Introduction

Citizen scientists supporting environmental research priorities

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Citizen science is the generation of new information from the participation of “non-scientists” in traditional scientific activities. Research activities in geoscience, ecology, atmospheric science and physics have benefited from the participation of non-professional volunteers, who collect samples, make observations, classify data and/or share their computation capacity. In environmental sciences, the contribution of citizen scientists ranges from web-based participation in processing and classifying images to full-scale fieldwork. Given the growing significance of citizen scientists' participation in the production of scientific knowledge, it is important for scientists to better understand the advantages and challenges involved in applying this approach.

People have modified the environment the world over, which has generally led to its degradation. Therefore ecosystem monitoring and management is clearly important to sustaining environmental function in the face of increasing impacts from human activity. Nowhere is this perhaps more important than in freshwater ecosystems, whose primary importance for human populations, biodiversity and climate regulation makes them a top priority for national and international agencies, as well as local communities that benefit from the services they provide. The professional scientific community should play a central role in guiding these local communities towards a constructive participation in the generation of scientific knowledge and the contribution to environmental monitoring.

Recent citizen science projects have shown that productive partnerships between scientists and the public can be formed. The increase in spatial and temporal resolution of environmental information made possible by citizen science can provide a complementary data source for research and agency monitoring. The FreshWater Watch programme was created to provide citizen-science generated data on the health and extent of freshwater ecosystems in large number of major urban centres. As a global programme, it is focused on a comparative analysis of freshwater ecosystems under varying degrees and types of anthropogenic pressure. At the local level, specific studies are assessing the impacts of combined sewer overflows, urbanisation, modified agricultural practises, river restoration, extreme climate events and alternative catchment management practises on freshwater ecosystems. The advantages of a common platform to address this range of research objectives are related to the comparability of the data, as the measurements are made using the same methods and following a common training programme. Other advantages include quality control, as measurements are made under a wide range of conditions and using a consistent platform for communication, feedback and engagement with participants. Having data on a common geographic database also allows for a wider and shared participation. The programme has created an international community of citizen scientists and professional scientists that share experiences and ideas across language and cultural confines.

FreshWater Watch programme participants come from corporations, local wildlife and river trusts/associations, educational institutions, environmental NGOs and local communities. All participants are trained following a common approach focused on providing a clear understanding of the need for volunteer involvement and the value of the data acquired. Training in data acquisition is performed by professional scientists in field-based training days or using online training tools, with passing an online training quiz necessary before being able to upload data.

Scientific partners come from research institutes, environmental NGOs as well as national and regional government agencies. Each local FreshWater Watch programme supports the partner's objectives by increasing the spatial and temporal coverage of data acquisition. Additional parameters, appropriate for trained non-scientists, are added locally to the global methods in relation to local objectives. These include microbiological sampling, sensor based measurements of conductivity, pH, temperature, flowrate, dissolved oxygen, observational data related to ecosystem (wetland) extension, local meteorology, local agricultural practises, litter presence and typology.

The present special edition brings together results from projects in ten major population centres. The studies show the advantages as well as the shortcomings of activating citizen scientists to support freshwater ecosystem research and monitoring. Local research objectives range from exploring the impact of massive urbanisation in the Huangpu river basin in Shanghai (Zhang et al. this issue) to searching for un-impacted freshwater habitats in the Greater London (Williams et al. this issue). Several contributions explore the drivers to ecosystem degradation in major cities in Asia (Thornhill et al. this issue) and North America (Shupe et al., Scott et al., Farnham et al. this issue). The dynamics of anthropogenic litter (Neville et al., Lévesque et al., this issue) and harmful algal blooms (Cunha et al., Li et al. this issue) in Canada, China and Brazil show that both catchment scale and local scale information gathered by citizen scientists can help explain geographic as well as temporal dynamics. Finally, there is a consideration in each of these analyses of the limits of citizen science and the necessity of sustained participant activity. This special edition is the first to address this important new tool in the study of freshwater environments across such a wide geographic and cultural scale.