Taxonomic research in South Africa: the state of the discipline

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THE NEED FOR TAXONOMY IS IMPERATIVE as we cannot protect organisms that are not known and which remain unidentified and uncharacterised, thereby limiting our capacity to understand them and to assess the influence of environmental change and other alterations in their condition. There is currently insufficient taxonomic capacity to keep abreast of the rate of new discoveries — our museums and herbaria already contain numerous unnamed species that await description. We outline the steps that our taxonomists have taken to promote their work — through conferences and the establishment of professional societies — and make the case for its enhanced support as an integral part of science policy.

Introduction

There are estimated to be 7–15 million species on Earth, of which only about 1.7 million have been described.[1] The need for taxonomy thus remains imperative and, given the relentless pressures of our consumptive society, is perhaps now greater than it has ever been.[2] While scientists the world over are working to conserve what is left of our biodiversity, they face huge constraints, including the conservation of the more than 5 million species yet undescribed. We cannot protect organisms that are not known and which consequently remain unidentified and uncharacterised. Lack of identification, in turn, limits our capacity to understand them and to assess the effect of environmental change and other alterations in their condition.[1]

Taxonomy is the science of detecting, describing, naming and classifying organisms and is, of course, critically important to disciplines such as conservation, a prerequisite for informed ecological management policy. Currently, there is insufficient taxonomic capacity to keep abreast of the rate of new discoveries of living organisms; this requires an enhanced ability to deal with the outputs of current field work.[3] Our museums and herbaria already contain numerous unnamed species that await description. This taxonomic obstacle to conservation and management of the world's biodiversity has attracted the attention of the Conference of Parties to the Convention on Biological Diversity (CBD), resulting in the creation of the Global Taxonomy Initiative (GTI).[4] The aim of the GTI is to 'underpin decision-making on the conservation of biological diversity, sustainable use of its components, and equitable sharing of the benefits derived from the utilization of genetic resources' and deals with the taxonomic information required by participating countries to support the implementation of the CBD at the generic, species and ecosystem levels.

Local taxonomists take action

The GTI Africa Regional Workshop was held at the Kirstenbosch National Botanical Garden, Cape Town, from 27 February to 1 March 2001 and was hosted by the then National Botanical Institute of South Africa and the National Herbarium and Botanic Gardens of Malawi, under the auspices of the CBD. This resulted in the Kirstenbosch Declaration, which incorporated the main resolutions reached by the delegates.[4] What followed was a thorough taxonomic needs-assessment for Africa,[5] with almost half of the respondents indicating that no such assessment had yet been done in their countries. Most previous needs-assessments focused on vascular plants, and fauna. Lagging behind are the non-vascular plants, and fungi. All national representatives at the Cape Town meeting indicated that major biological collections were kept in their countries, but that staffing was inadequate in most of these, and that the number of taxonomists practising locally was insufficient to address biodiversity issues. Three main stumbling blocks preventing progress in taxonomic effort in Africa were identified: lack of staff and of project-related research funding, and inadequate support to cover institutional running costs.[4]

Local funding initiatives

The establishment of the South African Biosystematics Initiative (SABI), which was instigated and managed by Herbert and his colleagues,[6] came as an opportu-

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nity for South African systematists to augment their often meagre, sometimes non-existent, research funding. The budget allocated for this, released by the Department of Science and Technology through the National Research Foundation (NRF), has been enthusiastically welcomed by the systematics fraternity and will undoubtedly lead to increased productivity in biological systematics. It is important, however, that the community of taxonomists responds, and submits quality proposals in the field of descriptive taxonomy, and beyond. The NRF has repeatedly declared that it is receptive to the requests of systematists and taxonomists. But if we, as a community, are neglectful in the submission of funding proposals that address basic taxonomic questions, then who will there be to classify and curate newly discovered species?

Where do we come from? — taxonomists together

The establishment of the South African Society for Systematic Biology (SASSB) was preceded by a workshop that took place on 14 January 1998 at the Kirstenbosch Research Centre, and this was attended by 64 systematists from 40 institutions.[7] Following this event, a comprehensive survey of the current state and needs of biological collections and expertise in South Africa was undertaken,[8,9] with preliminary results presented later in the year, at a meeting on 6 and 7 August at the University of Pretoria.[10]

The inaugural conference of the SASSB took place in January 1999 in Stellenbosch and brought together, for the first time, local and foreign systematists from a variety of biological backgrounds.[11] Conference attendance since 1999 has ranged from 133 (1999) to 68 (2008) (see Fig. A in supplementary material online at www.sajs.co.za), with the number of first-time attendees ranging from 73 (2000) to 29 (2008) (Fig. B online). In total, 465 individual delegates have attended SASSB conferences over the past 10 years.

It is alarming to note, however, that more than six out of ten of delegates do not re-attend subsequent conferences (Fig. C online). One may speculate that this is a reflection of irregular student attendance or a consequence of a meeting programme that may be perceived by delegates to be not worthwhile. Only four individuals have attended all seven conferences.

The relative proportions of contributions in each of the four broad categories — zoology, botany, mycology, and general — vary considerably (Fig. D online). Zoological contributions have tended to dominate conferences, although the 2006 meeting in the Kruger National Park saw a large attendance by botanical systematists. Mycology has been poorly represented across the board, and presentations by general systematics have fared only slightly better. The especially high number of zoological presentations at the 2003 conference may have been due to a link with the Entomological Society of Southern Africa conference, which was held immediately before the SASSB conference.

SASSB 2008

The 2008 SASSB conference was held together with that of the South African Association of Botanists (SAAB) 2008, as well as a meeting of the International Association of Plant Taxonomists (IAPT) and immediately followed the Cape Biota meeting. The presentations for the SASSB, SAAB and IAPT meetings were mixed, without discrete boundaries, and as a result we decided to include systematics presentations that were registered under SAAB and the IAPT in the 2008 SASSB analysis, thus resulting in the inclusion of 14 additional plant taxonomic contributions.

The 2008 SASSB conference was held at the Drakensville Mountain Resort in the KwaZulu-Natal Drakensberg from 15–17 January. It was attended by 68 SASSB registered delegates and covered contributions from 232 authors (including the 14 additional botanical contributions). Totals of 57 oral and 14 poster presentations were given, of which 39 were zoological and 28 botanical. Mycology was represented by four oral presentations. Sessions included animal phylogenetics, biogeography, plant phylogenetics, and taxonomy: plant and animal, and biodiversity and conservation.

Of the 39 zoological presentations, only 10 (26%) were on invertebrates, which comprise about 99% of animal diversity, and 29 (74%) were on vertebrates. In addition, only one paper dealt with a taxonomic revision of insects, which comprise about 75% of all animal species. Similar patterns were evident for the 2005 and 2006 conferences, with 19% and 16% invertebrate contributions and 81% and 79% of contributions on vertebrates, respectively.

The biodiversity and conservation sessions included contributions related to threatened taxa such as golden moles (Afrosoricida: Chrysochloridae). The biogeography session included presentations on diverse groups including cannibal snails (Pulmonata: Rhytididae), crayfish (Decapoda: Parastacidae) and the plant family Acanthaceae. Phylogenetic contributions ranged from the diversity of *Symbiodinium* in corals, the systematics of African spurfowls (*Pternistis* spp.) to phylogenetic studies of the southern African thicket species *Schotia* (Fabaceae), and the link between annuality and aridity in the karoo as displayed by the genera *Ifloga* and *Trichogyne* (Asteraceae: Gnaphalieae). Other contributions were presented on pollen diversity in Cyperaceae, the demise of the Apiaceae genus *Peucedanum* in Africa, the systematics of certain southern African cisticolas (Cisticolidae), and ticks of the genus *Rhipicephalus*.

The overall quality of talks was excellent, and throughout, conference delegates could be seen engrossed in conversations about their work. This, as much as the formal presentations, is the real benefit and purpose of conference attendance: to network, establish collaborations and to exchange ideas. One hopes that friends and colleagues will choose to meet again at the next SASSB conference to be held in July 2009 in KwaZulu-Natal. The conference will be linked with the Zoological Society of Southern Africa (ZSSA) conference, celebrating the 50th anniversary of the society's establishment, as well as Darwin year (150 years since the publication of *The Origin of Species,* and 200 years since Charles Darwin's birth).

Where are we now?

Systematists in South Africa are increasingly conspicuous at two levels — completing the inventory and generating phylogenies. However, excessive 'tree thinking' has led to a segregated study of phylogeny that may, according to O'Hara,[12] be the beginning of another new 'splinter' discipline, where the 'tree thinkers' (with their focus on cladistics) will distance themselves from classical taxonomy. But what of descriptive taxonomy that generates revisions and monographs? Monographs and their derivatives are important, because without them, no significant progress in taxonomy (or phylogenetic biology) can ever occur. Monographs represent the correlation of knowledge that exists in the form of scattered reports of species and subordinate taxa, reconsidered and revisited,[13] and are often supplemented with much new information. Given the paucity of taxonomists, very few groups get revised. Taxonomy should not be carried out at the expense of phylogenetics, but it should rather form the foundation that supports and informs

it. Studies in biological diversity require exceptionally informative phylogenetic analyses, but without a solid taxonomic foundation, it would be difficult (impossible?) to interpret the results. Nowadays, although the generation of molecular phylogenies is justifiably included as a component of virtually all systematics studies, morphological taxonomy should feature as a critically important component of such investigations. Indeed, how can one conduct a molecular phylogenetic analysis without such a foundation? The knowledge of the field naturalist cannot be replaced. What is the value of rapid identification of plants through molecular techniques if there is no one able to go into the field and find and identify a specimen by visual recognition?[14] Put differently, the quality of phylogeny will be enhanced considerably by morphology that is adequately studied and investigated, and the taxonomy well documented.

The problems bedevilling the implementation of taxonomy initiatives are little more than a microcosm of how the community at large perceives environmental science: necessary, but one hopes someone else will be prepared to pay for it. A dialogue between science and society is required, so that taxonomy can be firmly incorporated into the mainstream of science policy.

The world around taxonomy and taxonomists continues to change. Broad acceptance of the reality of the biodiversity crisis has opened up new spheres of relevance and opportunity for the discipline. But this is no time to be complacent. Taxonomy and taxonomists have undergone a remarkable few decades of rapid disciplinary evolution, but if we do not continue to evolve and adapt, then like many of the species that we study, we risk extinction.[3] Taxonomists need to enhance the status of their discipline as a modern scientific endeavour, and exploit new ways to emphasize its broader societal relevance. For example, the provision of species-conservation assessments should become a routine part of all taxonomic treatments.

Monographic or revisionist study of a not-too-large group remains the best academic subject for a doctoral thesis in taxonomy, providing the student with the intellectual training to investigate the past, and to learn the processes of discrimination, synonymy, and the intricacies of nomenclature.[13] Monographs are essential tools that facilitate progress in understanding biodiversity. Monographs and revisions should be encouraged and supported anew, and the content of these projects needs to strike the right balance between research continuity (traditional approaches) and novelty (new and modern techniques). This implies that the activities of taxonomists should never disregard the policy-maker. We therefore require a balance between mission-orientated research and research that creates and drives its own mission. The latter approach obviously carries a greater degree of risk. This should also be acknowledged by funding agencies and the institutions that employ taxonomists.

It will be difficult to guarantee the future of plant diversity science without international collaboration.[3] Here, 'virtual collections' may be a starting point. These could be compiled as large metadata depositories, to which anyone may contribute — an international effort of which individuals or institutions may still share ownership, but that facilitates collaboration and accelerates information-transfer and sharing. The majority of already-described species may, through this facility, be reliably characterized, without the laborious process of visits to and loans from herbaria or museums.[15] The value of exchange at institutional level should never be undervalued. Moreover, capacity for zoological systematics in South Africa is not able to encompass the large range of taxa that exist and are represented, and expanded links with international researchers will be needed to ensure that we can at least identify those taxa that have economic, ecological, evolutionary or conservation significance, and no less significant, those taxa that are apparently unimportant in this context. In addition, some mechanism for fostering local research capacity and output for the invertebrates in South Africa is also critical. We have to reverse the trend of declining research and collection support capacity in our museums[6] — a situation which continues to be a major concern.

Cross-disciplinary collaborations should also be encouraged. As an example, Gotelli[16] states that community ecologists require four things from taxonomists: taxonomic keys, current nomenclature, species occurrence records, and resolved phylogenies, preferably online.

In summary, we as taxonomists have to re-evaluate our role and be more strategic about the outputs of our research endeavours, and by so doing, re-energize our science,[13] with the consequence that downstream users such as conservation scientists, managers and policy-makers come to regard it as an indispensable discipline. We believe that taxonomy will always be essential for credible biology.[17] South African taxonomists can ill-afford to bask in achievement and expect to be noticed and valued for past contributions. They need to justify their calling through sustained productivity of high quality.

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This article is accompanied by supplementary figures online at www.sajs.co.za

Supplementary material to:

Smith G.F., Buys M., Walters M., Herbert D. and Hamer M. (2008). Taxonomic research in South Africa: the state of the discipline. *S. Afr. J. Sci.* **104**, 254–256.

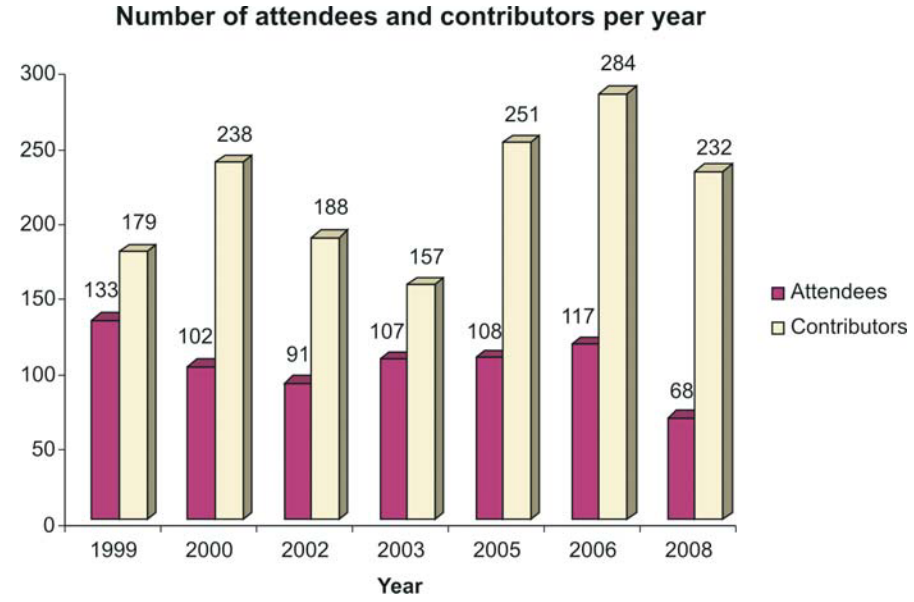

Fig. A. Number of delegates attending South African Society for Systematic Biology (SASSB) conferences from 1999–2008 compared with the overall number of contributors per conference.

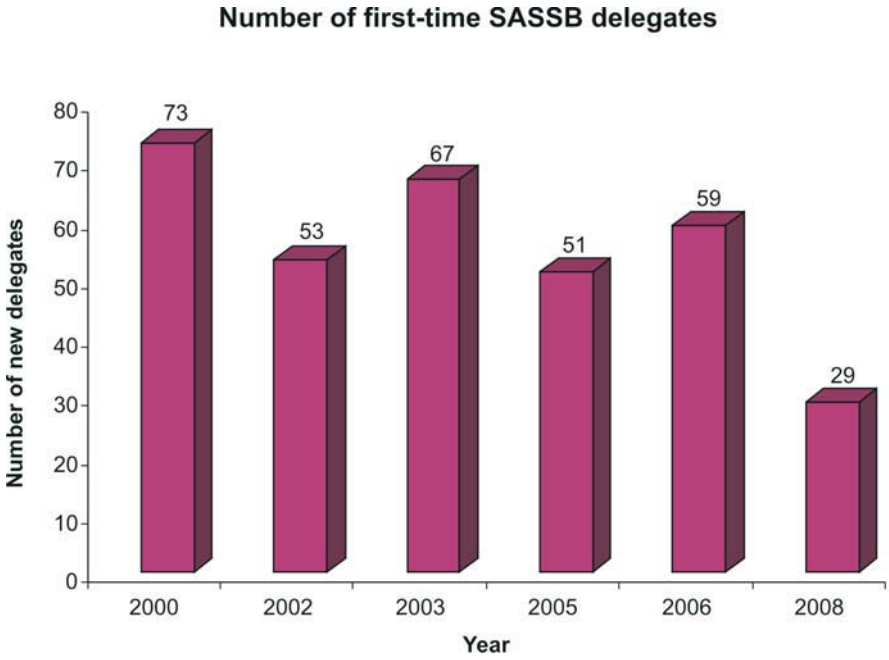

Fig. B. Number of delegates attending a SASSB conference for the first time.

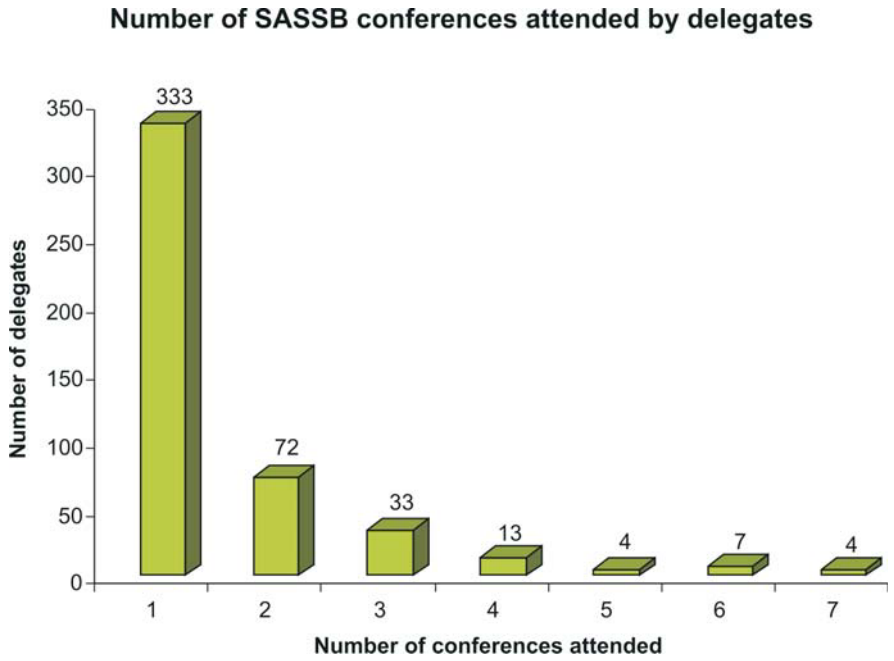

Fig. C. Number of SASSB conferences attended by delegates from 1999–2008.

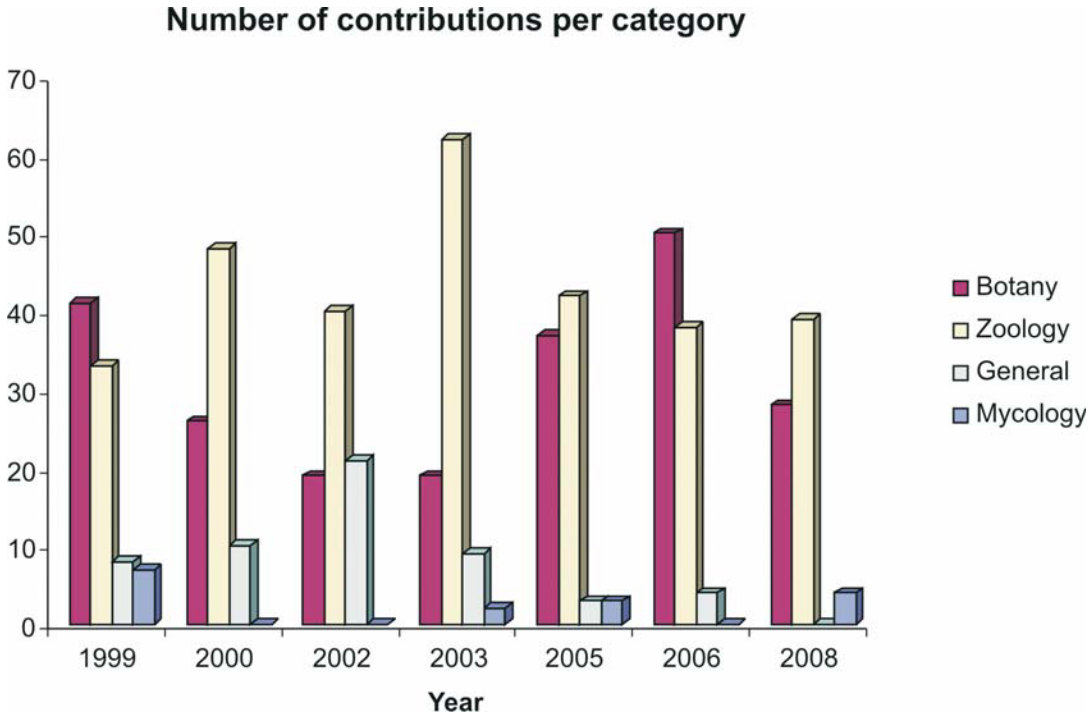

Fig. D. Number of SASSB contributions per category from 1999–2008.