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Editorial

The pitfalls and potential of citizen science in ornithology

During the 19th century, North American hunters were used to engage in a tradition known as "Christmas Side Hunt", which meant killing as many birds as they could regardless of the use, distribution or aesthetic value of the species hunted. At that time, conservation was taking its first steps, and there was a growing concern among ornithologists for the short- and long-term consequences of this tradition on bird populations. At the turn of the 20th century, the American ornithologist Frank Chapman, one of the founders of what later became the National Audubon Society, tried to convince hunters and citizens that a different, equally enjoyable way to spend Christmas Day existed and proposed a new version of this holiday tradition, naming it "Christmas Bird Census" (hereafter CBC). The idea was simple: go afield to count birds rather than hunt them. At the first count, 27 observers (mostly ornithologists and enthusiast birders) from 25 places in the United States and Canada participated and counted 18.500 individuals of 90 different species. A hundred years later, in the early 2000s, the count involved over 50.000 people at 1.823 sites in 17 different countries (mostly in the U.S. and Canada), recording almost 55 million birds belonging to 1796 species (National Audubon Society 2001).

This is one of the most emblematic cases of citizen science ante litteram applied to ornithology. Thanks to the enthusiasm of ornithologists at Audubon Society and the commitment of people, the CBC has become more and more popular over time and thousands of people sign up every year. The observations recorded during the CBCs allowed the creation of one of the most comprehensive databases of bird distribution in North America and the data are not exclusively used to study changes in species abundance, but also to investigate, for example, the effects of climate change on migration routes and forecast future scenarios of range shifts. But what exactly is citizen science?

The term "citizen science" (hereafter CS), literally the "science made by citizens", was coined in 1989 and indicates any activity that involves the public in scientific monitoring and research. By bringing together many disciplines and skills, from the general, lay public to nonprofessional researchers, CS has the potential to make a great impact on society as a whole. We all probably agree that scientific research is done primarily by scientists. However, gathering data of sufficient quality and extent is often (if not always) challenging due to logistic and economic constraints. The participation of the community (the main concept behind CS) can overcome many of the limitations that scientists face, since amateurs and, more broadly, citizens can provide valuable help in collecting data on a much larger scale.

Since its official definition, CS has become highly popular and widespread across many countries and is probably experiencing its "golden age" thanks to technological progress and a different relationship between science and community. A bibliometric analysis conducted by Chaubey and Singh in 2021 highlighted a sharp growth of CS-based scientific publications in only five years, from 227 published papers in 2015 to 493 in 2020, led by publications in the research areas of Environmental Sciences & Ecology and Biodiversity & Conservation. On the one hand, the spread of the internet and smartphones has made sharing observations extremely simple and within everyone's reach, even in real time. On the other hand, scientists have realised that communicating results not only within the scientific community but also to a wider audience is important, especially for conservation purposes. Scientists are therefore increasingly relying on the community's help for their research endeavours, which has made people more responsible and aware of their active role in the scientific process. Science is thus not perceived anymore as something exclusively done by scientists, but as an enterprise the entire society can benefit from.

In this regard, we should not forget that many CS projects, before becoming a tool to collect long-term data, were initially conceived with an educational intent. This aspect persists, and CS finds exceptional acceptance among schools that increasingly participate in CS projects. Although not directly connected to ornithology, a brilliant example of such a CS-driven educational program is "School of Ants", a worldwide project to study ants' distribution and diversity mostly targeting teachers and students. The project, joined also by Italian institutions (www.schoolofants.unipr.it/), not only provides material to build ant-catching kits but also organises training courses for teachers. By actively supporting teachers with scientific expertise and materials, scientists make sure that teachers will be able to implement the data collection or any other scientific process accurately. In this way, we are sure that CS can promote the use of novel teaching methods and, more importantly, affirm itself as a promising approach for new learning experiences that can bring future generations closer to scientific research and biodiversity conservation.

It might seem that CS is the solution to many problems without creating new ones. Is this the case? Not necessarily. CS has many inherent shortcomings that any scientist (in our case, any ornithologist) must take into consideration. The participation of the community implies different levels of engagement, from simple crowdsourcing to "extreme citizen science", where people can collaborate on problem definition and data analysis in addition to data collection (Fraisl et al. 2022). Furthermore, projects relying on CS vary widely in their scope, design, and intent, which determine whether data is required to be validated before addressing ecological questions or monitoring biodiversity. This is the case, for example, in unstructured CS projects, which broadly use observations uploaded to CS platforms such as iNaturalist (www.inaturalist.org) or eBird (www.ebird.org) and, thus, do not provide any specific protocol for data collection. Recent research showed that ecological modelling stemming from unstructured CS projects can be strongly biased. Using bird data, authors tested the effect of different parameters, such as abundance, tendency to fly in flocks and flock size, plumage colouration and body size on the reliability of ecological models and found that large-sized birds are overrepresented in this type of CS projects, likely due to their higher detection probability (Callaghan et al. 2021). Nevertheless, rigorous data filtering, for instance, excluding all unreviewed observations, can reduce the limits of observational data from CS and provide output as robust as that obtained with other monitoring tools such as bird ringing (see e.g. Ambrosini et al. 2023). Although caution is warranted when using unstructured occurrence records, datasets from CS can be used in numerous scientific studies. Further, they are also relevant to wildlife managers, as they can help identify important habitats for birds.

In contrast, the reliability of semi-structured and structured projects is high as they are designed to address specific study questions and implement structured protocols to enhance sampling and collect high-quality data a priori, either specifically involving experienced observers (e.g. expert birders) or training citizens through the use of purpose-built guides. National atlas of breeding birds and monitoring programs, also of single target species, lend themselves excellently to (semi-)structured CS projects. For instance, FeederWatch (www.feederwatch.org/) is a structured CS monitoring project where citizens are trained to gather data with high throughput. Supported by the Cornell Lab of Ornithology, the project is a survey of birds regularly visiting feeders or community areas during winter and provides citizens with posters to recognize common feeder birds. Another project is the “Tawny Owl Calling Survey” sponsored by BTO (British Trust for Ornithology), which asked participants to listen to Tawny Owl (*Strix aluco*) hooting (also from their garden, local parks or woodland) and allowed tracking tawny owl distribution over the years in the UK while getting new insights into the conditions affecting detectability and site occupancy (Hanmer et al. 2021). In Italy, the “Atlante degli Uccelli nidificanti in Italia” (Lardelli et al. 2022) coordinated by CISO (Centro Italiano Studi Ornitologici) is the result of a huge, joint effort of ornithologists and nonprofessional birders combining direct field surveys with observations from Ornitho (www.ornitho.it/).

Having reached this point, we would like to open a brief parenthesis. The constant increase in the number and relevancy of CS projects has required the implementation of regulations and ethical standards that scientists and volunteers should be aware of to get it right. Any scientific project should align with FAIR (Findable, Accessible, Interoperable, and Reusable) principles, which support open sciences practices by fully promoting accessibility, reproducibility and transparency of the entire scientific process. As part of the scientific process, activities involving CS should equally embrace the same principles and ensure the availability of data to scientists, managers and policymakers. In other words, no data should be collected to be left in a drawer. In this context, a global community of citizen science practitioners and researchers has formulated the "Ten Principles of Citizen Science" (Robinson et al. 2018), which serve as a unified set of core guidelines for governments, decision-makers, researchers, and project leaders to reference when financing, designing, or evaluating CS initiatives. The issue is complex and many aspects are out of the scope of this editorial. We just wish to highlight that both parties have rights and obligations in gathering and analysing data, and, in some cases, co-authoring research papers. The empowerment of laypersons in knowledge production and sprawling data collection are great achievements of CS programs, but more power means more responsibilities as well.

Finally, CS projects can be part of research aiming to assemble datasets on particular phenotypes such as colour variants (Laitly et al. 2021). This is the case of “Buteo Morph”, a project launched in 2015 (Kappers 2020) to record sightings and classify individuals of different colour morphs of the colour polymorphic Common Buzzard (*Buteo buteo*), to map morph distribution on a large European scale. It is worth stressing that in this type of CS projects, volunteers might not be asked to go to the field at all but look at pictures while sitting comfortably at home. For instance, to assess whether morphs in Tawny Owls have different camouflage advantages under snowy conditions, Koskenpato and colleagues (2020) conducted an online CS experiment where volunteers were asked to spot a grey or a brown tawny owl specimen from pictures taken under different landscape conditions. Another interesting, ongoing project is “Mark my bird” (www.markmybird.org/), where, with the help of volunteers, evolutionary ecologists from the University of Sheffield aim to measure bills from 3D scanned images of museum specimens for all 10.000 extant species of birds to investigate evolutionary rates.

Unfortunately, despite the value of volunteers to research programs and the benefits to society, CS is still largely criticised for its potential lack of scientific soundness. Amongst the most frequently raised criticisms are the variability in participant effort and numbers within and among surveys and the difference in skills and competence among volunteers. Additional concerns about the quality of the data include the lack of randomization in the localities where surveys or counts take place. It is obvious that to favour the participation of the broader community, the design of CS projects is often the result of a trade-off between maximising the output of usable data and minimising the time and effort required of volunteers. Yet, in response to these concerns, many programs have developed novel ways to standardise data collection and make analysis and interpretation of results more reliable (Fraisl et al. 2022). Overall, CS has been proven to be a valuable aid in obtaining constantly updated data, while in the past, survey and monitoring programs were often carried out several years apart for logistic limitations. Similarly, CS can be extremely helpful in creating ambitious datasets that would be impossible by simply relying on scientific personnel.

To summarise, given the increasing interest in citizen science, we believe that projects relying on public participation could offer new opportunities in many areas of ornithology. In the context of large-scale monitoring programs, public engagement can substantially improve the extent of monitored sites contributing to a better picture of species distribution and abundance. Likewise, conservation programs can greatly benefit from CS in a twofold way: identifying new areas important for birds, which is crucial to planning effective conservation actions, and raising awareness among the community through active participation. Therefore, citizen science has the potential to provide exciting groundwork for developing new methods and tools, which can boost all aspects of bird study.

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References

Ambrosini R., Imperio S., Cecere J.G., Andreotti A., [...] & Costanzo A. 2023. Modelling the timing of migration of a partial migrant bird using ringing and observation data: a case study with the Song Thrush in Italy. Movement Ecology 11: 47.

Callaghan C.T., Poore A.G., Hofmann M., Roberts C.J. & Pereira, H.M. 2021. Large-bodied birds are over-represented in unstructured citizen science data. Scientific Reports 11: 19073.

Chaubey A.K. & Singh A. 2021. Analysis of citizen science scientific publications: A scientometric study. Library Philosophy and Practice 1–13.

Fraisl D., Hager G., Bedessem B., Gold M., [...] & Haklay M. 2022. Citizen science in environmental and ecological sciences. Nature Reviews Methods Primers 2: 64.

Hanmer H.J., Boothby C., Toms M.P., Noble D.G. & Balmer D.E. 2021. Large-scale citizen science survey of a common nocturnal raptor: urbanization and weather conditions influence the occupancy and detectability of the Tawny Owl Strix aluco. Bird Study 68: 233–244.

Kappers E.F. 2020. Polymorphic common buzzards in time and space. PhD thesis.

Koskenpato K., Lehikoinen A., Lindstedt C. & Karell P. 2020. Gray plumage color is more cryptic than brown in snowy landscapes in a resident color polymorphic bird. Ecology and Evolution 10: 1751–1761.

Laitly A., Callaghan C.T., Delhey K. & Cornwell W.K. 2021. Is color data from citizen science photographs reliable for biodiversity research? Ecology and Evolution 11: 4071–4083.

Lardelli R., Bogliani G., Brichetti P., Caprio E., [...] & Brambilla M. 2022. Atlante degli uccelli nidificanti in Italia. Edizioni Belvedere, pp. 1–703.

National Audubon Society 2001. The 101st Christmas Bird Count. Available from: https://www.audubon.org/conservation/science/christmas-bird-count/american-birds-annual-summary-christmas-bird-count.

Robinson L.D., Cawthray J.L., West S.E., Bonn A. & Ansine J. 2018. Ten principles of citizen science. In: Citizen science: Innovation in open science, society and policy. UCL Press, pp. 27–40.

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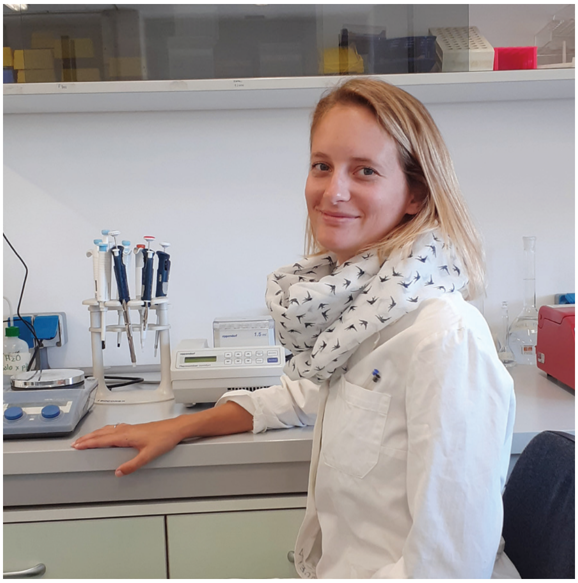

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