Linking 'citizen scientists' to professionals in ecological research, examples from Namibia and South Africa

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SUMMARY

The use of trained members of the public ('citizen scientists') to help monitor and collect data in science-driven environmental research projects is not a new concept e.g. the Cornell bird program, USA, has been 'partnering' with the public since the 1960s (University of Cornell 2008). However, this concept has yet to find much following in developing countries where often the greatest need for conservation lies. We examine the effectiveness of citizen scientists ('plant custodians', 'paraecologists' and 'eco-club volunteers') in monitoring (e.g. species rediscovery, red list classification, range extension) and how it integrates with ecological research (e.g. ethnobotany, livestock census), citing examples from three biodiversity hotspots in Southern Africa (Namibia and South Africa).

Information collected by custodians has helped to prioritise plant species that are in need of conservation attention. Paraecologists have played a key role in supporting the fieldwork of researchers. Various eco-club activities have been undertaken with schools, and a network of eco-club volunteers has been developed.

BACKGROUND

Environmental change and anthropogenic activities threaten biodiversity and compromise essential ecosystem services from local to regional and global scales (Andelman & Willig 2004). These changes have meant that the geographic extent and time scales of ecological research are now necessarily expanding (NAS 2003, Jürgens 2007).

Obtaining ecological data for scientifically sound analysis may involve intensive work, requiring availability of relevant data across spatial levels and time scales. This is a real challenge, particularly in less affluent areas of the world, like Africa, which are often home to a rich biodiversity, but are densely populated and most threatened (Myers *et al.* 2000, Pautasso 2007). Hence, the need to find most efficient and effective ways to obtain the scientific knowledge required to understand them and to deal with them wisely (NAS 2003). One solution is to encourage more 'citizen scientists' to help researchers with their work, such as collecting valuable field data.

What are citizen scientists? Citizen scientists, in the sense broadly used, refer to lay people normally resident in the vicinity of research sites, have received no formal academic training in the discipline concerned but are trained on the job. They conduct monitoring and transfer collected data to managing scientists. In many cases, they get involved on a voluntary basis, but in some cases they could also be remunerated. Some examples of citizen scientist projects in the world are: bird counting by the Audubon Society (Audubon Society 2008) and Cornell Laboratory of Ornithology (University of

Cornell 2008) in the USA, the 'Big Garden Birdwatch' of the Royal Society for Protection of Birds, UK (RSPB 2008); water quality by World Water Monitoring Day project, USA and global (Araya & Moyer 2006); insects by parataxonomists in Costa Rica and Papua New Guinea (Janzen 2004, Parataxonomist Training Centre 2008); wild flowers by custodians and eco-club members in South Africa (Raimondo 2004, Von Witt 2006); generalist monitoring by paraecologists, *i.e.* on the job trained ecologists, in Namibia and South Africa (Schmiedel 2006).

Overall the participation of citizen scientists in biodiversity monitoring approaches is important for two main reasons. Foremost, it often allows scientists to accomplish research objectives more feasibly i.e. in terms of labour and time cost, than would otherwise be possible. In addition, citizen science projects promote public engagement with the particular research, as well as with science in general. This in turn will help raise awareness regarding environmental problems and issues.

In this paper we show the role of two citizen scientist programmes (the Custodians of Rare and Endangered Wildflowers programme and the Paraecologists programme) in biodiversity monitoring and research, in a Southern African context at three biodiversity hotspots (Myers *et al*. 2000), namely the Succulent Karoo of Namibia and South Africa, and the Cape Floristic Region and the Maputaland-Pondoland-Albany Region of South Africa.

ACTION

The Custodians of Rare and Endangered Wildflowers programme: The Custodians of Rare and Endangered Wildflowers (CREW) programme runs a network of custodians and eco-club volunteers in South Africa. CREW was established in 2003 to help in the conservation of threatened plants and habitats in the Cape Floristic Region, having since expanded throughout South Africa - including Succulent Karoo and Maputaland-Pondoland-Albany biodiversity hotspots (Fig. 1). It works to achieve this by involving local plant enthusiasts in sampling priority areas, monitoring threatened plants and supporting the community to develop conservation livelihoods. CREW is composed of four professionally guided coordinating units which are largely supported by members of the public (custodians) who volunteer to undergo training on plant identification and then collect much-needed data on rare and endangered plants in their local areas. In addition custodians often assist with communication between researchers and landowners as well as assisting in the implementation of public educational activities. Continually, CREW runs three to four plant identification courses per year to top up custodian's skills. Presently, there are 23 teams nationwide (each team containing up to 10 active members) representing a range of socio-economic backgrounds: from students, unemployed persons living in an informal settlement to working and retired professionals.

Paraecologist programme: The paraecologist programme in Southern Africa was established in 2004, and is run under Biodiversity monitoring Transect Analysis (BIOTA-Africa), an interdisciplinary, international biodiversity research and monitoring programme that investigates the changes in biodiversity that occur due to climate change and human land use (BIOTA AFRICA 2008, Krug *et al*. 2006). A paraecologist in this context is typically a member of local land user communities in the vicinity of research sites, usually have received no tertiary education; often they come from historically disadvantaged social groups and are usually aged between 20 to 45 years old. Paraecologists operate along a 2,500 km transect passing through Namibia and South Africa (within the BIOTA-South network; Fig.1). This transect crosses the Succulent Karoo biodiversity hotspot.

The role of the paraecologists is to support the research activities of scientists in the field, both during their presence and absence. Paraecologists work independently, but periodically they are supervised and mentored by BIOTA or associated colleague researchers (who could be based in Namibia, South Africa or even Germany). In addition to learning with experts in the field, paraecologist training is further consolidated through annually conducted training workshops lasting 2-3 weeks. As of 2008, BIOTA South employs eight paraecologists operating across eight sites.

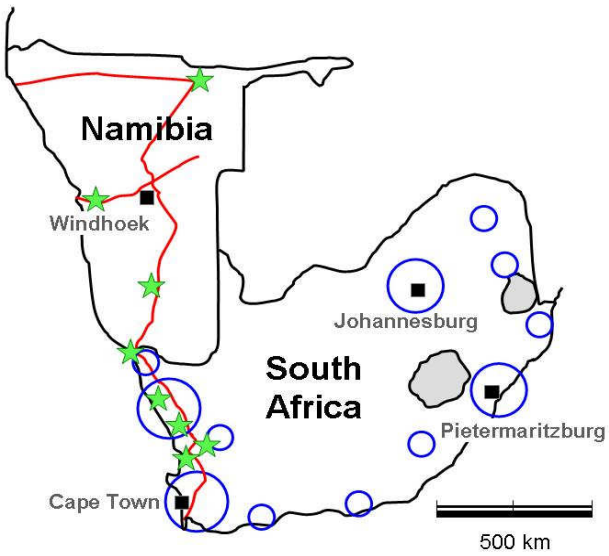

Figure 1. Location of custodians (circle) and paraecologist (star) operation areas. BIOTA South transect is indicated by the red line.

CONSEQUENCES

Valuable support to biodiversity research: Information collected by custodians (Fig. 2) has helped to prioritise species that are in need of conservation attention by playing a vital role in the determination of a species red list status. Custodians have played key roles in extending the known range, in identification and in rediscovery of species, particularly those that have not been seen in the wild for decades (Tables 1 and 2). One such example is that of the flower *Wurmbea capensis*, rediscovered in 2004, having previously been collected only in 1932. As of 2007 there are 12 such 'rediscovered' species. Often, findings have also led to new research, for example, field observation of populations of the very rare terrestrial orchid *Corycium microglossum*, has led to investigations regarding the survival of its pollinators.

Figure 2. Custodians of Rare and Endangered Wildflowers (CREW) searching for plant species, South Africa.

Table 1. Summary table on important plant species findings by custodians (2003-2007).

Year	New species	Rediscovery	Range extension	Red-list reclassification
2003	-	-	1	1
2004	1	4	3	7 (1)*
2005	1	1	9	6 (1)
2006	1	1	8	8 (1)
2007	1	6	5	6 (2)
Total	**4**	**12**	**26**	**28 (5)**

* Species in parenthesis are still under assessment.

Table 2. Summary table of important outputs by Custodians of Rare and Endangered Wildflowers (2003-2007).

Year	Plant species	New species	Rediscovery	Range extension	Red-list reclassification (where present)
2003	*Phyllobolus caudatus*			√	DD → VU
2004	*Staavia phylicoides*		√		EW → CR
	Serruria furcellata		√		EW → CR
	Acrodon parvifolius			√	NL → EN
	Arctotheca forbesiana			√	ID → CR
	Lachenalia sargeantii		√		EW → CR
	Wurmbea capensis		√		EW → VU
	Oxalis duriuscula			√	K → NT
	Acmadenia sp.nov.	√			STBA
2005	*Babiana pygmaea*			√	
	Ixia purpureorosea			√	R → EN
	Cullumia sp. nov	√			STBA
	Aloe bowiea			√	
	Lachenalia liliflora		√	√	EW → CR
	Polhillia pallens			√	R → VU
	Moraea gigandra			√	EN → VU
	Moraea amissa			√	CRPE → CR
	Pterygodium cruciferum			√	
	Moraea worcesterensis			√	EN → CR
2006	*Aristea nigrescens*	√			STBA
	Erica filamentosa			√	EN → VU
	Ixia campanulata			√	EN → VU
	Sparaxis maculosa			√	
	Geissorhiza tulbaghensis			√	NL → CR
	Ixia vinacea			√	ID → EN
	Lachenalia sargeantii			√	CR → VU
	Erica baueri baueri			√	VU→ EN
	Erica riparia			√	ID→ EN
	Lachenalia arbuthnotiae		√		CRPE →CR
2007	*Lachenalia mathewsii*		√		CRPE → CR
	Cullumia selago		√		VU → EN
	Metalasia bodkinii		√		DD → VU
	Lachenalia mathewsii		√	√	CRPE → CR

	Aristea nigrescens			√	STBA
	Babiana noctiflora			√	NL → EN
	Babiana blanda			√	EW → CR
	Acrolophia barbata		√	√	
	Tripteris sp. nov.	√			STBA
	Ixia recondita		√		

Key: Current IUCN red list categories
Extinct in the Wild (EW); Critically Endangered (CR); Endangered (EN); Vulnerable (VU); Near Threatened (NT); Least Concern (LC); Data Deficient (DD); Not Evaluated (NE)

Other older categories:
Not listed (NL); Still to be assessed (STBA); Rare (R); Possibly extinct (PE); Indeterminate (ID); Insufficiently known (K)

Paraecologists (Fig. 3) play a key role in supporting the annual field work of researchers. Their local knowledge, supplemented by on-the job training means, they can work independently on specific tasks, with minimal quality control check by researchers. Paraecologists' routine tasks include soil sampling, annual vegetation and animal monitoring, as well as liaising with local land users This qualified support by the paraecologists is of great importance for the pace of the annual monitoring work, which otherwise is very time consuming. Table 3 gives examples of paraecologists' activities over the last years.

Figure 3. Paraecologists setting up a field experiment, Namibia.

Table 3. Some examples of paraecologist activities.

Project	**Specific tasks**	**Regional focus**
Annual monitoring of vegetation	Monitoring of vegetation relevés, measuring mapped plant individuals..	South Africa, Namibia
Livestock census and monitoring livestock condition	Participative monitoring of livestock conditions (partly including weighing) with livestock owners.	South Africa, Namibia
Weather monitoring	Maintenance and download of automatic weather stations; reading rain gauges.	South Africa
Socio-economic research	Conducting interviews with land users.	South Africa, Namibia
Ethnobotany	Compiling information on medicinal plants and medicinal use.	South Africa, Namibia
Public presentation and awareness raising	Oral and poster presentations on own work and of collaboration with researchers; radio interviews; writing articles for local newspapers and newsletters.	South Africa , Namibia

Public education and training: CREW is actively involved with various eco-club activities with schools and has a network of eco-club volunteers (representing the youth) across the country (South Africa). Continuous training of volunteers is also an essential part of the project and many plant identification courses are run in addition to on-field training. In a number of cases such training has assisted members of underprivileged groups to secure employment afterwards. Another venture is "Plant Monitoring Day" (Fig. 4), an annual innovative educational exercise, led by custodians aimed at making students and their teachers aware of the rich diversity of plants in their local surroundings (Von Witt 2006).

Side by side with their biodiversity monitoring activities, paraecologists are also involved in environmental awareness-raising among members of their community. Paraecologists are also active in writing and initiating newsworthy articles of relevance in their local media. Commendably, they have also been active in designing their own projects e.g. monitoring of scorpions, collection ethnobotanical information and educational story telling (Pröpper & Gruber 2007). They have also been given opportunities to present their work at regional conferences in Southern Africa. In return, their involvement in local activities has often helped communicate local community research needs and concerns to researchers.

Figure 4. Students participating in Plant Monitoring Day, South Africa.

Challenges and the future: Overall both programmes have been successful in their mandate. The key challenge faced to date by CREW is in the continuity of maintenance funding to keep up monitoring and pay for continual expansion. This challenge has been met so far when the South African National Biodiversity Institute took over monitoring of threatened species and ecosystems, a mandate well aligned with that of CREW's. The momentum of the enthusiasm generated amongst communities and landowners is still going strong and there is a constant influx of institutions getting involved.

The challenges encountered by the paraecologist programme have been mainly of an organisational nature and supervision arrangements, particularly in the early stages of establishment. Nevertheless, paraecologists are playing increasingly important roles in the continuation of monitoring activities. With the planned extension of the BIOTA monitoring activities in Africa beyond its present geographical area (BIOTA West, BIOTA East and BIOTA Morocco for example), there is no reason why the paraecologist programme could not play an important role there. We envisage future acceptance and buy-in of the paraecologist programme by local stakeholders.

In conclusion, harnessing the potential of working with local communities offers an excellent opportunity, with scientists and the public both benefitting from such alliances. The paraecologist and the custodian programmes are examples where scientists and the public make such bonds successfully. It is likely we shall be depending more and more on them in the future.

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