LESSONS FROM THE CONSERVATION ASSESSMENT OF THE SOUTH AFRICAN MEGAFLORA[1]

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ABSTRACT

South Africa has the world's richest temperate flora, with 20,456 indigenous vascular plant taxa recorded. With the current estimate of the global flora at 379,881 taxa, 5% of the world's plant diversity is represented within South African borders. Between 2004 and 2008, South African botanists completed a comprehensive assessment of the status of the South African flora using the International Union for Conservation of Nature and Natural Resources (IUCN) Red List categories and criteria, version 3.1. South Africa is the first floristically megadiverse country to fully assess the status of its entire flora and to achieve Target 2 of the Global Strategy for Plant Conservation (GSPC): "[a]n assessment of the conservation status of all known plant species, as far as possible, to guide conservation action." Herein, we discuss the critical success factors that allowed an assessment of such a megadiverse flora within five years. Establishing a centralized team of ecologists to develop Red Lists, collaborating with a wide range of botanical experts, streamlining the assessment process via automation, and establishing a data management system that served local conservation needs were crucial to the success of the project. Utilizing the IUCN categories and criteria proved to be, and is suggested as, the most cost-effective measure for other megadiverse countries wanting to achieve Target 2. Quantitative assessments can be done with minimal data, and comprehensive assessments of all known taxa ensure conservation attention for a greater proportion of a flora. The example of South Africa demonstrates that conservation assessments can be done relatively cheaply in developing megadiverse countries (less than $30 per taxon for South Africa). As megadiverse countries have high numbers of endemic plant taxa, it is well worth the investment by IUCN and conservation donors to support continued and future assessment projects.

Key words: Conservation assessments, Global Plant Conservation Strategy Target 2, IUCN Red List, South African flora, threatened species.

There is a global imperative to assess the conservation status of plant species to improve and measure conservation efforts. Currently, vascular plants worldwide are poorly represented on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species (Krupnick et al., 2009; Stuart et al., 2010), and only 15,190 or 4% of the estimated 379,881 vascular plant species worldwide (Paton et al., 2008) have been included in the list. Such low representation makes it difficult to use plant assessments as meaningful indicators of biological diversity. There is an increasing need for such measurable indicators in order for Red Lists to assess national and global targets for conservation and sustainability. The United Nations Environment Programme (UNEP) utilizes the IUCN Red List to measure progress toward its Millennium Development Goal 7, which is tasked to ensure environmental sustainability and thereby reduce biodiversity loss. Similarly, Target 12 of the Aichi Biodiversity Targets (2011–2020) of the Convention on Biological Diversity (CBD) also depends on conservation assessments, with the goal that by 2020 the extinction of known threatened species has been halted and their conservation status, particularly of those most in decline, has been improved and sustained (CBD, 2010a).

The Global Strategy for Plant Conservation (GSPC), which was adopted by Parties to the CBD in 2002, and revised in 2010 for a further 10 years (2011–2020), lays out a strategy for plant conservation. One of the 16 quantitative targets to be achieved by 2020 is Target 2: "[a]n assessment of the conservation status of all known plant species, as far as possible, to guide conservation action" (UNEP, CBD, 2010b; Wyse Jackson & Sharrock, 2011). To date, relatively few parties have made progress toward achieving this target (Secretariat of the CBD, 2009). A number of the other targets for the strategy depend on knowing which plants are threatened,

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especially Target 5, "[a]t least 75 per cent of the most important areas for plant diversity of each ecological region protected with effective management in place for conserving plants and their genetic diversity," Target 7, "[a]t least 75 per cent of known threatened species conserved in situ," and Target 8, "[a]t least 75 per cent of threatened plant species in ex-situ collections, preferably in the country of origin, and at least 20 per cent available for recovery and restoration programmes" (UNEP, CBD, 2010b, <http://www.cbd.int/gspc/targets.shtml>). Greater progress is needed in plant assessments in order to approach and to achieve the GSPC targets.

Between 2004 and 2008, South African botanists completed a comprehensive assessment of the status of the South African flora using the IUCN Red List categories and criteria (IUCN, 2001; Raimondo et al., 2009). South Africa is among 17 floristically megadiverse countries that collectively hold 70% of the world's species diversity (Mittermeier et al., 1997). South Africa is the first among these countries to comprehensively assess its vascular plant flora and to achieve Target 2 of the GSPC.

South African Plant Conservation

South Africa has the world's richest temperate flora, with 20,456 indigenous vascular plant taxa recorded (Raimondo et al., 2009). With the current global estimate of 379,881 taxa (Paton et al., 2008), 5% of the world's plant diversity lies within South African borders. In addition, the extraordinary level of vascular plant endemism, with ca. 13,265 taxa representing 65% of the flora, is singular and internationally recognized. South Africa is one of only two countries in the world that has three of the world's 34 biodiversity hotspots within its borders, namely the Cape Floristic Region (6210 endemics), the Succulent Karoo (2439 endemics), and the Maputaland-Pondoland-Albany Region (1900 endemics; Mittermeier et al., 2005). South Africa is indisputably a custodian of a significant store of the world's flora, both in terms of diversity and endemism. Monitoring the threat status of this extraordinary flora and ensuring its effective conservation is, therefore, a high priority.

South Africa has a centralized institution for biodiversity monitoring in The South African National Biodiversity Institute (SANBI), which is an independent entity linked to the Department of Environmental Affairs. SANBI is responsible for generating and disseminating information on the nation's biodiversity, and its findings are used to guide national conservation legislation and policy. As part of its mandate under the National Environmental Management: Biodiversity Act (NEMBA, 2004), SANBI must monitor and report on the conservation status of species and ecosystems. As a result, SANBI coordinates assessments of the conservation status of South African plant and animal species using the IUCN Red List categories and criteria. This builds on a long history of using the IUCN Red List system, where assessments of plant taxa date back to 1980 (Hall et al., 1980). Subsequent updates (Hilton-Taylor, 1996a, 1996b, 1997; Golding, 2002; Raimondo et al., 2009) have all utilized the IUCN Red List criteria of the time.

South Africa is fortunate among megadiverse countries to have a disproportionably high level of capacity in terms of taxonomic expertise and field botanists. The majority of the flora has received taxonomic treatment, with 62% of plant taxa having been revised since 1970 (Von Staden et al., 2013). In addition, a network of 20 local herbaria across the country house a representative sample of plant specimens, with the majority of specimens (90% of the country's ca. 3,263,200 plant specimens) concentrated in only six herbaria (BOL, GRA, NBG, NH, NU, PRE; National Research Foundation [NRF], 2011), three of which are managed by SANBI. Good electronic data in the form of digitized herbarium specimens and spatial layers for vegetation classification and national land use exist (Mucina & Rutherford, 2006), and 44% of South Africa's plant specimens have been electronically encoded (NRF, 2011). Most of these specimens are georeferenced to at least a quarter-degree square grid. This richness of taxonomic literature and electronic specimen and land-use data, combined with expert knowledge, enabled assessments to be carried out that satisfy the data requirements of the IUCN Red List categories and criteria.

Critical Success Factors

Critical success factors that allowed a large flora of over 20,000 plant taxa to be assessed within five years include a core team to coordinate and conduct Red List assessments, extensive collaboration with the local botanical conservation community, and the development of a data management system that serves local conservation needs.

Establish a Red List Team to Conduct Assessments

South Africa is one of a few countries with a team employed specifically to conduct IUCN Red List assessments. This team collaborated with an extensive network of 169 professional and amateur botanists from across the country to obtain information for plant taxa. While conducting the threat assessments between 2004 and 2008, the team consisted on average of one project manager, three ecologists, and two support staff (e.g., student interns). A dedicated Red List team is considered essential for processing a large number of assessments as it reduces the need to train a large number of expert contributors in the use of the IUCN Red List system, which is complex and takes time to master. A small team of experienced staff can process a large number of assessments far faster than a large group of botanical experts dedicating their time toward threat assessments on a voluntary and part-time basis. The South African strategy delegated the core IUCN Red List team to host workshops and conduct interviews with taxonomic experts to efficiently obtain information not available in the literature or in electronic datasets. Although the IUCN Red List system is quantitative and objective, giving the responsibility of completing threat assessments to many different expert contributors results in inconsistent assessments, due to variation in precautionary and evidentiary approaches to listing among experts. A dedicated IUCN-trained team ensures consistency in the way the criteria are applied across different taxonomic groups. As with any large flora, at any given time there are many plant groups that are not receiving taxonomic attention, and, therefore, no botanical experts are available to do assessments for these groups. In such cases, the available botanical literature and taxonomic revisions need to be processed. Dedicated IUCN-trained Red List staff can focus on such plant groups. It is essential that scientists employed to do Red List assessments understand plant life histories and the response of plants to prevalent threats in different ecosystems. Field experience and a sound understanding of ecological characteristics of different habitats are also essential. IUCN Red List assessments are often undertaken by taxonomists, but in the South African experience, having a team of mostly ecologists working with taxonomists provided greater consistency in the interpretation of the environmental and biological parameters used to determine Red List status.

Although all South African assessments were done by SANBI Red List staff, it was absolutely vital to the success of the project that assessments were not done in isolation, and extensive collaboration with the local botanical conservation community was necessary. The Red List team acted as a central point through which the South African conservation community was involved in the listing process. The data informing the South African Red List were compiled with input from 169 professional botanists, taxonomists, conservationists, as well as amateur plant enthusiasts. These experts contributed a large volume of vital information not otherwise available in literature or spatial datasets. Whether or not the experts had extensive and recent field experience made the greatest difference to the value of the data they were able to contribute. Experts were consulted via workshops that focused either on plant families, particular plant groups, taxa of special interest (e.g., succulents, medicinal plants), or regional floras. Individual interviews were also held with experts throughout the duration of the assessment process. Collaboration with botanists based at local herbaria and academic and conservation institutes not only resulted in obtaining valuable IUCN Red List data, but also led to significant and widespread acceptance of the Red List as an important conservation tool. The IUCN Red List has subsequently been applied in many conservation initiatives, including the 2012 update of important legislation such as the list of Threatened and Protected Species on South Africa's Biodiversity Act (NEMBA, 2004).

STREAMLINE THE ASSESSMENT PROCESS VIA AUTOMATION

Electronically accessible herbarium specimens have been widely recognized as a useful resource whereby to conduct assessments of plant species (Schatz, 2002, 2009; Hernández & Navarro, 2007; Brummitt et al., 2008; Krupnick et al., 2009). Typically for countries with large floras, many plant taxa will be widespread and not threatened and the time spent assessing such common species should be minimized. In order to efficiently assess the large number of plant taxa that occur in South Africa, the assessment process was automated for widespread and common species. Electronic specimen data were used to automatically assign 9387 widespread taxa into the IUCN category of Least Concern (LC). Electronic specimen data were also used to prioritize 6000 taxa of restricted distributions that had never been assessed before, and these were targeted for further investigation. Based on this experience, the use of electronic specimen data is recommended as a first step in threat assessment to distinguish those species that are clearly widespread, abundant, and unlikely to be in danger of extinction from those species of lesser extent that need further investigation. This process focuses assessment resources on those plant species for which there is a greater likelihood that they could be threatened.

DEVELOP A DATA MANAGEMENT SYSTEM THAT SERVES LOCAL CONSERVATION NEEDS

When assessing a large number of species, a well-designed data management system can be a vital time-saving device. The IUCN promotes the use of their Species Information Service (SIS) as a suitable data management portal for conducting assessments. This SIS system was developed at the same time that South Africa was assessing its flora, and one of the consequences is that South Africa developed its own relational database purposefully compatible with the SIS. Thus, we can compare the relative benefits of the IUCN SIS system from the time of the 2009 South African assessment with the local database in order to assess a large number of plant taxa from any area within the flora of a megadiverse region. The SIS system was developed to facilitate online assessment by IUCN specialist groups, where scientists working simultaneously on assessments may be based in a wide range of locations. In contrast, the South African assessments were conducted by a centralized team so the database did not need online capabilities and was constructed to interface with existing data sources in the country. For example, taxonomic information, such as scientific names, plant life history traits, and countries of occurrence, were automatically imported from South Africa's National Herbarium Computerized Information System (PRECIS), which saved significant time. Speed of data capture and ease of navigation are critical factors for allowing rapid completion of threat assessments. The SIS system allows for a large amount of data to be captured as part of the assessment process that may be relevant to species conservation but not necessarily critical in justifying categorization. Not only is completing the many data fields time consuming, but navigating through the associated forms can also significantly delay the completion of assessments. The South African approach was to select only a very limited number of critical data fields that could be displayed on a single form or screen view, and complete only those data fields for each species assessed, thereby allowing the completion of a large number of assessments within a short timeframe. SIS has recently made available the option to construct custom data views according to users' preferences and has improved ease of database navigation; however, allowing bulk data importing is still under review consideration.

The online SIS system constrains data held by the IUCN, such that this information is accessible only through IUCN-defined query protocols and is thus either not available or adaptable to answer novel and evolving local conservation questions. South Africa's threatened species database is more flexible, having been designed to serve local conservation needs, e.g., to provide the lists of species requiring protection from national and provincial conservation legislation as well as informing which species and even subpopulations to include as biodiversity targets in conservation plans.

The IUCN SIS is an international system, and, therefore, data capture options to support threat assessments are generalized and not adaptable to local data needs. In South Africa, not all data were captured as specified by the IUCN; instead, what was nationally required took precedence. For example, the IUCN's habitat classification system is too coarse for local requirements. Three of South Africa's nine major vegetation biomes comprise the Succulent Karoo, the Nama Karoo, and the Albany Thicket, which all fall under the IUCN's classification of Subtropical/Tropical Dry Shrublands. Data more locally appropriate for South Africa were captured, yet compatibility with SIS was maintained so that data could still be provided in the required format to the more globally relevant IUCN Red List.

Spatially georeferenced data for subpopulations of threatened species in South Africa turned out to be the single most useful dataset generated as part of the assessment process. It allowed for subpopulation distribution information to be intersected with other spatial information, such as vegetation maps or maps of protected areas, and this facilitated the automation of a large volume of the supporting data required by the IUCN. Other assessment projects for plants, including threat assessment of Madagascan and Hawaiian endemic plant families, have also relied heavily on georeferenced data (Schatz, 2002; Krupnick et al., 2009, respectively). In addition, spatial data associated with subpopulations is highly useful for informed conservation planning (Hoffman et al., 2008). The South African Red List database has been designed to capture spatial data associated with subpopulations. However, the IUCN SIS system does not currently have this capability.

Lessons Learned

(1) *Invest in using the IUCN system.* The latest version of the IUCN Red List categories and criteria is a quantitative, objective system that can be consistently applied across a range of taxonomic groups worldwide. The quantitative criteria are based on scientific studies of populations among many different species; these criteria also apply to the biological conditions under which they are highly likely to go extinct (Mace et al., 2008). The quantitative nature of the system demands that assessments be justified by supporting data that indicate how a species meets the conditions for inclusion in the threat category in which it is listed. This results in a high degree of transparency in the listing process. South Africa has found it valuable to

use the IUCN system because the Red List assessments for a number of species under threat have been legally challenged. This typically occurs when infrastructure, agriculture, or other developments are halted as part of the Environmental Impact Assessment process due to the presence of threatened species. The fact that the IUCN system is objective and scientifically based and is widely used internationally has meant that assessments for threatened plant species have been successfully defended. For example, a development that would have destroyed a subpopulation of the orchid *Brachycorythis conica* (Summerh.) Summerh. subsp. *transvaalensis* Summerh., an Endangered Red List taxon, was halted in 2011 in Gauteng Province, South Africa.

Further, the quantitative nature and transparency of the IUCN system enables more meaningful conservation decisions that are based not only on the threat category a species is listed under, but also on the different reasons a species may qualify as being in danger of extinction. In using the IUCN Red List, South African conservationists were able to consider how the threat criteria under which a species qualified could be used to recommend conservation actions or to set conservation targets. In conservation plans, for example, biodiversity targets for species vary by the threat category and also by criteria under which a species has been listed (Pfab et al., 2010). Similarly, guidelines dealing with threatened plant species in Environmental Impact Assessment reports are based not only on species status, but also on the qualifying criteria (Driver et al., 2009).

One of the perceived disadvantages of the IUCN system is that it is data intensive and, therefore, too time-consuming to complete large numbers of threat assessments for taxa within a reasonable time (Brummitt et al., 2008; Schatz, 2009). However, the quantitative and data-intensive nature of the IUCN Red List process was for South Africa one of its greatest advantages. The value of the data obtained as part of the threat assessment process for strategic, informed conservation decision-making outweighed the effort in capturing it. It became apparent that the problem with evaluating a plant species against the IUCN Red List criteria was not necessarily the amount of data required, but rather that resources were required to comply with the IUCN documentation requirements, i.e., the documentation required when an assessment is lodged with the IUCN. Many of the current documentation requirements for the IUCN have been developed to support analyses of the Red List database and are not necessary for reporting on the state of biodiversity at the international level, or for guiding conservation at the local level. South Africa has not submitted a full set of data for all species to IUCN, but instead has submitted only a minimum set of supporting data justifying the classification of plant species against threat criteria. A strict focus on a minimum set of supporting data is one of the main reasons it has been possible to assess 20,456 plant taxa within five years. The IUCN is currently reviewing the minimum data requirements partly on the basis of lessons learned from the South African plant assessment process.

Where the IUCN Red List system does not meet all local conservation needs, it is possible to augment it for national purposes without compromising its capability to be an effective international biodiversity monitoring tool. Because the IUCN system is focused entirely on determining a taxon's risk of extinction, it is less effective for prioritizing all taxa in need of conservation action. South Africa has a high number of range-restricted or rare endemics that are of high national conservation priority. However, if populations of such taxa are not declining, then the IUCN system would classify them with widespread and abundant taxa as Least Concern (LC). To address this, additional categories for highlighting taxa of conservation concern that were not detected by the IUCN system were developed for use in national conservation (Raimondo et al., 2009). For example, plant taxa known from only one subpopulation in South Africa but which face no threats were listed under the national category Critically Rare. Species that are listed according to this additional category appear on the South African national Red List but are classified as LC when the threat assessments are submitted to the IUCN Red List.

(2) *Quantitative assessments can be done with very little data.* Like many megadiverse countries, South Africa has many plant taxa that are poorly known. An estimated 38% or ca. 7000 taxa have outdated or no taxonomic treatment (Von Staden et al., 2013), and 26% or 5505 taxa have fewer than five specimens represented in the National Herbarium. Despite this lack of good data, it was possible to assign all South African plant taxa to one of the IUCN categories. Most assessments were desktop assessments done with only three basic information resources: taxonomic literature, electronic herbarium specimen data, and spatial land cover data. In South Africa, threatened plant species tend to be concentrated in specific areas where high levels of endemism coincide with high levels of threat, especially impacts of land use. Many plant species with similar distribution ranges and habitats are thus facing similar threats. Experienced assessors were able to

use their knowledge from assessing well-known species to infer the status of poorly known species from similar regions and habitats. Understanding the impact of local threats on particular life histories and ecological processes was central to this process. Because there is no monitoring data or recent field information available for most South African plant species, a civil society volunteer programme was established to gather information for the Red Listing process. This volunteer programme (the Custodians of Rare and Endangered Wildflowers) worked synergistically with the assessment process by prioritizing threatened, but poorly known species for field surveys (SANBI, 2012). Field data collected by volunteers were successfully used to either confirm the Red List status or to correct erroneous classifications of these previously poorly known species.

Brummitt et al. (2008) note that the majority of species listed on the IUCN Red List have been conducted by IUCN specialist groups with extensive field knowledge. They promote an approach to increase the number of plant taxa on the Red List, similar to that used in South Africa, in which non-experts conduct desktop assessments. Brummitt et al. (2008) specify that assessors need to have a thorough understanding of the IUCN categories and criteria, access to a database of georeferenced specimen collections, and some basic geography information system (GIS) knowledge. Our experience supports this approach as a practical way to assess large floras. However, a vital addition is that assessors need to have a sound understanding of the interactions between local threats and plant life histories and ecological processes in the region of assessment. In the South African assessment, this understanding was gained largely through extensive interaction of Red List staff with botanical experts, ably supplemented by the practical field experience of threatened plant surveys obtained through the Custodians of Rare and Endangered Wildflowers Programme.

(3) *Costs and cost-saving recommendations*. The South African Red List cost $593,291 to assess 20,456 taxa, at an average cost of $29 per taxon. This is relatively inexpensive when compared to other regional assessment projects. The Pan-Africa Freshwater Biodiversity Assessment that assessed 5000 taxa from a range of taxonomic groups cost $383.87 per taxon (W. Darwall, unpubl. data), whereas the European Red List, which assessed 5600 taxa also from varying taxonomic groups, cost $239 per taxon (M. Biltz, unpubl. data). Other estimates of the cost of conducting plant assessments have been as high as ca. $440 per taxon (Stuart et al., 2010), but the cost of the South African assessment was closer to the costs typically incurred when there is a large volunteer contribution. For example, the Global Cycad Conservation Status assessment, conducted by the IUCN Species Survival Commission (SSC) Cycad Specialist Group, cost ca. $26 per taxon (J. Donaldson, unpubl. data). In the case of the cycad assessment, the volunteer contribution has not been estimated, which emphasizes the low real cost associated with the South African Red List assessment. An assessment of selected plant families in Madagascar cost under $30 per taxon (Schatz, 2009). We thus predict that assessments of plants in other developing countries with megadiverse flora and fauna could also be done at a similar, reasonable cost. As megadiverse countries have high numbers of endemic plant taxa, it is worth the IUCN and conservation donors investing in supporting assessment projects in these countries in order to cost effectively increase the number of plant taxa on the IUCN Red List.

The approach adopted in South Africa meant that threat assessments of widespread and common species were automated, and only taxa that were of potential conservation concern were assessed in detail. In total, 12,044 South African plant species received focused attention. The cost of assessing these taxa of potential conservation concern decreased with time (Table 1), changing from $158.25 in the first year of assessment (2004) to $39.72 in the final year (2008). This change in cost was due to experience gained by assessors over the course of the project, which decreased the amount of time needed to assess each species. There is, therefore, a financial incentive to invest in a team of assessors when assessing a large number of taxa that may take several years to complete.

Consultation with experts was pivotal to the success of the South African Red List project and involved a combination of workshops and interviews. It was financially more efficient to assess species via interviews with individual experts than via workshops (Fig. 1), because in a large flora botanists tend to have specialized knowledge either of a certain region of the country or of a particular taxonomic group. As a result, there was little or no added value gained from bringing experts together, as expert knowledge seldom overlaps. However, some groups, such as medicinal plants, did require assessment via workshops because the impact of harvesting on populations needed to be debated with a range of the knowledgeable experts.

(4) *Comprehensive assessments ensure conservation attention for greater proportion of flora*. All previous Red Lists conducted in South Africa evaluated only a small proportion (less than 20%) of the indigenous

Table 1. Break down of staffing and costs of the South African Red List programme.

	2004	2005	2006	2007	2008
No. of support staff (e.g., student interns)		2	3		
No. of junior ecologists employed	1	3	5	1	1
No. of ecologists with over five years experience	1	2	1.5		1
Project manager	1	1	1	1	1
No. of expert consultants contracted	1		2	1.5	0.5
Total number of staff	4	8	12.5	3.5	3.5
Financial cost of staff	$80,506.33	$156,708.86	$206,075.95	$59,493.67	$76,708.86
Workshop expenses	$0	$3037.97	$2911.39	$1012.66	$1265.82
Expert interviews	$835.44	$278.48	$2227.85	$1392.41	$835.44
Total cost (U.S. $)	$81,341.77	$160,025.32	$211,215.19	$61,898.73	$78,810.13
No. of assessments conducted	514	3462	4537	1547	1984
Cost per assessment	$158.25	$46.22	$46.55	$40.01	$39.72
Total cost of project	$593,291.14				

flora. As a result of the first comprehensive assessment of all 20,456 taxa, 10% or 2045 taxa of conservation concern were added to the Red List for the first time. Of these, 942 were taxa threatened with extinction. The majority of these were historically of conservation concern but were never previously assessed (Fig. 2A). Many threatened taxa and other taxa of conservation concern are overlooked when only selective assessments are done. For example, one of South Africa's most threatened plant genera is *Marasmodes* DC. (Asteraceae). The six cryptic species in this genus were never all evaluated in a South African plant Red List before, even though they are all restricted historically to extensively transformed habitats and are all on the brink of extinction. The urgent conservation needs of the majority of the species in this genus were identified for the first time through this comprehensive assessment and resulted in an annual monitoring effort for the six described *Marasmodes* species as well as the discovery of four undescribed species. An argument often used against comprehensive threat assessments for plant conservation is that it is a waste of effort to try and assess all species when most are too poorly known to obtain enough data to measure against the criteria. Conducting a comprehensive assessment has allowed South Africa to identify the major gaps in botanical knowledge and has led to the prioritization of taxonomic research (Von Staden et al., 2013).

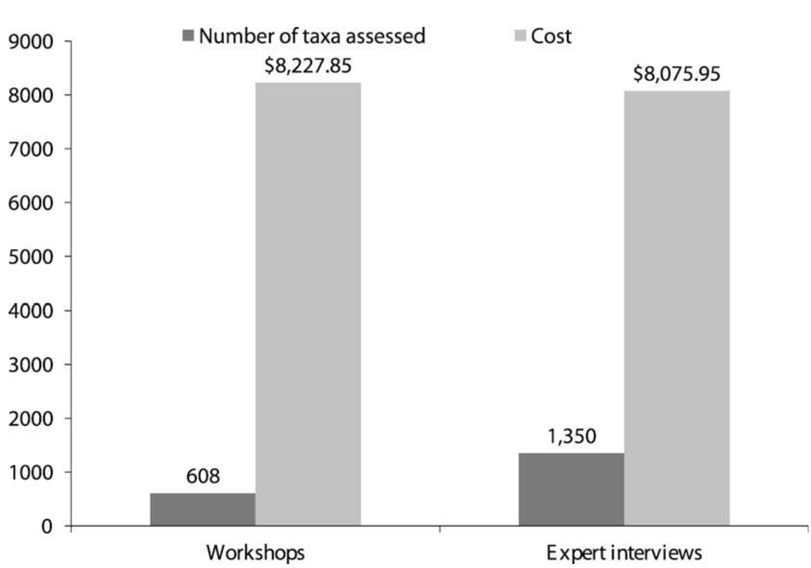

Figure 1. The total relative costs of conducting workshops or expert interviews are compared to the number of plant taxa assessed for South Africa via each of these approaches.

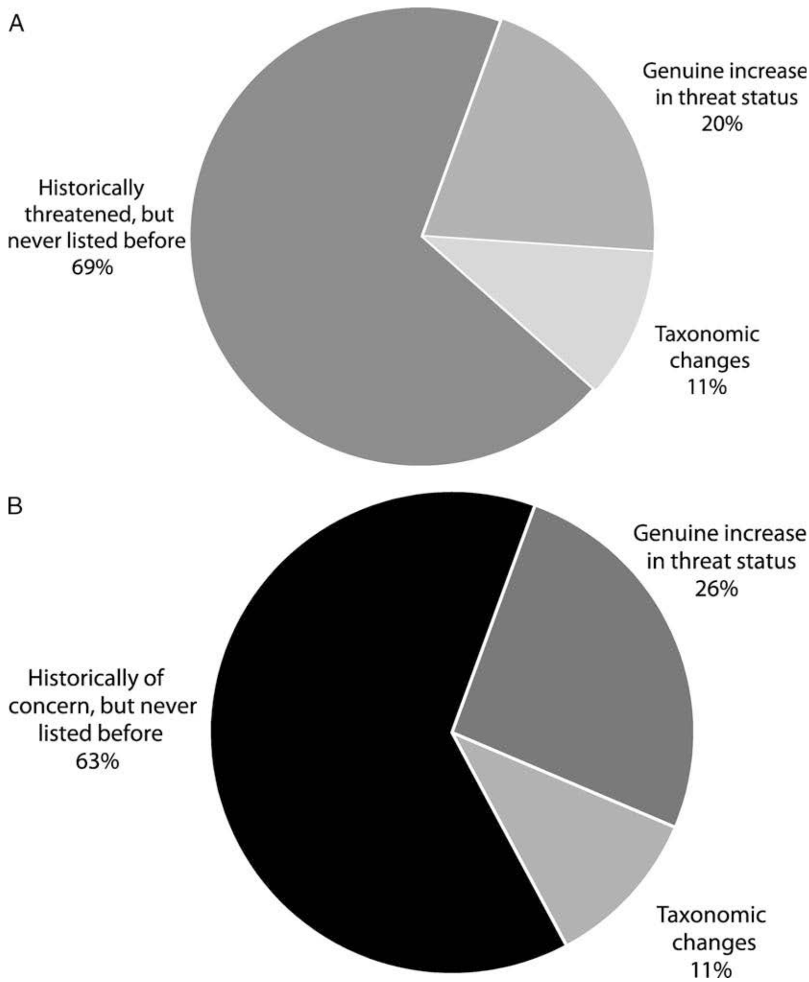

Figure 2. —A. Rationales for the addition of 942 taxa to categories of threat on the South African Red List for the first time. —B. Rationales behind the addition of 2045 taxa of any conservation concern to the South African Red List for the first time. Assessments follow the IUCN categories and criteria, version 3.1.

When comparing the proportion of threatened taxa in South Africa to those in other megadiverse countries, the impact of substantive assessment programmes becomes clear. South Africa, like other megadiverse countries that have conducted IUCN assessments of endemic taxa, has a high proportion (greater than 10%) of taxa that are threatened (Fig. 3). Other megadiverse countries such as Australia (20,148 plant taxa) and Brazil (35,107 plant taxa) that have not yet undertaken substantive assessment programmes have identified far lower proportions of their floras as threatened, only 4% and 6%, respectively (see Fig. 3) (Griffin & Hilton-Taylor, 2008; Chapman, 2009; Forzza et al., 2010, <http://floradobrasil.jbrj.gov.br>).

Conclusion

The South African experience shows that it is possible to assess a large group of plant taxa, such as the flora of a megadiverse country, using the global standard of the IUCN Red List system. The lessons learned from this process should inform the approaches adopted by other megadiverse countries as these will confer cost savings on similar projects and can help to make the Red Listing process more meaningful for local conservation action. Overall, the Red Listing process has had a positive impact on conservation efforts and is enabling South Africa to report against global targets for conservation and sustainability, such as those required by UNEP (Millennium Development Goals) and the CBD. As a

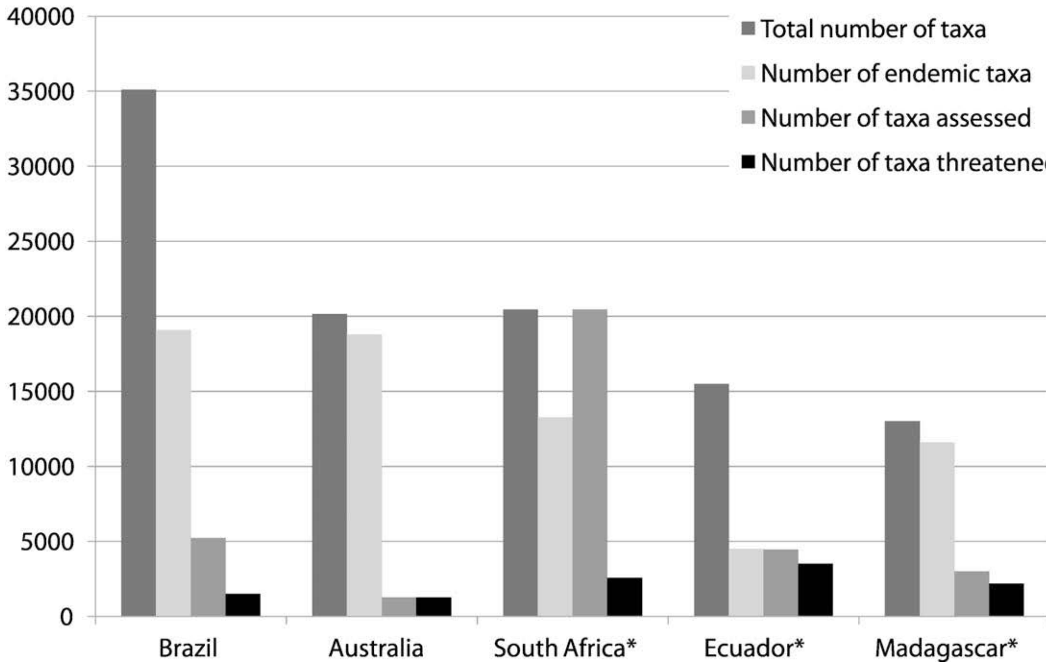

Figure 3. Taxonomic comparison of the five megadiverse countries: Brazil, Australia, South Africa, Ecuador, and Madagascar. Assessments in South Africa, Ecuador, and Madagascar (marked by asterisks, *) follow the IUCN categories and criteria, version 3.1. Data were obtained from Chapman, 2009 (Australia); Floradobrasil, 2010 (Brazil); Griffin & Hilton-Taylor, 2008 (IUCN); Groupes des spécialistes des Plantes de Madagascar (Madagascar); León-Yánez et al., 2010 (Ecuador); and Raimondo et al., 2009 (South Africa).

result, we encourage other megadiverse countries to conduct comprehensive conservation assessments, particularly of plants, using the IUCN system. As one step toward this goal, Red List training and experiences are currently being shared between Brazil, Colombia, and South Africa.

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