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ORIGINAL PAPER

Application of the IUCN Red Listing system to setting species targets for conservation planning purposes

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Abstract Biodiversity targets, or estimates of the quantities of biodiversity features that should be conserved in a region, are fundamental to systematic conservation planning. We propose that targets for species should be based on the quantitative thresholds developed for the Vulnerable category of the IUCN Red List system, thereby avoiding future listings of species in an IUCN Red List threat category or an increase in the extinction risk, or ultimate extinction, of species already listed as threatened. Examples of this approach are presented for case studies from South Africa, including threatened taxa listed under the IUCN Red List criteria of A to D, a species listed as Near Threatened, a species of conservation concern due to its rarity, and one species in need of recovery. The method gives rise to multiple representation targets, an improvement on the often used single representation targets that are inadequate for long term maintenance of biodiversity or the arbitrary multiple representation and percentage targets that are sometimes adopted. Through the implementation of the resulting conservation plan, these targets will ensure that the conservation status of threatened species do not worsen over time by qualifying for higher categories of threat and may actually improve their conservation status by eliminating the threat of habitat loss and stabilizing population declines. The positive attributes ascribed to the IUCN Red List system, and therefore to the species targets arising from this approach, are important when justifying decisions that limit land uses known to be detrimental to biodiversity.

Keywords Biodiversity targets · Bioregional plans · Conservation targets · Land-use planning · Multiple representation · Systematic · Threatened species

Abbreviations
CR Critically Endangered
EN Endangered

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VU Vulnerable
NT Near Threatened
LC Least Concern

Introduction

Systematic conservation planning (Margules and Pressey 2000) entails a process whereby a system of conservation areas, or areas considered sensitive from a biodiversity perspective, is designed to incorporate representative examples of biodiversity features in a planning region. Implementation of a conservation plan is not necessarily restricted to the establishment of formal protected areas. The plan may also be used for land use planning, guiding decisions on land use change and encouraging conservation friendly activities on private land.

Typically a conservation planning exercise would involve the selection of appropriate biodiversity surrogates, data collection for and mapping of these surrogates in a Geographic Information System, setting of biodiversity targets and finally an assessment of the extent to which the biodiversity targets are met in the existing protected area system, usually with the assistance of conservation planning software. Areas of land are subsequently selected to meet the targets not achieved within the existing protected area system. The process would generally aim to fulfill the principles of complementarity (duplication of important attributes are avoided), efficiency (most protection for the least cost/area), defensibility (in being able to justify the areas selected into the conservation plan), accountability (in being able to account for decisions taken in relation to the conservation plan), flexibility (in the face of competing land uses), irreplaceability (a measure of the likelihood that an area will be required to meet biodiversity targets; Ferrier et al. 2000) and persistence (capturing of ecological processes and exclusion of threats to ensure long term viability).

Fundamental to a conservation planning exercise is the setting of biodiversity targets, which are simply quantitative estimates of how much of each biodiversity feature should be included in a conservation plan (Pressey et al. 2003) to ensure efficient representation but with a high likelihood of persistence within the planning region. Biodiversity features can range from coarse filter surrogates such as vegetation types and ecoregions that generally represent common and widespread species, to fine filter surrogates on the lower levels of the biodiversity organizational hierarchy such as rare, threatened and other conservation-worthy species of fauna and flora (Noss 1987; Burgman et al. 2001; Pfab 2002). Threatened species listed on IUCN Red Lists are logical fine filter surrogates, as they have been identified as those species most in need of conservation action (Mace et al. 2008). Species that are not yet threatened, but that are of conservation concern (e.g. rare or declining species; Victor and Keith 2004), are also important candidates for consideration in conservation plans, as there is still time to effectively implement management. Inclusion of common and widespread species is probably unnecessary in most cases as the sizes of species targets have been shown to be relevant to only geographically restricted or rare species (Rondinini et al. 2005).

A goal of conservation is to maintain sufficient populations of species to prevent them becoming threatened or to ensure that their threatened status does not worsen. It is debatable whether this goal is achieved by the current approaches to setting species targets for conservation planning purposes, which range from simple approaches of representing each species at least once (Loyola et al. 2009) to multiple representation targets (Vazquez et al. 2008) where the number of sites to represent a species are often decided arbitrarily, and to percentage targets involving arbitrarily selected proportions or percentages of the distribution areas of species (Rondinini et al. 2005; Meynard et al. 2009; Sarkar et al. 2009). A more complex method of setting targets for species has been devised by Burgman et al. (2001), but the method is data intensive requiring knowledge of demographic and environmental uncertainties, disturbance regimes, deterministic trends causing permanent habitat loss and catastrophes. In this paper we propose basing species targets on the quantitative criteria developed for the IUCN Red List (2001), a system designed for objectivity, transparency, consistency, accessibility and rigor and which importantly is also scientifically defensible and applicable to a variety of species and habitats (Mace et al. 2008).

The aim of the IUCN system is to identify taxa that are facing a high probability of extinction, using objective methods and quantitative criteria. Taxa can be classified into categories of threat depending on their probabilities of extinction, i.e. Critically Endangered, Endangered or Vulnerable, or are designated as Near Threatened, Data Deficient, Extinct or Extinct in the Wild. There are five broad criteria (A to E) based on quantitative thresholds that are used to assess the probabilities of extinction for taxa. To meet the minimum categorization (i.e. level of Vulnerable) for Criterion A, the taxon must show a population reduction over a set time period of at least 30%, or 50% where the decline is reversible, understood and has ceased. Taxa qualifying for Vulnerable under Criterion B would have a limited geographic range (<20,000 km^2) or restricted area of occupancy (<2,000 km^2) and at the same time meet two of the following three subcriteria: a continuing decline; a severely fragmented population or ten or fewer locations (location being an area in which a single threatening event can rapidly affect all individuals of the taxon present); extreme fluctuations in specified population parameters. Taxa with small global populations would qualify for Vulnerable under Criterion C if the total population size numbers fewer than 10,000 mature individuals and there is either a continuing decline of at least 10% over a set period or a continuing decline in numbers of mature individuals combined with small (<1,000 mature individuals) or single subpopulations and/or extreme fluctuations in the number of mature individuals. Taxa with very small (fewer than 1,000 mature individuals) and/or very restricted populations (area of occupancy <20 km^2 or five or fewer locations), and that are potentially subject to threatening processes, would qualify for Vulnerable under Criterion D. Where a quantitative analysis indicates a probability of extinction in the wild to be at least 10% within 100 years, a taxon would qualify for Vulnerable under Criterion E. For further more detailed explanation and definitions, refer to IUCN (2001).

In contrast to previous (pre-1994) methods for assessing extinction risk, the IUCN (2001) system does not adequately account for rarity in the absence of extreme fluctuations, decline or potential threat, and as a result there is no equivalent for the old “Rare” category except in special circumstances. For this reason, Victor and Keith (2004) proposed a quantitative system of assessing, recording and documenting taxa that should be considered for legal protection and conservation as a “safety net” to avoid taxa ultimately becoming threatened (referred to as the Orange List). The Orange List draws attention to taxa that are rare but are not declining or facing potential threats, as well as taxa that are declining but at rates lower than the thresholds specified for the A criterion. These taxa of conservation concern are useful additional biodiversity surrogates for conservation planning purposes to which the targets proposed in this paper can be applied.

Methods

Biodiversity targets for species should aim to include sufficient populations in a conservation plan to avoid future listing of the species in an IUCN Red List threat category and thereby avoid a high risk of extinction in the wild. The species targets proposed here aim to avoid an increase in the extinction risk of Endangered and Vulnerable species or the extinction of Critically Endangered species, to improve the conservation status of Critically Endangered, Endangered and Vulnerable species (by removal from the Red List, although this may not be possible for naturally rare species, i.e. species with very small or restricted populations that are Red Listed under the D criterion), and to prevent other conservation-worthy species (e.g. Near Threatened or Orange List species) from meeting the IUCN criteria for Vulnerable.

We propose that biodiversity targets for species should be based on the quantitative thresholds developed for the IUCN Red List criteria, particularly in relation to the Vulnerable category (IUCN 2001). The minimum targets as follows, would then apply.

All known populations of Critically Endangered, Endangered and Vulnerable taxa listed under the IUCN Red List criteria of B, C or D, should be included in a conservation plan as any loss of populations, locations or individuals of such a taxon will increase the taxon's extinction risk. In relation to the Orange List system developed by Victor and Keith (2004), all populations of taxa qualifying for the Critically Rare, Rare or Rare-sparse categories should be included. Essentially, all populations for any rare taxa with fewer than 11 known localities (localities being geographically separate sites at which the taxon has been recorded) should be included, independent of how that rarity is defined or assessed, in order to avoid an immediate threatened listing in the event of a decline or extreme fluctuations in specified population parameters (assuming that one locality would be equivalent to one location).

The A criterion has the potential to force the listing of species with extremely abundant populations onto IUCN Red Lists (Mace et al. 2008). Incorporating all known populations of these species into a conservation plan would be impractical and in fact unnecessary. As such, for all threatened (Critically Endangered, Endangered, Vulnerable) species solely listed under the IUCN Red List criteria of A or E as well as any other conservation worthy species (e.g. Near Threatened species), 11 locations (or in the absence of any potential threat, 11 populations or 11 localities) should be conserved, thereby avoiding a Vulnerable listing under the B criterion in the event that the species is subject to a decline or extreme fluctuations in specified population parameters whilst meeting the geographic range thresholds. At least 10,000 mature individuals should also be conserved, thereby avoiding a Vulnerable listing under the C criterion in the event that the species is subject to a decline or extreme fluctuations in specified population parameters. The number of mature individuals can be converted into a spatial target by determining the area of habitat required to support the relevant number of individuals. This approach to taxa solely listed under the A or E criteria would effectively stabilize a population decline before the species qualifies for Vulnerable under the other IUCN criteria. In fact, in the absence of a population decline and as long as the conservation target of 11 locations and 10,000 mature individuals can be maintained, the status of the species may improve with time as it would cease to qualify for listing under the A or E criteria (Mace et al. 2008).

In order to avoid conflicts in outcomes of conservation planning exercises at different geographical scales (Vazquez et al. 2008), targets should be proportionally assigned to the planning region. For example, if 10% of the range/distribution of a species occurs within the planning region, the proportional target would be at least one location (or population or locality) and 1,000 mature individuals.

For species recovery, species targets should aim to increase the number of locations (or populations or localities) to at least 11. If the species is naturally geographically rare, this may not be possible. This target is more appropriately applied to taxa that were formerly widespread and have declined to such an extent that they currently occur at fewer than 11 locations. Similarly, where the number of mature individuals of a formerly more common species is now fewer than 10,000, the species target should aim to increase the number of mature individuals to at least 10,000. These recovery targets would entail the setting aside of sufficient suitable habitat within the conservation plan where future re-introductions can take place.

Although extensive consultation and testing of the IUCN Red List system strongly suggest that it is robust across most organisms, the criteria do not take into account the life histories of every species. As such, specialist knowledge on the spatial and temporal requirements of a species may indicate that a higher target is necessary. However, it is our opinion that the approach proposed in this paper provides a good basis for setting biodiversity targets for species and is especially useful where the life histories of the taxa are poorly known.

In this paper, we use the term "population" in the general ecological sense, except where the term specifically applies to Red List criteria, when "population" is defined as the total number of individuals of the taxon (IUCN 2001).

Results

Case studies from South Africa are presented below, where the proposed approach to target setting has been applied to plant and animal taxa listed as threatened under the IUCN Red List criteria of A to D. Examples of taxa listed as Near Threatened and in the category of Rare (Victor and Keith 2004), as well as one species in need of recovery are also presented. The plant case studies originate from the Gauteng and the animal case studies from the KwaZulu-Natal provinces of South Africa (Fig. 1), both of which have well established conservation planning projects underway within the relevant provincial nature conservation authorities. Both national and provincial targets are therefore provided as part of the case study

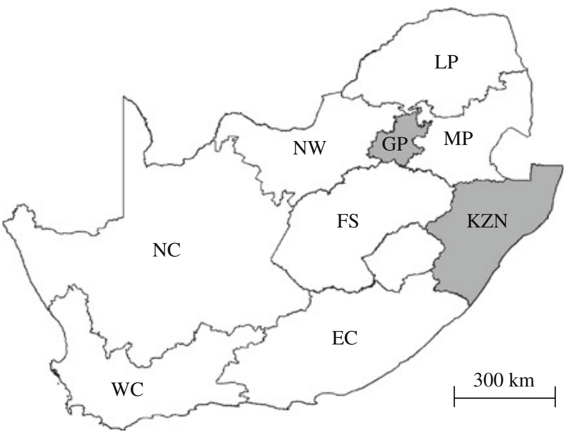

Fig. 1 Provinces of South Africa—Gauteng (GP), KwaZulu-Natal (KZN), Limpopo (LP), Mpumalanga (MP), North-West Province (NW), Free State (FS), Eastern Cape (EC), Western Cape (WC), Northern Cape (NC)

discussion. In the Gauteng province, populations of threatened and rare plant species have been located, mapped and surveyed since 1998 (see Pfab and Victor 2002). The IUCN Red List statuses for plants follow Raimondo et al. (2009), and for animals follow Friedmann and Daly (2004), Hamer (2006) and Herbert (2004). Information contained in the South African National Biodiversity Institute's (SANBI) species distribution database was used for calculating targets for some of the plant case studies. [SANBI's species distribution database integrates PRECIS, the computerized database of herbarium specimens lodged in South Africa's national herbarium (Magill et al. 1983), ACKDAT, a computerized database of J.P.H. Acocks's field notes (Rutherford et al. 2003), the database of the Protea Atlas Project (Rebelo 1991), the CREW Threatened Plants database and the National Vegetation Database.]

Plant listed under A criterion: *Bowiea volubilis* subsp. *volubilis*

National status: VU A2ad

This taxon occurs in the eastern parts of South Africa from the Eastern Cape and northwards throughout sub-Saharan Africa, to at least as far north as Kenya. It is under severe pressure from harvesting for medicinal use over the majority of its range in South Africa, with an estimated minimum decline of 30% having taken place over the past 30 years.

National conservation target: 11 locations and 10,000 mature individuals.

Provincial (Gauteng) conservation target: one location and 500 mature individuals (according to SANBI's species distribution database, approximately 5% of the distribution range of this taxon occurs within Gauteng). This target equates to approximately two of the 11 populations mapped and surveyed since 1998 (Fig. 2) (survey results indicate an approximate average population size of 300 individuals), although the populations ultimately selected into the conservation plan would be dependent on the irreplaceability values calculated for the site selection units in which they are present. Due to the nature of

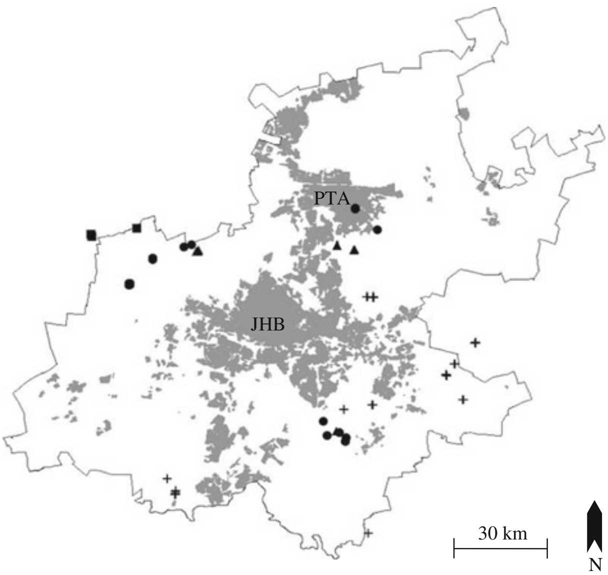

Fig. 2 Populations of *Bowiea volubilis* subsp. *volubilis* (*filled circle*), *Habenaria mossii* (*filled triangle*), *Kniphofia typhoides* (*plus sign*) and *Frithia pulchra* (*filled square*) mapped and surveyed in the Gauteng province since 1998 relative to urbanized areas (*gray shading*) and the major cities of Johannesburg (JHB) and Pretoria (PTA)

the threats in Gauteng (potential urban development on small land parcels), the location target is easily met. In situ management is essential to prevent harvesting of individuals from populations required to meet the conservation target, otherwise a continuing decline in the number of mature individuals would eventually result in qualification for Vulnerable under the C criterion.

Snail listed under B criterion: Dlinza Forest pinwheel snail *Trachycystis clifdeni*

Global status: CR B1ab(iii)

The Dlinza Forest pinwheel snail is endemic to KwaZulu-Natal and is known only from a single location (Fig. 3). The quality of its habitat is declining. It is threatened by human disturbance and removal of understory plants, as well as potential pollution of the swamp where the snail is known to occur.

National/provincial conservation target: All known populations. Habitat suitable for *T. clifdeni* should be searched to locate any additional populations.

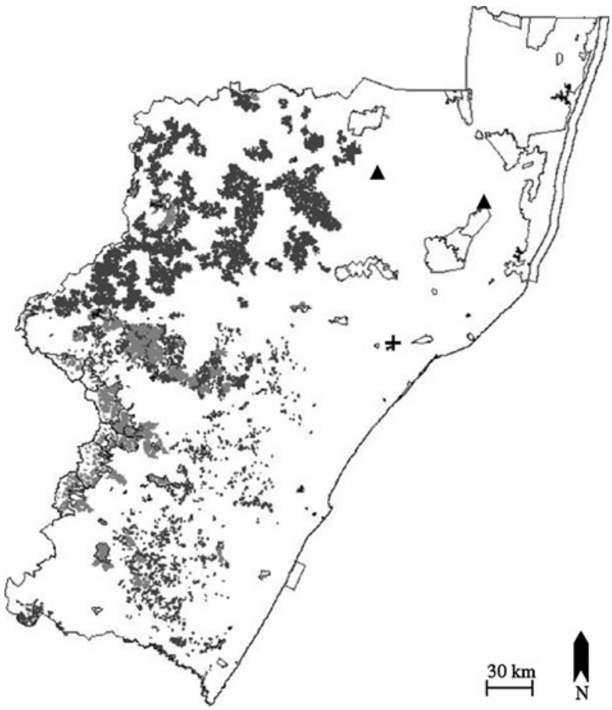

Fig. 3 The known localities for *Trachycystis clifdeni* (*plus sign*) and *Doratogonus hoffmani* (*filled triangle*), and areas of suitable habitat within or immediately adjacent to statutory protected areas essential for the conservation of oribi (*lightly shaded areas*) and additional areas of suitable available habitat of a viable size (*darkly shaded areas*) that could support viable populations of oribi in order to achieve the conservation target for KwaZulu-Natal. *Lightly shaded areas* comprise (1) all habitat within protected areas that can accommodate viable populations of oribi, (2) all habitat within protected areas that, in combination with suitable adjacent habitat, can accommodate viable populations of oribi and (3) habitat within protected areas that cannot support viable oribi populations either in isolation or in combination with adjacent suitable habitat (and where management interventions such as regular translocation of oribi would be required to maintain viability). *Polygons* indicate location of statutory protected areas in the province

Orchid listed under C criterion: *Habenaria mossii*

Global status: EN C2a(i); D

This species is endemic to Gauteng, found mainly around Johannesburg, Pretoria and Krugersdorp. Surveys of the remaining habitat within the province revealed that there are only about 230 mature individuals. These occur as seven scattered populations, the largest of which only has 70–80 mature individuals, but there are generally less than 40 mature individuals per population. A continuing decline is noted for the species due to rapid urban expansion.

National/provincial conservation target: All known populations, including all populations located and mapped since 1998 (a total of four; Fig. 2) as well as suitable habitat to support a further three populations, with a minimum patch size of 26 ha (survey results indicate an average area of occupancy of 26 ha for populations of this species), to represent historically recorded populations that to date have not yet been located during field surveys but are presumed extant.

Animal listed under D criterion: Hoffman's black millipede *Doratogonus hoffmani*

Global status: VU D2

Hoffman's black millipede is known only from KwaZulu-Natal where it occurs in scarp forest in the Hluhluwe-iMfolozi Game Reserve and in the Ngome Forest (Fig. 3). The Hluhluwe-iMfolozi Game Reserve is a formal conservation area and most of it is under no immediate threat, although the forested area is small (<2,000 ha). The northern part of Ngome Forest is grazed by cattle, and there are proposals to allow the sustainable use of the forest by local communities. Degradation of either the forest core (where breeding takes place) or the forest edge (utilized by the adults) could cause a reduction in the population. The fire regime is likely to have altered through human activities such as agriculture, silviculture and pastoralism and this may pose a threat to the species. The species has not been collected from other forests in the area and it is unlikely that individuals are able to disperse between the two localities where it has been collected.

National/provincial conservation target: All known populations. In situ management should aim to mitigate anthropogenic impacts and searches for *D. hoffmanni* in the intervening forest areas should be undertaken to determine whether additional populations exist.

Plant listed as Near Threatened: *Kniphofia typhoides*

Global status: NT A2ac

This species occurs in marshy areas in grassland between Parys, Lydenburg, Paulpietersburg and Newcastle, in the provinces of Gauteng, Mpumalanga, Limpopo, the eastern parts of North-West Province, Free State and KwaZulu-Natal. Extensive declines in the population in the last 30 years are suspected as a result of loss of habitat to coal mining, overgrazing by cattle, urbanization (especially in Gauteng), crop production in the eastern North West Province and invasion by weeds and other exotic species in Western Mpumalanga and North West Province (Craib 1996). The overall extent of the decline is however uncertain.

National conservation target: 11 locations and 10,000 mature individuals.

Provincial (Gauteng) conservation target: three locations and 2,500 mature individuals (according to SANBI's species distribution database, approximately 25% of the distribution range of this taxon occurs within Gauteng). Based on field surveys, this target equates to all of the eight confirmed and surveyed populations (Fig. 2). Due to the nature of the threats in Gauteng (potential urban development on small land parcels), the location target is easily met.

Plant listed as Rare: *Frithia pulchra*

Global status: LC; *national status*: Rare

This succulent species occurs in Gauteng and North West Province, where it is found along the Magaliesberg mountain range from west of Hartbeespoort Dam to Rustenburg. It forms one large population, spread over an area of about 100 km^2. There are no serious threats to the species that are likely to cause a decline, although collecting for horticultural purposes could potentially pose a threat.

National/provincial conservation target: The entire population, part of which occurs in Gauteng (Fig. 2).

Animal in need of recovery: Oribi *Ourebia ourebi*

National status: EN C2a(ii)

Oribi were once far more widespread and numerous than they are today, although the former population size is unknown. There are at present an estimated 2,500 oribi in South Africa. More than 25% of the population has disappeared since 1981 due to escalating loss of grassland habitat and continued persecution by humans. Oribi usually occur in low densities and are highly selective feeders that seldom use agricultural lands or pastures as a source of supplementary winter food, and are therefore useful indicators of grassland health. The effects of habitat destruction and fragmentation, inappropriate land management and hunting have severe impacts on the numbers of oribi in an area.

National conservation target: At least 10,000 mature individuals, implying that sufficient suitable habitat to support 10,000 mature individuals must be conserved to allow for future re-introduction efforts.

Provincial (*KwaZulu-Natal*) *conservation target*: 4,500 mature individuals (approximately 45% of the extant distribution of oribi in South Africa falls within KwaZulu-Natal), split into three management areas: 2,250 mature individuals in the north and 1,125 in the south-east, where the average ecological density for oribi for both areas is 1 animal per 12 ha (Everett et al. 1991), and 1,125 mature individuals in the south-west, where the average ecological density is 1 oribi per 27 ha (Oliver et al. 1978; Rowe-Rowe and Scotcher 1986). In a "safe" environment, such as a formal conservation area, a minimum viable population of only 90 individuals of all ages can be supported, equating to a minimum viable area of 2,430 ha of suitable habitat in the south-west and at least 1,080 ha in the other two management areas, while outside of formal conservation areas at least 24,300 ha in the south-west and at least 10,800 ha elsewhere of contiguous suitable habitat would be required to support a minimum viable population of 900 individuals of all ages (Coverdale et al. 2006). By taking into account the number of mature adults ($\geq$1 year old) in a viable population in the south-west area and the other two areas, using the mean ratios of juveniles to adults recorded by Rowe-Rowe (1982) and Oliver et al. (1978), and Everett (1991), respectively, it was established that 172,300 ha of suitable habitat is required to meet the target for oribi in KwaZulu-Natal (Fig. 3). The protected area system and adjacent areas of suitable habitat, comprising 150,700 ha of the target, are essential for the conservation of oribi, while an additional 10,800 ha of suitable habitat is required in both the north and the south-east management areas to meet the provincial conservation target.

(Habitat suitability models are considered legitimate surrogates of the area of occupancy when this is unknown; Rondinini et al. 2005).

Discussion

The approach to setting conservation targets for species for conservation planning purposes described in this paper is likely to be an improvement on approaches used thus far. The complex approach devised by Burgman et al. (2001) is data intensive due to its reliance on an in-depth knowledge of the species and its habitat, knowledge that often does not exist, while setting simple targets of representing each species at least once does not ensure long term persistence of species (Van Teeffelen et al. 2006). Single representation targets are inadequate for long term maintenance of biodiversity (Cabeza and Moilanen 2003) and do not capture genetic diversity (Neel and Cummings 2003). There have been, however, some attempts to build persistence into single representation targets by selecting sites of a minimum viable size, selecting sites where species are more abundant or have persisted over time (Wiersma and Nudds 2006), or by adding to the baseline target a retention target of additional sites (Pressey et al. 2003).

Multiple representation targets and percentage targets have been used previously (e.g. Armstrong 2001, 2002), but such targets may be arbitrary and may not address persistence (Wiersma and Nudds 2006). High percentage targets, where a high proportion of a species' area of occupancy is proposed for inclusion in a conservation plan, may ensure persistence but at the expense of efficiency (Sarkar et al. 2009) and may in fact be unnecessary.

Our approach gives rise to multiple representation targets, unless of course the species is known only from a single population, thereby ensuring long-term persistence of species (Cabeza and Moilanen 2001, 2003). As the number of locations or localities, populations or individuals proposed for conservation are based on the IUCN (2001) thresholds for the Vulnerable category, our approach to target setting can be ascribed with the same elements attributed to the IUCN Red List system, i.e. scientifically defensible, objective, transparent, applicable to a variety of species and habitats, standardized for consistency, accessible and rigorous (Mace et al. 2008). These attributes are particularly important when justifying decisions that limit land uses considered to be detrimental to biodiversity. Application of these targets will at the very least, through the implementation of the resulting conservation plan, ensure that the conservation status of threatened species do not worsen over time through qualifying for higher categories of threat and may in fact improve the conservation status of threatened species by eliminating the threat of habitat loss and stabilizing population declines before the species in decline qualify for Vulnerable under criteria B, C and D. The proposed species targets furthermore ensure that sufficient individuals, locations/localities and populations of other conservation worthy species, such as declining or rare species (Victor and Keith 2004), are included in a conservation plan to avoid future risk of extinction due to habitat loss.

A prerequisite for the use of the conservation targets proposed here is that the species must have been evaluated according to the IUCN (2001) Red List criteria, and correctly in accordance with these criteria. Although all plant species in South Africa have been categorized according to the 2001 IUCN criteria (Raimondo et al. 2009), this is not the case for most invertebrate and some vertebrate species. Emphasis needs to be given to Red Listing invertebrate taxa in order for this proposed system of setting targets to be broadly applicable in South Africa. A similar situation pertains in other parts of the world.

Over and above the targets proposed in this paper, it is important that unoccupied patches of suitable habitat are additionally conserved in order to provide for the metapopulation requirements of species (Cabeza and Moilanen 2003), especially important for those species considered to be fair dispersers (Cousins et al. 2003). Simple metapopulation occupancy models predict equilibrium occupancy at 37% (Lopez and Pfister 2001), a useful first approximation for determining the number of unoccupied patches that should be conserved in addition to existing populations when species are poorly known.

In conclusion, it must be emphasized that simply preventing the destruction of habitat in which populations of a threatened species occur or establishing formal protected areas do not guarantee persistence (Pfab and Witkowski 1999). In situ management to maintain key ecological processes and reduce impacts from threats such as alien species and pollution is vital.

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