics on the inclusivity of the learning collective. Most of the participants had become leaders in their teams without necessarily holding a high school diploma. The fact that only team leaders volunteered was seen as a potential obstacle to the involvement of workers without any hierarchical position or responsibility. When a female gardener who did not lead a team finally decided to participate, it was hoped that this would convince others that Propage was genuinely accessible to all and encourage them to participate.

Empowering outcomes

The use of computers and simple mobile applications has been presented as an effective means of including groups with limited literacy or numeracy skills in citizen science (Bonney et al. 2014). Our case study offers other possible avenues for encouraging participation from groups with limited skills. Importantly, the techniques of educating attention were linked to the previous knowledge and experiences of the participants, sometimes dating back to their childhood or teenage years. Propage in Grenoble was not only aimed at learning new knowledge about insects, but also involved sharing, dialogue, new partnerships, trust and community building. Participation in the programme also influenced the participants' careers, as they acquired naturalist knowledge to reinforce their professional status and legitimacy. It even had far-reaching consequences on some participants' personal lives. For instance, 45-year-old Christophe, who had become interested in insects and butterflies before Propage started, related this change to his decision to quit smoking and reorient his life:

> After I quit smoking, I had to find something good to do to occupy myself. I felt I had never stopped, never looked up since I started working until I was 40, 41, 42. So at one point, I thought: this must change. I don't know why, perhaps because I quit smoking. So now, as a hobby and passion, I go hiking, I've got my backpack with my cameras. I go out every day after work, two to three hours, and take pictures to identify insects, principally in spring and summer.

Stéphane, 44 years old, began organising open evening sessions in his neighbourhood to show how to tend gardens in a more biodiversity friendly manner:

> I'll try to organize meetings in my neighborhood to show people what I know. Because I have a strong professional background now.
>
> **Q:** Will this be part of your work? Or of an environmental NGO?
>
> **A:** No, just myself. I'll start with neighbors, people I know, and expand gradually. For instance start with a small meeting at somebody's place and explain alternative methods to tend gardens. And gradually people ask questions. I wanted to start last year but I didn't have enough time with small children at home but, yes, I will do it. It's something I want to do. I want to share what I know. I'm really keen on this: changing practices by drawing on my experience and knowledge.

Laurent, 30 years, spent time during his holidays looking for butterflies and teaching his young daughters how to identify them. The Propage project therefore played an unanticipated role in some volunteers' personal lives, families or neighbourhoods, beyond their professional sphere.

Conclusions

Based on a French case study, this chapter outlined some key lessons about the conditions that facilitate the implementation of citizen science. In particular, we focused on the conditions under which citizen science supports more responsive and inclusive forms of learning. The degree of inclusiveness varies according to how citizens are involved in scientific research. Providing participants with well-designed documents, information and appropriate tools were definitely crucial to the success of citizen science. However, other techniques also affected participants' bodily responses and created a positive, reassuring atmosphere for learning, which were crucial for involving less educated and non-specialist participants.

If citizen science projects are to involve not only skilled experts but also wider target groups, it is important that participation is meaningful and adjusted to participants' own interests, histories and ways of thinking and learning. If the sense of meaning is lacking, potential participants may refuse to be involved or withdraw rapidly, leaving only the 'usual-suspects' (see also Jupp 2008). This may also lead to a situation in which transformative outcomes are limited or absent. For example, citizen science may fail to support collective reflection or the development of more versatile roles for participants. Techniques accommodating individual specificities and fostering ownership and responsibility of the process and its outcomes may be more effective in producing transformative outcomes than techniques based on participants' instrumental roles. However, such conclusions have been challenged by previous studies pointing out that also instrumental, data-driven approaches to citizen science can have far-reaching effects in participants' lives (Lawrence 2006). Detailed studies about transformative effects can illuminate how they emerge from various kinds of citizen science initiatives and how they influence participants in different contexts.

Our case study of the Propage project in Grenoble demonstrates the value of such studies. It also appeared that our in-depth interviews with the volunteers helped David, the project's initiator in Grenoble, to discover the far-reaching effects of this citizen science project in the green space workers' professional and personal lives. Our study also enabled him to

reflect on the social learning process and strengthen commitment to the project as a result. The changes triggered by citizen involvement in citizen science projects can remain invisible to the promoters and practitioners of citizen science, even the most considerate and mindful ones. This underlines the potential role of the social sciences in highlighting and reinforcing these changes (see also Mahr et al. in this volume).

Based on our study, the close and continued attention to participants as individuals and to their diverging learning abilities and skills, on the one hand, and attention to the collective dynamics of learning within the group, on the other hand, proved to be key factors for increased inclusiveness. This required instructors to learn about participants' professional and personal trajectories, concerns and motivations, and ways of learning. It also required reflection on how these could support a collective learning process. Similarly, it was important to recognise factors otherwise external to the citizen science project, such as the conditions pre-dating the project and wider social dynamics of participation. In the case of Propage in Grenoble, the long and passionate commitment of a few people was crucial in getting green space workers interested in insects. Where and when this is not the case, developing close personal interactions in the field is likely to be all the more important.

Other factors might also play important roles in different contexts. While it is clear that inclusiveness is not an automatic outcome of citizen science projects, but depends on the techniques and practices of involving participants, studies exploring both successful and unsuccessful examples can further help to understand how openness, inclusiveness and broader diffusion of the benefits and learning outcomes can be fostered within citizen science.

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