Successfully Implementing a Citizen-Scientist Approach to Insect Monitoring in a Resource-poor Country

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The involvement of citizen scientists—volunteers who do not necessarily have a science background—in ecological projects has been hugely successful in highly developed countries. These projects are ideal for gathering data that would be too expensive or time consuming to collect relying solely on paid expert personnel (Cohn 2008). Projects involving volunteers have, for example, led to valuable bird and butterfly atlases. These projects are not just about the data: a key aim is raising the participants' awareness about the science behind the projects. These projects combine research and outreach, which can improve understanding of biodiversity while simultaneously raising awareness about the threats to it. Because of its synergies, this approach promises benefits that go beyond what specialized projects can achieve. Most important, volunteers and scientists are truly interacting, whereas in traditional science outreach, citizens remain on the receiving end of the information flow.

Although the citizen science approach has been successfully implemented in highly developed countries such as the United States—where numerous ecological projects involve volunteers (Cohn 2008)—the same approach faces hurdles in less-well-resourced countries, which often make citizen participation seem unviable. This is alarming: many resource-poor countries have a rich but poorly known biodiversity, as well as low public awareness of biodiversity. But the benefits of citizen science projects can be realized in relatively resource-poor countries, where such an approach may offer an opportunity to integrate biodiversity monitoring with education.

Special challenges for resource-poor countries

The importance of biodiversity is widely recognized. For example, 191 nations are parties to the Convention on Biological Diversity, an international treaty that aims to sustain the diversity of life on Earth. Two key objectives of the convention are "identification and monitoring" and "public education and awareness" (articles 7 and 13). Resource-poor signatory countries face many difficulties in implementing these objectives, because doing so requires both money and a highly skilled workforce. In resource-poor countries, monitoring or science education programs have to compete with other priorities for scarce resources. Furthermore, the invertebrate biodiversity of these countries is often especially poorly known, making the effort needed to monitor it even greater. At the same time, these countries need to educate a largely poor population—whose main priority is meeting the basic requirements for existence—using an education system that is often already overstretched and underresourced. In this context, a citizen science approach can work if it can bring about synergies that reduce the overall need for resources. A number of challenges must be overcome, however.

Volunteers in citizen science programs often need to provide considerable resources of their own. For example, bird atlas projects often require expensive equipment such as binoculars and GPS (global positioning system) recorders. Furthermore, volunteers must often upload records through the Internet. Therefore, in poorer countries, it has typically been only the better-off and already more environmentally aware citizens who have participated. In particular, the rural poor are excluded, or are reached only by separate traditional outreach activities.

In resource-poor countries, governmental organizations often focus on monitoring, whereas nongovernmental organizations focus on education. This division of tasks misses many opportunities. When monitoring, a volunteer gains an appreciation of biodiversity and the functioning of ecosystems that cannot be achieved with a pamphlet-based approach. In the current situation, many potential volunteers with valuable local knowledge are unlikely to become involved in survey work. In some projects in developing countries, local people have been employed as parataxonomists. These nonvolunteer projects typically involve only a few people. Yet large-scale education about biodiversity becomes ever more important as the populace in developing countries increasingly loses contact with its natural environments. Many inhabitants of rural areas migrate to urban centers, and even within rural areas, small, urbanized communities form. In this way much indigenous biodiversity knowledge is lost, as those leaving nature behind are also unlikely to be reached by biodiversity outreach programs. A public that lacks familiarity with biodiversity can hardly be expected to bring about policy changes needed to protect biodiversity.

The Iimbovane Outreach Project: The schools approach

The Iimbovane Outreach Project (*http://academic.sun.ac.za/Iimbovane*), currently

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implemented by the DST-NRF Centre of Excellence for Invasion Biology in South Africa, shows how biodiversity monitoring and education can be combined in one program. This program, which I studied during its first three years while it was partly funded by the United Kingdom's Darwin Initiative, is designed to allow its integration into the school curriculum for grade 10 in the Western Cape Province.

Iimbovane means "ants" in the local isiXhosa language, and indeed ants are at the center of the project. Ants play a central role as seed dispersers in the ecosystems of the Cape Floristic Region (Johnson 1992), where most of the participating schools are located. Thus, information on ant diversity and its change over time is of broad significance. The project provides spatially explicit, temporally replicated, relatively broadscale information on ant distribution. Such information on invertebrates is generally rare in poorer countries, including South Africa. The project uses pitfall traps—small, plastic beakers inserted flush into the ground—to capture ground-dwelling insects such as ants that fall into the beakers, which are partially filled with a catching fluid. Pitfall trapping provides scientifically valid data using mainly inexpensive equipment, a key requirement for a large-scale project in a resource-poor country.

Ants are easy to survey, even for 15-year-old scholars. Students collect pitfall traps and conduct simple vegetation structure surveys in disturbed sites close to their schools. Scientific staff process and identify the samples to guarantee the validity of the data. Schools are provided with image-based keys, ant reference collections, and at least one microscope for students to try their hand at ant identification. Throughout the year, scientific staff visit schools for lessons on biodiversity, where scholars also get to use their data, and those from nearby pristine sites surveyed by project staff, to answer basic environmental questions. In these lessons, scholars compute simple diversity indexes and learn to draw and interpret graphs. For most scholars and teachers, such activities would usually be very challenging. However, the activities furnish students with transferable skills, in keeping with the more skills- and outcomes-based approach of the new South African national curriculum, which explicitly calls for scholars to "demonstrate an understanding of the nature of science" (Department of Education 2003). All activities take place within the curriculum and thus are not an additional burden.

What has been achieved?

The Iimbovane project has been hugely successful: So far, more than 30 teachers have been trained, and more than 3000 students from 13 high schools have participated. Furthermore, at the request of educational authorities, the project has also trained curriculum advisers and participated in general biodiversity training for biology teachers. A teaching manual is currently in press to allow all interested schools in the region to implement the project in an adapted form. Iimbovane targets young people from communities that are not traditionally reached by science outreach or biodiversity-related volunteering programs, and empowers teachers to teach the novel subject of biodiversity. Iimbovane raises students' awareness of the natural environment while also giving them opportunities to learn about career possibilities. Scholars can then function as conduits of knowledge in their communities and reach additional people through this route.

On the scientific side, the project provides data twice a year on 33 ant assemblages, including assemblages in two biomes of global significance: the fynbos and the succulent karoo (Mittermeier et al. 2004). The data are being used to address several ecological questions—for example, whether the exceptional diversity of plants in the Cape Floristic Region is reflected in ants.

Iimbovane uses the existing infrastructure of the state education system in rural areas and urban townships to successfully bring the benefits of a citizen-science approach to sectors of society that usually would be unlikely to participate in biodiversity monitoring. In this way it allows citizens to be involved in research in a country where such opportunities are otherwise rare. At the same time, Iimbovane is helping the country fulfill its monitoring and education obligations under the Convention on Biological Diversity. Iimbovane ought to inspire others to develop similarly imaginative approaches.

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