Citizen Science: A New Approach Towards Monitoring National and International Biodiversity

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Abstract

In 2020, the World Health Organization (WHO) declared the outbreak of the novel coronavirus disease COVID-19 a public health emergency of international concern. The emergence of COVID-19 has shown that when we destroy biodiversity, we destroy the system that supports human life. The more biologically diverse an ecosystem is, the more difficult it is for a pathogen to quickly spread or dominate. Loss of biodiversity provides opportunities for pathogens to cross between animals and humans. We need to learn and adapt faster than ever, and the COVID 19 virus has lessons that apply to the global crisis of biodiversity loss. For this reason, our best vaccine for the future is to protect nature and biodiversity. It is no longer just about ecology, but about knowing that if we want to limit the occurrence of pandemics, we must have a healthy nature. The legal status of wildlife was not recognized in a single day, but it took many years of history to gain global support through political, social and scientific. It is necessary to know the current scenario of wildlife conservation and protection at the national and international levels. Protecting wildlife and natural habitats is increasingly important in the 21st century. Destruction and loss of natural habitats, illegal exploitation of wildlife, over exploitation of resources and lack of conservation awareness have a negative impact on biodiversity and ecosystems. To meet collective commitments to protect and monitor biodiversity, it is essential that the world's governments and NGOs, as well as the research community, use all possible sources of data and information, including new, rapidly growing sources such as Citizen Science (CS), in which volunteers participate in some or all aspects of the environmental assessment. They use the Essential Biodiversity Variable framework to describe the range of biodiversity data needed to monitor progress towards global biodiversity goals and to assess strengths and gaps in geographic and taxonomic coverage. In particular, Citizen Science data provides extensive data on species distribution and population abundance, species characteristics such as phenology, and ecosystem function variables such as primary and secondary productivity. Most Citizen Science programs are located in Europe, North America, South Africa, India and Australia. Successful Citizen Science programs would facilitate the scaling up of current efforts, strengths in data coverage could be better utilized, and strategies that could maximize synergies for biodiversity monitoring. This paper explores the origins of Citizen Science and its evolution over time and also looks at the current scenario and future challenges and opportunities for Citizen Science.

*Keywords:*citizen science, biodiversity, nature conservation, nature conservation.

Introduction:

Citizen science is an important tool for democratizing science and promoting the goal of universal and fair access to scientific data and information. While the benefits of civic engagement and the contribution of citizen science (CS) to societal goals such as environmental justice are widely recognized. Global biodiversity monitoring is urgently needed worldwide to assess the impacts of environmental change on biodiversity. One way to increase monitoring is through citizen science.

"Citizen science" is the term we use in this chapter to describe a variety of approaches that involve people voluntarily in monitoring, including participatory monitoring where people work together to develop the monitoring. There is great unrealized potential for citizen science, especially in Asia and Africa. However, to fulfil this potential, citizen science will need to meet the local needs of participants, communities and decision-makers, including people's own use of data and their motivation to participate and support global biodiversity monitoring needs, including the United Nations Sustainable Development Goals and biodiversity targets. Activities should be feasible and useful. In the present research the author covered various examples from around the world to demonstrate how monitoring can engage different types of participants through different technologies to record different variables according to different sampling approaches. Taken together, these examples show how citizen science has the potential to provide a step-change in our ability to monitor biodiversity and therefore respond to threats at all scales, from the local to the global.

WHAT IS CITIZEN SCIENCE?

Citizen science is an increasingly popular approach to conducting monitoring and scientific research. Citizen science is defined as the involvement of volunteers in science, so it has the dual benefit of contributing to "real" science while also involving many people in science. Citizen science projects are often set up by "professional" scientists. Volunteers then contribute data to the project. Such an approach is called "contributory citizen science" and is now very widely accepted. However, there are many different types of citizen science, including projects strongly shaped by voluntary participants, so-called collaborative and co-created projects. For projects involving environmental monitoring where the end use of the data is clear, the citizen science contribution model is usually the most relevant and globally accepted. Citizen science is a collaboration between scientists and people (volunteers) who are just curious or interested and motivated to make a difference. People collect data by taking pictures of clouds or watercourses, documenting changes in nature, using smartphone sensors to help scientists monitor water and air quality, or playing games to help accelerate health and medical research. A citizen science project can involve one person or millions of people working together toward a common goal. The public is usually involved in data collection, analysis or reporting.

Features of citizen science

a) anyone can participate,
b) participants use the same protocol so that data can be combined and of high quality,
c) data can help real scientists reach real conclusions a
d) a broad community of scientists and volunteers collaborated and shared data accessible to both the public and scientists.

The fields that citizen science develops are diverse: ecology, astronomy, medicine, computer science, statistics, psychology, genetics, engineering and many others. The massive collaboration that can occur through citizen science enables investigations on a continental and global scale, leading for decades to discoveries that a single scientist could never achieve alone. "Community science", "Amateur science", "crowdsourced science", "voluntary monitoring" and "public participation in scientific research" are also common monikers for citizen science.

Who can be a citizen scientist?

Citizen scientists are usually not professional scientists. Rather, they are curious or concerned people who collaborate with professional scientists in a way that advances scientific research on topics of interest to them. Today, citizen scientists come from all walks of life, including retirees who seek to connect socially with others and apply their seasoned knowledge and experience in ways that help others; online gamers who lend their skills to specially designed programs for analysing folding protein structures and shaping the building blocks of life; educators and students who want more hands-on experience outside the classroom; environmental justice advocates who want to see critical data with their own eyes.

Citizen Science as A Monitoring Tool

Monitoring to assess spatial and temporal trends in biodiversity is increasingly important as human populations and resource use expand. Most monitoring is done by government agencies charged with managing natural resources and non-governmental organizations (NGOs) with a mission to protect biodiversity. Citizen Science is a place

through which volunteers participate in research, often through data collection at different temporal and spatial scales. Citizen Science operates on the principle that nature lovers of all ages and skill levels can make meaningful and reliable contributions. Citizen Science can be structured to cover a range of non-competing goals, from informal public education to hypothesis-driven research.

As a tool for collecting data on biodiversity, Citizen Science is a particularly effective way of monitoring at broad geographic and temporal scales. Using Citizen Science to monitor biodiversity holds the potential to change public attitudes towards science, the environment and conservation, as active participation in monitoring is an informal learning experience. Citizen Science enables the integration of monitoring into hypothesis-driven research, promoting an understanding and appreciation of the scientific method and the nature of scientific inquiry.

Although there are many organizations running Citizen Science projects, here we list a few organizations, each running several Citizen Science projects. Like the CLO, Bird Studies Canada and the British Trust for Ornithology run many bird-related Citizen Science projects. Nature Watch is a collaboration between Nature Canada, the University of Guelph and Environment Canada's Ecological Monitoring and Assessment Network. Nature Watch has volunteer monitoring networks for amphibians (FrogWatch) to support awareness of soil ecology (WormWatch) and phenological projects related to climate change (PlantWatch and IceWatch). Journey North focuses on engaging students in tracking the migration and phenology of wildlife across a range of taxonomic groups. Monarch Watch is a gateway to several different types of monarch butterfly monitoring projects.

Citizen Science plays a vital role in monitoring biodiversity. However, it has been challenging for scientists to communicate with citizens involved in biodiversity monitoring during the COVID-19 pandemic. In such circumstances, digital technology has served as a tool for monitoring biodiversity through citizen-scientist collaboration. Trained volunteers shared ecological data, photographs and videos of species and disruptions in ecosystems due to anthropological activities through various digital platforms such as email, WhatsApp, Facebook, Twitter and dedicated mobile applications. The Wildlife Institute of India has taken the initiative by launching an Android application 'Ganga Data Collector' and Facebook pages 'Glimpses of Ganga' and 'Ganga Rejuvenation' under the project 'Biodiversity Conservation and Ganga Rejuvenation' to monitor the biodiversity of the Ganges River involving a local community known as "Guardians of the Ganga" or "Ganga Prahari". These trained volunteers shared photos and videos of recorded species, their mortality and rescue operations, along with data on water quality and prohibited activities such as illegal fishing and habitat degradation due to pollution and mining.

Sustainable Development Goals and Citizen Science

The UN's 17 Sustainable Development Goals (SDGs, thereafter Goals) aim to achieve peace and prosperity for people and the planet, were adopted by all UN member states in 2015. All Goals and their 169 targets are expected to be achieved in 2030. In order to monitor progress towards the goals, their respective targets are measured by using 231 indicators. The indicators are planned to be collected and shared annually, at global, regional and national levels. Those indicators are set by the Inter-agency and Expert Group on SDG indicators to update each target's implementation progress.

Citizen Science For Freshwater Biodiversity Monitoring

Biodiversity and water quality monitoring are important aspects of ecosystem health assessment and measuring change in Essential Biodiversity Variables. With exponential anthropogenic population growth, increasing demand for water resources, especially rivers for irrigation, hydro-power generation, urbanization, and industrialization has led to various forms of habitat degradation and hydrological alteration. These detrimental changes are affecting freshwater biodiversity. Therefore, effective action is needed to measure change in freshwater biodiversity. Various approaches have been suggested for global biodiversity monitoring, one of which is through a complementary mode of Citizen Science.

Monitoring Fish Diversity Of The Ganga River Through Digital Technology

Fish are the most diverse group of vertebrates. Fish can be used as an indicator of aquatic ecosystem

health and development of environmental policy. Fish are potentially most impacted by anthropogenic stressors, which can have a direct influence on the food resources, distribution, diversity, and biological behavior of both resident and migratory species. Major threats to freshwater fish diversity are habitat alteration and destruction, pollution, invasive species and exploitation. The Ganges basin is the largest river basin in India in terms of the catchment area, which drains an area of approximately 1,087,300 km2 in India and Nepal, constituting 20% of the country's land mass and supporting about 43% of its population. The basin covers 11 states, namely, Uttarakhand, Uttar Pradesh, Madhya Pradesh, Rajasthan, Haryana, Himanchal Pradesh, Chhattisgarh, Jharkhand, Bihar, West Bengal, and Delhi. The National Mission for Clean Ganga (NMCG), launched by the Department of Water Resources, River Development and Ganga Rejuvenation, under the Ministry of Jal Shakti, the Government of India has implemented the project "Biodiversity Conservation and Ganga Rejuvenation" with the Wildlife Institute of India. One of the main objectives of the project is long-term monitoring of the biodiversity including the fishes involving the local community of 11 Ganga states known as "Guardians of the Ganga" or "Ganga Prahari".

Using Citizen Science To Monitor Illegal Wildlife Trade In The Himalayas

According to UNEP, Indian wildlife species and products commonly smuggled out include tiger and leopard skins, their bones and other body parts, rhino horn and ivory. Also smuggled are turtles and tortoises, seahorses, snake venom, mango fur, snakeskin, Tokai gecko, sea cucumber, chiru fleece, musk pods, bear bile, medicinal plants, sandstone wood, and caged birds such as parakeets and mynas. The World Wildlife Crime Report 2020 found that, along with endangering endangered species, crime and wildlife exploitation can promote climate change and also negatively impact public health through the transmission of zoonotic diseases.

A new report on citizen apps says better data will help identify complicit communities and links to illicit trade. For the application to be viable, data collection must be multilingual, adapt to different business structures across communities, and be relevant to different ecological biomes. He points out that India also has several citizen science initiatives. For example, the mid-winter waterfowl census was a kind of national citizen science estimate, but it was coordinated by a few people on the ground with the help of a larger group of people.

Conclusion

Global biodiversity monitoring is urgently needed worldwide to assess the impacts of environmental change on biodiversity. One way to increase monitoring is through citizen science There are reported cases of successful biodiversity monitoring through Citizen Science. The involvement of local citizens is therefore essential for the success of biodiversity monitoring through established links between citizens and scientists. The technology may be a better choice for biodiversity monitoring through CS. However, internet connectivity, electricity, access to smartphones and laptops, and limited numbers of participants in remote, poverty-driven areas are challenges that affect digital training. Conducting training through digital platforms also has some disadvantages, especially when handling sophisticated instruments such as multi-parameter water quality meters. Although hands-on training is more important for handling the tools, sharing photos with experts via email or WhatsApp or specialized apps can largely resolve taxonomic ambiguity.

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