



Editorial

Science for the people, of the people and by the people: The potential of citizen science

Ever since language and script evolved, humans have documented their own lives, their business transactions, the lives of animals and of plants, and the movements of the stars. The earliest recorded diary was kept by Merer, who lived at the time of the construction of the Great Pyramid of Giza; Merer writes about the Tura limestone that he loaded on his boat to take down the Nile to the site of pyramid construction. This was nearly 4500 years ago. Before this, and since then, besides written documentation, oral traditions in the form of stories have served to provide a sense of the times, and have given us, our ancestors' descendants, the history of their experimentation with food, medicine, clothing and shelter.

The great tradition of natural history observations came from careful observations of native animals and later exotic creatures that were collected, watched and recorded by the likes of Cuvier, Humboldt, Belt, Wallace and Darwin, and that gave us a profound understanding of what animals did, when they did what they did, and why. Many of these natural historians had personal wealth, rich patrons, or made their living selling their specimens to museums or to private collectors.

Individuals began to sow the seeds of collective science. Hans Christian Cornelius Morgensen, a school teacher in the town of Viborg in Denmark, began the science of studying bird migration by ringing starlings in nest boxes in 1890 (Preuss 2001). Morgensen devised aluminum rings that were numbered. Because this was such a novel exercise, and received newspaper coverage, and because Morgensen was an astute observer of human nature, he introduced random codes into the serial numbers, so that people who wanted to claim that they had caught a ringed bird, when actually they had not, could be easily found out. Thus, he had already established a way to deal with spurious data that all science must guard against. Later with grants from the Carlsberg Foundation, Morgensen was able to expand the ringing operations. Bird ringing has mostly remained a non-governmental and privately funded exercise, and a vast number of volunteers have and are still engaged in this extremely important activity throughout the world. It was by bird ringing that the Indian ornithologist Sálim Ali was able to determine that it was the same grey wagtail from central Asia that visited his garden in Bombay (now Mumbai) every year for five successive years in the winter during the 1940s (Nickell 1968). This provided valuable data not only about individual survival but also about fidelity to migration destinations.

Later the natural history lens was trained on human tribes in Oceania, Amazonia and other areas. It was on Malekula in the New Hebrides (now Vanuatu) that Tom Harrison observed the Big Nambas people as an anthropologist would, and on returning to England in 1935, felt that the same anthropological principles could be applied to observing the 'tribes' of northern England. He homed in onto Bolton, in Lancashire, and named it 'Worktown'. In conjunction with the like-minded Charles Madge, the Mass-Observation project was initiated in 1937 (Hall 2015). Charles Madge was a reporter with the *Daily Mirror* and he was disturbed by 'the largely fabricated and contradictory accounts that appeared in the newspapers, including my own' (Hall 2015). Madge and Harrison decided to team forces to conduct 'Anthropology at Home'.

"How little we know of our next door neighbour and his habits; how little we know of ourselves. Of conditions of life and thought in another class or another district, our ignorance is complete. The anthropology of ourselves is still only a dream. It is left to the intuitions of men of genius to cope with the unknown mass. Such intuitions are to a human science of the future what cookery is to chemistry. The building up of such a science is an urgent problem for mankind".

“It was with thoughts like these that a group of people started Mass Observation, which aims to be a scientific study of human social behaviour, beginning at home. Such a study has already been begun by anthropologists in the case of primitive peoples, and tentatively by psychologists and sociologists in civilised countries. But in the latter case, the field to be covered is so vast and so apparently nebulous that the scientists have little more to offer than generalisations on method” [extract from the original pamphlet on Mass-Observation issued in 1937].

Mass-Observation at Bolton was originally conducted on the quotidian lives of cotton mill workers since the mill dominated the town, and later in 1939, hundreds of people wrote in with their observations from across the country in the form of a daily diary. This continued until the 1960s and serves as a valuable record of the lives, diets and privations of ordinary people during World War II and in the post-war recovery period (Hall 2015). From these accounts, much can be learned, and these diaries which are now housed at the University of Sussex are proving to be valuable research material.

Citizen science was born independently in different continents. There are data from the Regents of New York State on plant phenology between 1826 and 1872 that formed the benchmark for alterations in plant phenology due to climate change when compared with data collected by citizen volunteers between 2009 and 2017 (Battle *et al.* 2022). Watching migratory birds without ringing them was a valuable exercise that was started by Wells Cooke in 1881 in North America; this later evolved into the North American Bird Phenology Program with many volunteers writing in with their observations (<https://www.usgs.gov/centers/eesc/science/north-american-bird-phenology-program>). Such observations are invaluable to assess the impact of climate change on the arrival and departure dates of migratory birds and their populations at breeding and wintering grounds.

Why is citizen science as important or even more important today than it was in the last century? Why cannot science be left solely to the realm of professional scientists?

There is science that must be left to the specialists, e.g., development of the COVID vaccines. But there is science where citizens can contribute greatly to data generation that can then be used by scientists to find important patterns. Examples of these are plentiful and range from epidemiology via citizen surveillance on outbreaks of disease through species distributions to climate change. The mobile phone is a powerful piece of equipment that is available to citizens in most parts of the world; there are currently 8.1 billion mobile phone subscriptions relative to the world population of 7.9 billion people (<https://www.globaldata.com/reports/global-mobile-phones/>). China and India have the most mobile phones, with Africa having an overall usage of mobile phones of about 60% (<https://williamkamkwamba.com/african-countries-mobile-phones/>).

The phone can be used to record the current distribution of species of animals and plants, as well as the flowering and fruiting periods of plants. This is important because under climate change, plants and animals are on the move; plants and animals are breeding at times different from the normal, and are being found in places where they were not recorded before. Such unusual events are important to document and the more mobile phones out there that are documenting these occurrences, the more data for scientists to analyse. Such databases are now being built up throughout the world with the help of citizens (e.g., www.seasonwatch.in; <https://www.citizenscience.gov/natures-notebook/>; <https://www.usanpn.org/nn>). The Cornell Laboratory of Ornithology has developed the Merlin app which allows anyone with a smartphone to identify birds anywhere in the world by sound or sight. The eBird website also provides access to range maps so that sightings of rare or unusual birds that are outside of their range can be reported (<https://ebird.org>). Throughout the world, people are documenting themselves and the world around them and these are forming important social, cultural, scientific archives.

Citizen science has come of age and has evolved a set of 10 guiding principles for its proper implementation (Robinson *et al.* 2018). These are mature principles and include the following: (a) citizen scientists must receive feedback from the project, (b) citizen science is research like any other, with limitations and biases, whose effect on interpretations must be considered, and (c) citizen science project data and metadata must be made publicly available and results must be widely accessible.

Citizen science can contribute to the discovery of new species as happened for a blind, aquifer-dwelling catfish in the state of Kerala in southern India. *Horaglanis populi* was named after the people of Kerala who helped professional scientists make this discovery (Raghavan *et al.* 2023).

Clearly there is much to be gained from the encouragement of citizen science, and with ever evolving technologies for time- and location-data stamping, uploading sounds, spectra and images as well as data curation, citizen scientists can make real-time contributions in many fields.

References

- Battle KF, Duhon A, Vispo CR, *et al.* 2022 Citizen science across two centuries reveals phenological change among plant species and functional groups in the Northeastern US. *J. Ecol.* **110** 1757–1774
- Hall D 2015 *Work Town. The astonishing story of the 1930s project that launched Mass-Observation* (London: Orion Publishing)
- Nickell WP 1968 Return of northern migrants to tropical winter quarters and banded birds recovered in the United States. *Bird-Banding* **39** 107–116
- Preuss NO 2001 Hans Christian Cornelius Mortensen: Aspects of his life and of the history of bird ringing. *Ardea* **89** 1–6
- Raghavan R, Sundar RL, Arjun CP, *et al.* 2023 Evolution in the dark: Unexpected genetic diversity and morphological stasis in the blind, aquifer-dwelling catfish *Horaglanis*. *Vert. Zool.* **73** 57–74
- Robinson LD, Cawthray JL, West SE, *et al.* 2018 Ten principles of citizen science; in *Citizen science: Innovation in open science, society and policy* (Eds.) S Hecker, M Hacklay, A Bowser, *et al.* (UCL Press, London) pp. 27–40

RENEE M BORGES
Editor-in-Chief, Journal of Biosciences,
Centre for Ecological Sciences,
Indian Institute of Science,
Bengaluru 560012,
India
(Email: renee@iisc.ac.in)