Threatened Species Programme

# Threatened Species: A guide to Red Lists and their use in conservation

South African national biodiversity institute SANBI

## LIST OF ABBREVIATIONS

| | |
|---|---|
| AOO | Area of Occupancy |
| BMP | Biodiversity Management Plan |
| CBD | Convention on Biological Diversity |
| CITES | Convention on International Trade in Endangered Species |
| DAFF | Department of Agriculture, Forestry and Fisheries |
| EIA | Environmental Impact Assessment |
| EOO | Extent of Occurrence |
| IUCN | International Union for Conservation of Nature |
| NEMA | National Environmental Management Act |
| NEMBA | National Environmental Management Biodiversity Act |
| NGO | Non-governmental Organization |
| NSBA | National Spatial Biodiversity Assessment |
| PVA | Population Viability Analysis |
| SANBI | South African National Biodiversity Institute |
| SANSA | South African National Survey of Arachnida |
| SIBIS | SANBI's Integrated Biodiversity Information System |
| SRLI | Sampled Red List Index |
| SSC | Species Survival Commission |
| TSP | Threatened Species Programme |

# Threatened Species: A guide to Red Lists and their use in conservation

## OVERVIEW

The International Union for Conservation of Nature (IUCN)'s Red List is a world standard for evaluating the conservation status of plant and animal species. The IUCN Red List, which determines the risks of extinction to species, plays an important role in guiding conservation activities of governments, NGOs and scientific institutions, and is recognized worldwide for its objective approach.

In order to produce the IUCN Red List of Threatened Species™, the IUCN Species Programme, working together with the IUCN Species Survival Commission (SSC) and members of IUCN, draw on and mobilize a network of partner organizations and scientists worldwide. One such partner organization is the South African National Biodiversity Institute (SANBI), who, through the Threatened Species Programme (TSP), contributes information on the conservation status and biology of threatened species in southern Africa.

The IUCN Red List Categories and Criteria for identifying species at risk of extinction were extensively reviewed between 1991 and 1999, and the revised Categories and Criteria (version 3.1) came into use in 2001. All assessments submitted to the IUCN Red List must use this system. The system contains nine categories, with the main purpose of classifying species from lowest to highest risk of extinction.

This manual takes you through the steps of the Red-listing process. **Chapter 1** provides background information and various definitions related to threatened species work in South Africa. **Chapter 2** provides detail on the IUCN's system of Red List Categories and Criteria, as well as information on how assessments are conducted, and how Red List data are applied in species conservation. Finally, **Chapter 3** provides some examples of Red Listed species in South Africa from taxonomic groups assessed by the TSP and its partner institutions.

**Chapter 1:**

# Threatened species conservation in South Africa

## SANBI's Threatened Species Programme

The Threatened Species Programme (TSP) is primarily aimed at fulfilling the South African National Biodiversity Institute (SANBI) mandate to monitor and report on the conservation status of South Africa's indigenous plant and animal species. The TSP co-ordinates the collection of information on species, particularly those that are not well known, such as reptiles, spiders and marine fishes, through projects involving volunteers from the public, as well as scientists, taxonomists[1] and conservationists from partner institutions across the country. The data collected through these projects are used to assess species' status according to the internationally accredited Red List Categories and Criteria developed by the International Union for Conservation of Nature (IUCN).

In addition, the TSP co-ordinates and promotes the use of species information in all spheres of biodiversity conservation – from national and international conservation legislation and policy, to conservation planning, protected area selection, protection of threatened habitats, *ex situ* conservation[2] programmes, and the development of Biodiversity Management Plans[3] (BMPs) for species.

## What is a threatened species?

Threatened species are often also referred to as endangered species. These are species that have been classified as 'at high risk of extinction in the wild'. This means that if nothing is done to conserve them and their habitats, chances are very high that these species will go extinct.

1 A professional in the field of taxonomy, the science of describing and classifying plants and animals into species, orders, families, etc.

2 Breeding or growing species away from their natural habitats, for example in zoos or botanical gardens, with the purpose of re-introducing bred individuals to the wild

3 Legally binding management and conservation plans aimed at ensuring the long-term survival of specific species by assigning the responsibility of managing, monitoring, and reporting on the status of a species to a specific person or organization

## What is a protected species?

Protected species are species protected by international, national and provincial legislation. Hunting, picking, owning, importing, exporting, transporting, growing, breeding and trading of such species are illegal without valid permits or licences. The names of protected species are listed in international conventions, national acts and provincial ordinances. Examples include the following:

- The Convention on International Trade in Endangered Species (CITES), which regulates the international commercial trade of species. A list of CITES-protected species can be obtained from www.cites.org/eng/disc/species.shtml
- The list of threatened or protected species contained in the National Environmental Management: Biodiversity Act (NEMBA). These are nationally protected species that can only be owned, hunted, picked, traded, imported, exported, transported, bred or grown with a valid permit. A list of NEMBA-protected species is available at www.speciesstatus.sanbi.org/pdf/NEMBAToPslist23Feb.pdf
- The list of protected trees of the Department of Agriculture, Forestry and Fisheries (DAFF). In terms of the National Forests Act of 1998, no trees in natural forests, or tree species that appear on DAFF's list of protected trees, may be cut, disturbed, damaged or destroyed. Moreover, their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold without a licence granted by DAFF. A list of trees that are protected in terms of the National Forests Act can be downloaded from www.dwaf.gov.za/Documents/Notices/30253c.pdf

## Are all threatened species protected by law?

No. Species that can be legally protected are typically those that are threatened due to activities that can be regulated by permits, such as hunting or trade. Species that are threatened due to other reasons, such as habitat loss, require other forms of conservation, and are usually not included in Government Gazetted[4] lists of protected species.

## What is a Red List?

Red Lists and Red Data Books are scientific publications that document the conservation status of species. They are based on a system that categorizes species according to their risk of extinction. Red Lists are not in themselves legislation to protect species, but are used to inform threatened species legislation.

The idea of documenting threatened and extinct species originated in the 1940s with publications such as *Extinct and Vanishing Mammals of the Western Hemisphere* (Allen 1942). In 1956, the IUCN founded the Species Survival Commission (SSC), one of the oldest and largest commissions in the organization, to co-ordinate the documentation of extinct, endangered and rare species in Red Data Books. Initially, only a few selected species were included in Red Lists and Red Data Books based on recommendations by scientific experts. By the 1970s, Red List categories were developed to

### SOUTH AFRICAN LEGISLATION

**NEMBA** contains a **list of threatened or protected species** that are protected by national legislation. Species on this list are placed in one of four categories:

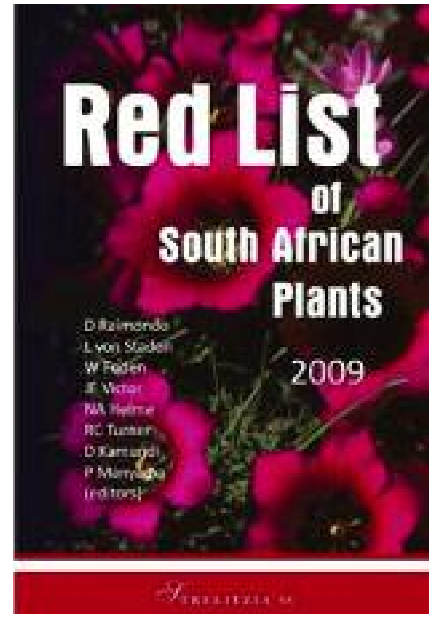
- **Critically Endangered species** – any indigenous species facing an extremely high risk of extinction in the wild in the immediate future
- **Endangered species** – any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a Critically Endangered species
- **Vulnerable species** – any indigenous species facing an extremely high risk of extinction in the wild in the medium term future, although it is not a Critically Endangered species or an Endangered species
- **Protected species** – any species which is of such high conservation value or national importance that it requires national protection

It is important to note that although the category names in this list are similar to those in the IUCN Red List system, and their category definitions are broadly similar to those of the IUCN categories, they are not equivalent. This is because two different species classification systems are used: The IUCN Red List system uses a set of five objective criteria based on biological factors to classify species in terms of their risk of extinction, while species contained in NEMBA, on the other hand, are categorized and listed based on expert opinion. Therefore, a species' classification in NEMBA may differ from its Red List category.

4 Officially published by National Government

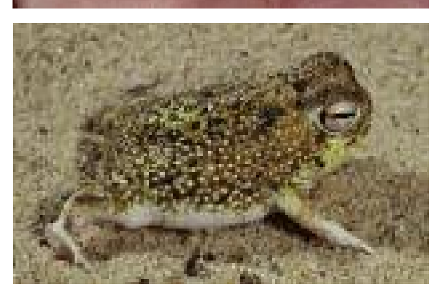
subdivide extinction risk according to degree of threat, as well as data uncertainty. However, species were still categorized according to expert opinion. As a result, the classification of species at risk of extinction was based on inconsistent, subjective perceptions, and was liable to scepticism, uncertainty and controversy, particularly where commercial interests were at stake or where strongly held opinions and emotions were involved in species conservation issues.

A review of the Red List categories during the 1980s revealed an urgent need for a more scientifically objective and robust system that can be reliably and consistently applied across taxonomic groups. In 1991, a process started to develop and test scientifically rigorous, quantitative criteria, to identify species at risk of extinction, in consultation with experts from major taxonomic groups. The first set of quantitative Red List Categories and Criteria was published in 1994. Further testing and review of the criteria led to the publication of the final version of the IUCN's Red List Categories and Criteria (version 3.1) in 2001 (IUCN 2001). These criteria will not be changed in the future so as to allow for objective comparisons of the changes in species' Red List status over time.




Today, the IUCN's Red List of Threatened Species, and its underlying system of categories and criteria for classifying species' extinction risk, is internationally endorsed for its strong scientific base, objectivity and transparency. It is for these reasons that the TSP has adopted this system. Since 2000, the SSC has also recommended a move away from selective assessments, to comprehensive assessments of all species within a taxonomic group or a particular region, regardless of whether they are suspected to be in danger of extinction or not. Such comprehensive assessments provide a more accurate indication of the state of biodiversity. The TSP and its partner projects have adopted this approach, and are producing comprehensive assessments for all South African plants, butterflies, reptiles, birds and amphibians.

In the meantime, the SCC's role has changed from producing Red Data Books, to managing a global network of nearly 8 000 volunteer scientists, who are now conducting the species assessments. This network also includes the TSP. Volunteer scientists are organized either based on the taxonomic group they work on, or into specialist groups by region. Specialist groups conduct assessments, and submit them to the IUCN. The maintenance of the IUCN's Global Red List of Threatened Species is the responsibility of a specialized unit within the IUCN, namely the Species Programme. Staff of this unit are responsible for checking the specialist groups' assessments to ensure that they apply the criteria consistently and accurately, and for providing tools and guidelines to facilitate assessments. The IUCN's Red List of Threatened Species is now too long to be printed, containing over 45 000 species. It is instead published on the IUCN's website (www.iucnredlist.org), and is updated annually.



## Chapter 2:
# Classifying a species as threatened with extinction

## Which species are most prone to extinction?

- **Species at higher trophic levels[5]**
  Predatory species at the top of the food chain occur at much lower densities than their prey and other plants and animals at lower trophic levels. They are often large animals with slow rates of growth and reproduction, needing to produce only a few offspring to maintain their populations. Due to the combination of low population size and slow rates of growth and reproduction, such species are particularly vulnerable to overexploitation and habitat loss.

- **Localized endemics[6]**
  Localized endemics are generally found in taxonomic groups that have undergone recent, rapid evolutionary diversification, such as the plant genera *Erica* and *Pelargonium* in the Cape Floral Kingdom; or where periods of environmental change have driven formerly widespread species into small pockets of suitable habitat conditions, known as 'refugia'; or where species have evolved in small, isolated areas of suitable habitat, such as islands or lakes. Such species are extremely vulnerable to human-induced habitat loss or degradation, which can quickly wipe out the entire population. For this reason, extinction rates on islands are higher than anywhere else in the world (see box 'Islands as hotspots of extinction' on page 10).

- **Species with small populations**
  As explained above, these are typically apex predators[7], but species at lower trophic levels, for example many tropical forest trees, can also occur at very low densities. Individuals of such species easily become isolated in small, unviable groups when their habitats are fragmented as a result of transformation for human use. Critically small populations are prone to local extinction due to environmental-[8] and demographic stochasticity[9], the Allee effect[10], and harmful genetic processes such as inbreeding depression[11].

- **Largest members of species guilds[12]**
  The largest members of a guild have higher metabolic demands, requiring larger areas of intact habitat to survive. They also generally are longer lived, slower to reach reproductive maturity[13], and produce fewer offspring. They therefore tend also to occur at lower densities than other guild members. Habitat fragmentation[14] is the most severe threat to such species. For example, all Madagascan lemur species that have gone extinct since humans have colonized the island were larger than the species remaining today.

- **Species with poor dispersal and colonization ability**
  Species with highly specific habitat requirements, but a poor ability to disperse to new areas of suitable habitat, are at high risk of extinction, even when their populations are relatively widespread. When their

5 Positions occupied in the food chain
6 Species that occur only in an extremely small area
7 Species at the top of the food chain: they have no other predators preying on them, for example lions, sharks and eagles
8 Environmental stochasticity: random variations in environmental conditions that affect the survival of populations. Random events cause local extinctions more readily in small populations than in larger ones
9 Demographic stochasticity: random variations in population dynamics such as breeding success or longevity. The effects of such variations are more severe in small populations and often cause local extinctions
10 The Allee effect occurs when the density of individuals is so low that breeding success is severely reduced or completely disrupted
11 Reduced survival and fertility in a population due to breeding between closely related individuals
12 Groups of organisms that are not necessarily closely related, but exploit the same environmental resources, thereby fulfilling the same ecological roles within ecosystems
13 The age at which a species breeds for the first time
14 When land transformation slices up natural areas into small and isolated pieces

habitats are fragmented, poor dispersers are unable to recolonize areas of suitable habitat where local extinctions have occurred, and individuals become isolated more quickly. Poor dispersers will most likely be hardest hit by climate change, as they are unable to move fast enough to keep up with the shifting of suitable habitat conditions.

- **Species with colonial or gregarious breeding habits**[15]
  Wide-ranging and abundant species that gather in a single place to breed are extremely vulnerable to disturbance or destruction of their breeding sites. Many ocean-roaming seabirds, such as the Spectacled Petrel (*see* '*Case study: Spectacled Petrel' on page 10*), return to a single oceanic island to breed. In the same vein, the communal nesting habit of the Passenger Pigeon (*see* '*Case study: The Passenger Pigeon' on page 9*) made their nests an easy target for hunters. Gregarious breeders such as the Passenger Pigeon often have very complex social structures, which break down when only a few individuals remain. Conservationists were unable to save the Passenger Pigeon from extinction because attempts to coax the last few individuals into captive breeding[16] failed.

- **Migratory species**
  Migratory bird species are not only dependent on the maintenance of their summer breeding and winter foraging habitats, but also on crucial resting points along their migratory routes, where large numbers of birds may gather in small areas. Disturbance and habitat destruction at resting points can affect large numbers of birds while they are at their most vulnerable, as migration is physiologically highly taxing. Animal species migrating overland following shifting food resources require large areas of intact habitat, and are therefore sensitive to habitat loss as well as obstructions to their migratory routes. The conservation of migratory species is very challenging, particularly for species such as birds and marine mammals, which migrate over very large distances, as it requires international co-operation to ensure the protection of these species across national borders.

- **Species dependent on unreliable resources**
  Species that depend on unreliable resources include desert species that rely on rainfall for critical steps in their life cycles, or nectar-feeding insects dependent on the flowering of particular host plants. Such plants and animals usually have very short life cycles, and their population size fluctuates greatly between successive generations, depending on the availability of the resource. Such species are prone to extinction at periods when their numbers are very low.

- **Ecologically naive species**
  Ecologically naive species have evolved without the threat of competitors or predators (including humans), and have subsequently lost the defensive behaviour patterns of their relatives. They are most typically found on remote islands. Ecologically naive birds, for example, become flightless and nest on the ground. Such birds are extremely vulnerable to introduced predators, such as rats, cats or mongoose. Island species also tend to be very tame, making them easy targets for hunters.

15 Gathering together in large groups to breed

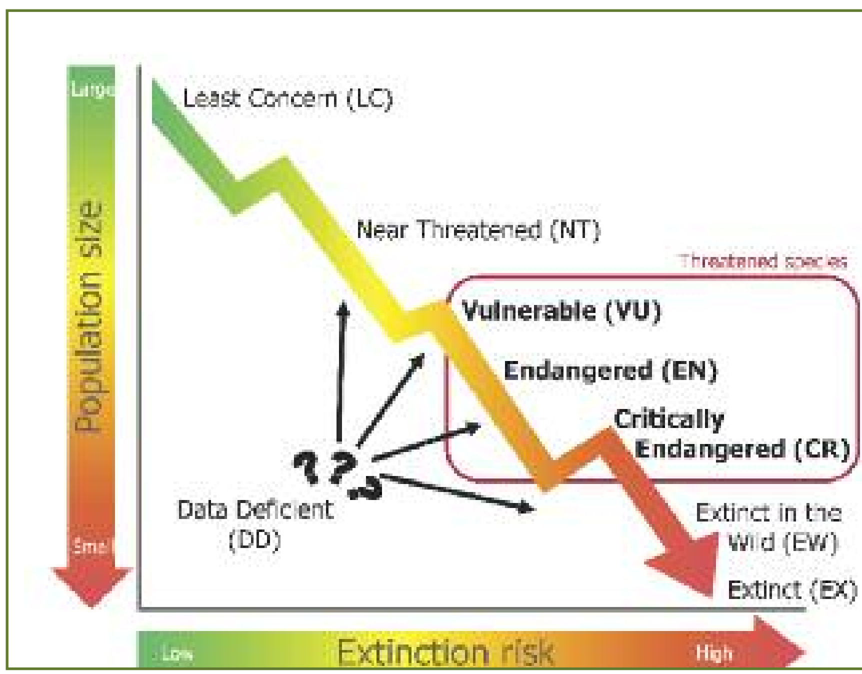
16 Raising plants or animals in zoos, reserves or other controlled conditions to increase the species

## IUCN Red List Categories and Criteria for identifying species at risk of extinction – how does the system work?

The IUCN's Red List system contains nine categories, with the main purpose of classifying species from lowest (Least Concern) to highest (Critically Endangered) risk of extinction (see Figure 1). Specific, quantitative criteria relating to species' population size and trends are used to determine whether a species is at risk of extinction or not. Species that are at high risk of extinction are placed in one of three categories: Vulnerable (VU), Endangered (EN) or Critically Endangered (CR). If a species is classified into one of these three categories, it is a threatened species. A species may be classified as Near Threatened (NT) if it nearly meets the criteria for inclusion in one of the categories of threat.

Species that are already extinct are also documented, in the categories Extinct (no individuals of the species remain) and Extinct in the Wild (no wild individuals remain, but the species survives in captivity or living collections). If insufficient information is available to determine a species' risk of extinction, it is classified as Data Deficient (DD). Species that have not yet been assessed against the Red List criteria are classified as Not Evaluated (NE).

**Figure 1: The IUCN Red List system categorizes species according to their risk of extinction.**



## There are specific rules for the classification of threatened species:

- The categories indicating that a species is threatened with extinction are ranked: A species classified as Endangered (EN) is at higher risk of extinction than a species classified as Vulnerable (VU), and a species classified as Critically Endangered (CR) is at the highest risk of extinction. A species' classification is guided by five criteria relating to different biological factors that indicate danger of extinction. A species should always be evaluated against all five criteria, but available data only need to meet the requirements for at least one criterion in order to classify a species as threatened.
- All five criteria apply to all three categories of threat (VU, EN and CR), but different quantitative thresholds[17] within each criterion determine in which of the three categories a species is placed (see Table 1 on page 14).
- A species is always classified in the highest category of threat for which it meets the quantitative thresholds of at least one criterion.

## The Red List criteria as biological indicators of extinction risk – the scientific basis of the Red List

The quantitative criteria for identifying species at high risk of extinction are determined by an understanding of which types of species are most prone to extinction, as well as scientific studies of the population dynamics of species. Studies have shown that extinction is most likely to occur within a short time frame when:

- the population size is very small;
- the rate of population decline is high (namely, mortality rate[18] is much higher than birth rate); and
- fluctuations in the population size are large in relation to the population's growth rate.

These principles have been built into the Red List criteria so that the criteria are able to detect symptoms of endangerment over a wide spectrum of life histories, ecology and behaviour of different species, rather than simply focusing on causes or 'threats'. Therefore, any process that results in rapid population decline, small population size or large population fluctuations will lead to a species being classified as facing a high risk of extinction. The five criteria are explained in the following pages:

NOTE: Terms marked in italics in the following section are concepts specific to the Red List criteria, and their definitions are often different from their normal biological use. The definitions of these terms are listed at the back of this manual (see page 27) for reference purposes.

17 Set numerical 'cut-off' values for measureable risk factors such as population size

18 The number of individuals dying over a specific period of time

**CASE STUDY:**

**The Passenger Pigeon**
(*Ectopistes migratorius*)

The Passenger Pigeon was once the most common bird in North America. It was a migratory species that lived in enormous flocks, which were as large as 1.6 km wide and 500 km long, taking several days to pass. It was estimated that such flocks contained up to a billion birds, which were some of the largest groups formed by any animal, second only to swarms of the desert locust. On 1 September 1914, *Martha*, the world's last Passenger Pigeon, died in a zoo in Cincinnati, Ohio. What was probably one of the most abundant birds in the world is extinct today. What happened?

During the early 19th century, Passenger Pigeon meat was commercialized as a cheap source of meat for slaves and the poor, and the birds were hunted on a massive scale. By the 1850s, it was noted that the pigeons were becoming scarcer, but the large-scale slaughter of birds continued and even escalated. One commercial hunter reported shipping three million pigeons to markets in 1878. Between 1800 and 1870, the pigeon population declined slowly, but a catastrophic population crash between 1870 and 1890 resulted in only a few birds remaining by the turn of the century.

Attempts to restore wild populations through captive breeding failed due to the gregarious nature of the birds, which practised communal roosting and breeding in large communal nests housing up to a thousand birds in a single tree. As too few birds remained, and their social structures had been disrupted, flocks continued to dwindle.

The Passenger Pigeon is a practical example of the principles behind Criterion A, and stands as a lesson to us today that no species is 'too common' to go extinct.

## Criterion A

**Large and rapid *reduction* in *population size* relative to the life history[19] of the species.**

Criterion A identifies species that are at risk of extinction due to high rates of population decline. Population decline is measured as the proportion or percentage by which the *population* is reduced over a specific time period. The faster a population declines (namely, the higher the percentage of individuals lost over a specific time period) the higher the species' risk of extinction (see quantitative thresholds for Criterion A in Table 1). The time period over which population decline is measured is not the same for all species, but set in relation to the life history, or *generation length* of a species. This is because different species survive and reproduce at different rates, related to how long they live. Apex predators, largest guild members and other long-lived species tend to have fewer offspring at a time and breed less frequently than shorter-lived species. As a result they may decline to extinction more easily even when mortality rate is only marginally increased.

When evaluating a species using Criterion A, *population reduction* does not have to be observed through monitoring or repeat population counts, but may be estimated or inferred from statistical methods for determining population size (such as mark-recapture techniques), habitat loss or other circumstantial evidence. Population decline may have occurred in the past as a once-off event, or it may be ongoing, or may be projected into the future (for example, species that are expected to decline due to climate change).

Species listed as threatened according to Criterion A are often criticized as 'too common' to be threatened. It is important to remember that species Red-listed under Criterion A are at high risk of extinction due to the large reduction in the population size, not the number of individuals that are left. Formerly very widespread and abundant species that have declined extensively may still appear common relative to naturally rarer species, but this does not mean that they are not threatened.

19 The sequence of changes that constitute an organism's life course, particularly focusing on reproduction and survival

## Criterion B

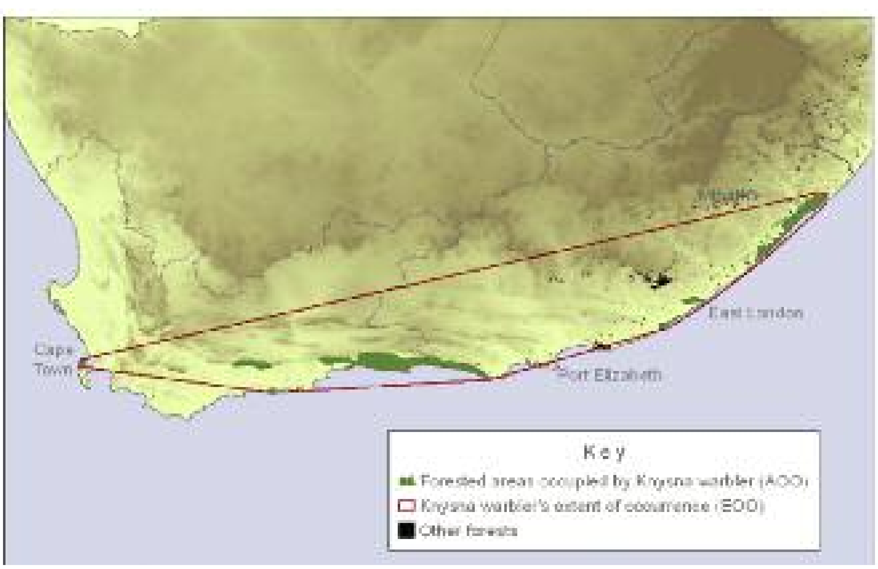
**Small geographic range[20] and decline, population fluctuation or fragmentation.**

Criterion B identifies localized endemics: species that are at risk of extinction because they only occur within a small area. Restricted ranges are however often a natural phenomenon. Studies of localized endemics have shown that if left undisturbed, they will persist for long periods of time so that their natural risk of extinction is in fact very low. Therefore this criterion also incorporates other factors contributing to increased extinction risk, such as *continuing decline* of the habitat or population, *extreme fluctuations* in *population size*, and *severe fragmentation* of the population into small, isolated *subpopulations*.

A small range size alone is not sufficient to classify a species as threatened in terms of Criterion B: at least two other sub-criteria relating to the above-mentioned factors need to be met as well. This criterion enables Red-listing of poor dispersers (which are prone to severe fragmentation) or species dependent on unreliable resources (which tend to have fluctuating populations) as long as they also have small distribution ranges.

When applying Criterion B, it is important that range size is measured consistently. Two specific measures, *extent of occurrence* (EOO) and *area of occupancy (AOO)* are used to determine extinction risk (Figure 2). The smaller the range (in either EOO or AOO), the higher a species' risk of extinction (see quantitative thresholds for Criterion B in Table 1). The range size used should always be a species' present range. Therefore species with naturally small ranges as well as those where habitat loss or population decline has resulted in them now being confined to very small areas can be classified as threatened according to Criterion B.

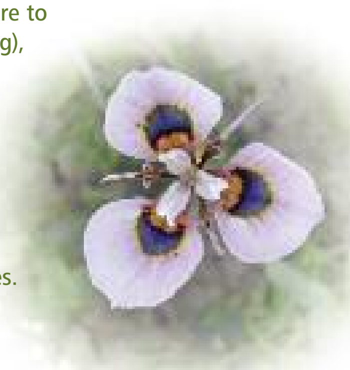
**Figure 2. The threatened Knysna Warbler (*Bradypterus sylvaticus*) has a relatively large extent of occurrence (EOO) across the Eastern and Western Cape, but this forest endemic occupies rather small areas of indigenous forests scattered across its range.**




### ISLANDS AS HOTSPOTS OF EXTINCTION

Nearly all documented human-induced extinctions prior to the year 1800 were of species endemic to islands, including the world's most famous extinct species, the Dodo, a former inhabitant of Mauritius, a small island in the Indian Ocean. Out of the 875 extinct species on the IUCN Red List, 537 (61%) are former island endemics (IUCN 2009). Island species have a number of odds against them, including very restricted ranges, isolation (due to an inability to disperse and colonize new habitats across vast areas of ocean) and lack of defences against introduced species. Island-type extinctions are however becoming increasingly common in mainland areas. This is due to human transformation of natural habitats, resulting in man-made 'islands' of natural areas surrounded by 'oceans' of crop fields, urban sprawl[21] and timber plantations. Species affected by habitat fragmentation[22] face the same challenges as island species in terms of restricted habitat availability, isolation from other individuals, and competition and predation by introduced species, which tend to colonize fragments more easily and more densely than large natural areas.

**THE PEACOCK MORAEA** (*Moraea villosa*) formerly participated in great abundance in the mass spring flower displays of the Cape Lowlands. This attractive flower, which occurs from Gordon's Bay to Ceres and Piketberg, has however lost more than 80% of its habitat to wheat fields and urban expansion. Only a few populations now remain on small fragments of natural veld surrounded by crop fields, where they are threatened by a lack of fire (plants need fire to stimulate flowering), competition from alien weeds spreading from adjoining fields, loss of pollinators, and pollution by agricultural fertilizers and pesticides.



20 The area where a species is found, as can be drawn on a map

21 The unplanned, uncontrolled or disorganized spreading of a city and its development into areas outside the urban edge

22 The slicing up of natural areas into small and isolated pieces by land transformation

Many threatened species such as the Peacock Moraea and Geometric Tortoise occur only on small 'islands' of renosterveld surrounded by 'oceans' of wheatfields such as this one near Piketberg.

## Criterion C

### Small *population size* and decline.

Criterion C identifies species that are at risk of extinction due to small *population size*. The smaller a species' population, the higher its risk of extinction (see quantitative thresholds for Criterion C in Table 1). However, species such as apex predators and other long-lived species naturally occur in smaller populations and at lower densities, but due to their specific life histories and biology, they are able to maintain their small populations without going extinct. Species with small populations are likely to face extinction only when there is also population decline. Therefore, to classify a species as threatened with extinction under Criterion C, the population must not only be small, but must also be declining.

There are two scenarios that make a small population more vulnerable to extinction, which are specifically accommodated under Criterion C. When most (more than 90%) of the remaining *mature individuals* are in one large *subpopulation*, a single threat (such as disease) can easily affect a large proportion of the population. The other high-risk scenario occurs when all *mature individuals* are in small isolated *subpopulations*, because each *subpopulation* is at high risk of local extinction due to the population dynamics of critically small populations (as dealt with in Criterion D).

**CASE STUDY:**

**Steller's Sea Cow**
(*Hydrodamalis gigas*)

This an extinct marine mammal belonging to the order Sirenia, a small group of herbivorous marine mammals including the Dugong and manatees. It was discovered by the naturalist Georg Wilhelm Steller when his exploration vessel was shipwrecked off the coast off north-eastern Russia in 1741. Steller and the ship's crew were stranded on Bering Island for nearly a year while the crew constructed another boat from the wreckage of their ship. During this time, Steller made detailed observations of the sea cow's behaviour and biology.

At the time of its discovery, Steller's Sea Cow occurred around a number of small islands known as the Commander Islands in the Bering Sea. Fossil records however indicate that Steller's Sea Cow was formerly much more widespread in the northern Pacific, occurring as far south as Japan and California. It is not known what caused the decline of the sea cow's population elsewhere, with speculations pointing to hunting by prehistoric humans. What is more certain, however, is that by 1741, a relict population[23] of only a few thousand individuals was all that was left.

Steller's Sea Cow was a long-lived animal with a very low reproduction rate. Females produced only one calf at a time, and Steller estimated gestation length[24] to be over a year. It had no predators, and was a docile, slow-moving animal feeding on kelp in shallow coastal waters, and had no fear of humans.

These traits made them an easy target for hunters, who arrived soon after Steller published his description of the species in 1751. The sea cow's small population size and very low reproduction rate meant that it was extremely vulnerable to exploitation from the onset, being unable to produce enough offspring to maintain their population size, even under very low hunting pressure. The unscrupulous slaughter of Steller's Sea Cows was however, as described by observers at the time, "excessive, greedy and wasteful", with only one in five harpooned animals retrieved, the rest escaping and dying of their wounds at sea. In 1768, a mere 27 years after the species was discovered, the last known Steller's Sea Cow was killed near Bering Island.

23 The surviving remnants of a historically extensive population

24 The time it takes for an embryo to develop in the uterus from conception to birth

## Criterion D

### Critically small *population size* or very restricted distribution.

Criterion D primarily identifies species that are at risk of extinction due to critically small *population size*. Any population undergoes fluctuations in numbers because of changes in environmental conditions or simply because of the inherent randomness of breeding success and population dynamics. If the population is large enough, such fluctuations normally don't affect the stability of the population. However, if the size of the population is critically small, there is the danger that random changes will deplete the population to levels from which it can't recover, and the species will go extinct.

Species listed under Criterion C may be viable at present population levels, provided they do not decline further due to external threats. Criterion D differs in that it identifies species which have already declined to such extremely low population numbers that they are unlikely to persist in the long term. It is thus not necessary for a species to be declining at present in order for it to qualify for a threatened status under Criterion D.

**CASE STUDY: Vulnerable D2**

**Spectacled Petrel**
**(*Procellaria conspicillata*)**

The Spectacled Petrel (opposite) roams the southern Atlantic between the east coast of Brazil, Uruguay and Argentina and the west coast of South Africa and Namibia. Although this seabird has a wide range, the entire population of between 20 000 and 50 000 birds return to a single island, Inaccessible Island near Tristan da Cunha, to breed. The size of Inaccessible Island is only 14 $km^2$, which means that during the breeding season the Spectacled Petrel has an extremely restricted *area of occupancy (AOO)* (see quantitative threshold for AOO under Criterion D in Table 1 and definition of AOO in the section on Definitions of specific terms used in Red List criteria on page 27).

The Spectacled Petrel is an ecologically naive species: Birds nest in burrows in marshy heathlands and along river banks. This means that eggs and chicks are within easy reach of mammalian predators such as feral cats, mice and

BACK FROM THE BRINK

When a species' population size becomes critically small, extinction is practically inevitable. Because critically small populations can go extinct due to random changes in population dynamics, saving such species from extinction is often beyond the control of conservationists. Critically small population size is the 'terminal phase' that all extinct species have gone through on their way to extinction.

In spite of such enormous odds against them, a number of species have been brought back from this brink of extinction and are thriving again today. The two species discussed here both declined to the critically small populations that would meet the quantitative thresholds of Criterion D, but thanks to concerted conservation efforts were saved from extinction:

The **Mauritius Kestrel** (*Falco punctatus*) declined to only four wild individuals in 1974, primarily due to the destruction of its subtropical forest habitat. This island endemic was at that stage **Critically Endangered** according to Criterion D. Other threats that caused this species to decline to critically low numbers were poisoning by organochloride pesticides intended to control malaria-carrying mosquitoes, and predation by introduced Black Rats, feral cats and small Indian Mongooses, which preyed on eggs and chicks. Intensive conservation interventions, including captive breeding, supplementary feeding, nest-site enhancement, provision of nest boxes, nest guarding, control of predators around nest and release sites, clutch and brood manipulations[25], treatment of parasite infestations on chicks, and the rescue of eggs and young from failing nests, resulted in a remarkable recovery of the species. The last captive-bred individuals were introduced in 1994, and since then, the wild population has continued to increase to about 1 000 individuals today.

25 Experiments in which the number of eggs hatched and the number of chicks are controlled

rats. Because the Spectacled Petrel breeds on only one island, the whole population could be severely affected if the island were to be colonized by introduced predators. Fortunately Inaccessible Island is a nature reserve and access to the island is strictly controlled. The accidental introduction of predators, however, remains a potential threat.

The Spectacled Petrel is also threatened by long-line fishing. Long-line fishing is a commercial fishing technique employing thousands of fishing hooks attached to a single line. Petrels and other seabirds used to feeding on discarded fish from fishing vessels dive after baited long lines as they are released into the water. Many become entangled on the hooks and lines and drown. Repeat surveys of the breeding colony in 1999, 2004 and 2009 have however shown that long-line fishing is not causing the Spectacled Petrel's population to decline at present, and that the population is in fact increasing (Ryan et al. 2006, P.G. Ryan, unpublished data). Therefore long-line fishing is presently only a potential threat to Spectacled Petrels.

### Species with very restricted distributions and potential threat.

Criterion D is also used to identify another type of species that is vulnerable to random environmental changes. These species do not necessarily have small population sizes, but they have extremely localized distributions, so that only one or a few threatening events[26] can easily wipe out the whole population. Similar to species with critically small population size, those qualifying for Sub-criterion D2 do not have to be declining at present, but there must be plausible potential threats that could lead to their extinction. Because their risk of extinction is relatively low compared with those with critically small population sizes, Sub-criterion D2 is only applicable to the category Vulnerable.

The **Alpine Ibex** (*Capra ibex*) was hunted to near extinction for its meat, horns, blood and other body parts, which were believed to have medicinal properties. The Alpine Ibex once had a wide range across the European Alps, but by the mid 19th century only a single small population of less than 100 individuals remained in north-western Italy, making this species **Endangered** according to Criterion D. It was only after the area where the last Alpine Ibex remained was seized as royal hunting grounds by King Vittorio Emanuele II in 1856 and a corps of royal gamekeepers was installed to ward off poachers that large-scale hunting of this species ceased. Protection of this small population helped the species to increase again, and in 1913, a descendant of the king donated the royal hunting grounds to conservation, creating Italy's first national park. Captive-bred individuals from this small population were reintroduced across the Ibex's former range, and since the 1960s wild populations stemming from these re-introductions have been increasing and naturally expanding their ranges across the Alps. It is estimated that the population is now more than 30 000 individuals and the current Red List status of the Alpine Ibex is Least Concern. However, as the entire current population are descendants from the small Italian population, the genetic variability of the Alpine Ibex is very low, making them less adaptable to environmental change and disease.

The Alpine Ibex is an important case study for another reason: it illustrates the fact that a species does not have to remain at high risk of extinction indefinitely. Conservation measures can successfully reduce a species' extinction risk so that it is no longer threatened.

26 Incidents such as habitat destruction, diseases or the introduction of new predators that would lead to the death of members of the species and the species to decline. See also definition of *Location* under IUCN terminology

## Criterion E

***Quantitative analysis* of extinction risk.**

Criterion E is used to classify a species as threatened when a statistical analysis shows that the probability of extinction is high within a short time frame. Quantitative thresholds include both the probability of extinction (expressed as a percentage) and the time frame to extinction in terms of *generation length*. A statistical model known as Population Viability Analysis (PVA) is most commonly used for Criterion E. Data on how threatening processes affect population variables such as birth and mortality rates are used to predict extinction risk. As PVAs require intensive and time-consuming demographic study and monitoring of species, Criterion E is not often used in Red List assessments.

**Table 1: The biological indicators of extinction risk as contained in each of the five IUCN criteria.**

Quantitative thresholds within each criterion determine in which category of threat a species is placed.
CR – Critically Endangered, EN – Endangered, VU – Vulnerable.

| Criterion | Biological indicator | Risk factor | Quantitative thresholds | | |
|---|---|---|---|---|---|
| | | | CR | EN | VU |
| A | Large and rapid reduction in population size relative to the life history of the species | Proportion by which population is reduced | >80% | >50% | >30% |
| B | Small geographic range and decline, population fluctuation or fragmentation | Extent of occurrence (EOO)<br>Area of occupancy (AOO) | <100 $km^2$<br><10 $km^2$ | <5 000 $km^2$<br><500 $km^2$ | <20 000 $km^2$<br><2 000 $km^2$ |
| C | Small population size and decline | Population size<br>Number of mature individ-uals in largest subpopulation<br>Proportion of population in largest subpopulation | <250<br><50<br><br>>90% | <2 500<br><250<br><br>>95% | <10 000<br><1 000<br><br>100% |
| D | Critically small population size or very restricted distribution | Population size<br>Area of occupancy (AOO)<br>Number of locations | <50 | <250 | <1 000<br><20 $km^2$<br>Five or fewer |
| E | Quantitative analysis of extinction risk | Probability of extinction over a specified time period | 50% | 20% | 10% |

## Which species may be assessed?

- The Red List Categories and Criteria can be applied to all species, except micro-organisms.
- The Red List Categories and Criteria may only be applied to wild individuals within their natural range.
- When no more natural habitat remains, individuals reintroduced for the purposes of conservation in areas outside the natural range may be assessed once the population has proved to be self-sustaining.
- The Red List Categories and Criteria are typically applied to species, but may also be applied to subspecies and varieties, or biologically isolated subpopulations of species, provided that an assessment at species level is completed first. No taxonomic ranks[27] below variety and above species may be assessed.
- Newly discovered species that are not yet formally described may only be assessed under the following conditions: (1) There must be general agreement that it is clearly a distinct species. (2) The assessment of the species must be of clear conservation benefit. (3) A voucher specimen[28] must be available in a museum or herbarium[29] to allow the species to be traced and identified without confusion. (4) The species must be described within four years of its inclusion in a Red List.
- No hybrids[30], cultivars or breeds may be assessed.
- No domesticated individuals, or feral individuals derived from domesticated sources, may be assessed.
- Naturalized or introduced individuals may not be assessed, unless the introduction was for the purposes of conservation, as described above.

## Global and national (regional) assessments

Red List Categories and Criteria are designed to be applied to the entire, or global, range of a species. Such assessments, which take into account the worldwide distribution range of a species, are known as **global assessments**, and are included in the IUCN's international Red List of Threatened Species.

However, the system also allows for assessments of geographical subsections of a species' global range. Such subsections are typically marked by a human-defined boundary, such as a country or provincial border, or a regional or eco-regional boundary, and are therefore independent of the biological processes that drive species' distribution. The assessments of such subsections are known as **regional assessments**, and use the same set of criteria as global assessments. Regional assessments, though, contain an additional step to adjust the regional status of a species to allow for individuals' movement between populations within and outside the region, and the concomitant impact on the extinction risk of the regional population.

Regional assessments are increasingly used by individual countries to determine the status of species within their borders. As conservation policies on threatened species are typically the responsibility of national bodies or governments, these regional (national) assessments help such bodies or governments to establish their conservation responsibilities towards species within their borders.

27 Similar organisms are grouped together at different levels or ranks, from broad (containing many organisms sharing only a few key characteristics) to specific (fewer organisms are included and they share most characteristics). The different levels at which organisms can be classified are from broad to specific: kingdom, phylum, class, order, family, genus, species, subspecies, variety and form

28 A sample or example of a species that is used as a reference for identifying the species

29 A collection of preserved plant samples that are systematically classified for study

30 Organisms produced by cross-breeding two different species

## How are assessments conducted?

### 1. Information collection

Red List scientists, who can be any biological scientist trained in the application of Red List criteria, will first collect all available information on the species that are to be assessed. Information is gathered from as wide a range of sources as possible, and can include any of the following:

- Taxonomic, scientific and other literature provides information on the distribution, habitat, ecology and life histories of species.
- Herbarium and museum specimens provide a historical overview of the location of species' subpopulations, thereby guiding field surveys. In the absence of field data, specimens can help scientists to estimate the number of subpopulations.
- Electronic spatial data, such as those used in geographic information systems (GIS), can be used to calculate the extent of species' habitats, and maps of land uses can provide information on the threatening processes that may affect species. The extent of occurrence and area of occupancy (used in Criterion B) are calculated in GIS, using geo-referenced point data that indicate the location of existing subpopulations. Electronic spatial data, including climate data, combined with maps of species' distribution ranges have been used to forecast the potential impact of climate change on certain species.
- Observation data obtained through public contributions to atlassing projects, either via structured surveys or submissions to virtual museums, provide vital information on the current distribution and status of populations of threatened species.
- Monitoring data of threatened species collected by scientific institutions and national and provincial conservation agencies provide valuable information on population trends.

Once all available information has been collected, Red List scientists may use it as a basis to conduct preliminary Red List assessments.

### 2. Assessment workshops

Species' Red List assessments are generally conducted through workshops involving persons with expert knowledge on the species that are to be assessed. Experts can be scientists, taxonomists, conservationists, or even amateur scientists with a good knowledge of a particular group of species. Before assessments commence, it is very important that expert contributors to assessments are made aware of the purpose of Red List assessments (namely to determine extinction risk) as well as the supporting data requirements for the five criteria. During the workshop, experts provide additional information to that already collected by the Red List scientists; the data are measured against the Red List criteria, and the appropriate Red List category is assigned to each species. Information typically provided by experts include the status of certain populations of the species that they are familiar with, local knowledge of threatening processes affecting the species, and general information on a species' life history, for example how often it reproduces, or its generation length. This type of information is often excluded from published literature.

#### WHAT ARE ATLASSING PROJECTS?

Atlassing projects are efforts, often involving citizen scientists, where the distributions of plants or animals are mapped in detail. It differs from herbarium/museum collections by not involving the collection of a specimen and as a result atlases contain much more data than the classical means of mapping species. Different projects collect different types of data, but all include the collector, date, locality, identity of the species and usually some population data as well. Citizen scientists contribute their time and resources on a voluntary basis and as a result, large scale projects are feasible.

## WHAT ARE VIRTUAL MUSEUMS?

Virtual museums are databases which store photographs of plants or animals. The ideal virtual museum is backed up by experts who identify the photographs, however amateur identification also works well, with some schemes allowing participants to progress from 'novice' to 'expert' status as they develop their identification skills. Virtual museums are increasingly used in atlassing projects, especially with groups that are more difficult to identify. Photographs are provided by amateurs along with data on locality, date and often anything else of interest.


### 3. Assessment review

After the workshop, the Red List scientists prepare the supporting documentation, containing the data validating species' Red List status for review. Red List assessments follow a peer-review system[31], and it is therefore important that all assessments are checked by reviewers who are independent from the assessment process.

### 4. Publication of assessments

After species' Red List assessments are completed, it is important that they are published in an accessible format so that they can be used to guide the conservation of threatened species. Global assessments conducted by the TSP are submitted to the IUCN for inclusion in the IUCN's international Red List of Threatened Species. Before inclusion, all submitted assessments are first checked to ensure that they have applied the criteria accurately and consistently. Red List assessments are still published in book format, but increasingly also on websites. The Red List status of species assessed by the TSP and its partner projects can be found on SANBI's Integrated Biodiversity Information System (SIBIS).

### 5. Updating of assessments

New information about threatened species continually becomes available, and it is therefore important that assessments are updated to keep abreast of the latest available data. Red Lists play an important role in guiding conservation, but if assessments are left to become outdated, the already limited conservation resources might not be channelled to those species requiring the most urgent intervention.

The IUCN recommends the reassessment of species' status every five to ten years.

Specific rules are also set to guide the movement of species between categories:

- If successful conservation attempts improve the status of a species, thereby lowering its extinction risk, that species needs to be moved to a lower category. However, this may only be done after the new status has been maintained for at least five years. This condition is intended to ensure that the conservation measures are indeed effective, and to prevent the premature withdrawal of conservation support for the species.
- If a species' situation has worsened, however, it should be moved to a higher category without delay.
- If new information reveals that a species has been classified incorrectly, the species should be reassessed and the correct category applied without delay.

31 Subjecting a professional's work, research or ideas to the scrutiny of others who are experts in the same field

## How are Red Lists used?

The IUCN defines the purpose of Red Lists as follows:

- To provide a global index of the state of biodiversity
- To identify and document those species most in need of conservation action if current rates of extinction are to be reduced

Today, Red Lists are no longer mere lists of species names and their conservation status – they are underpinned by a wealth of supporting data as required by the IUCN's quantitative criteria. It is precisely these data that make Red Lists a valuable resource, as analyses of Red List data can answer important conservation-related questions. This is why Red Lists are being applied in increasingly wide-ranging national and international conservation processes.

- **The Red List Index as an international indicator of biodiversity trends**

  In 2002, signatory governments to the Convention on Biological Diversity (CBD) resolved to "achieve by 2010 a significant reduction of the current rate of biodiversity loss". When setting such goals, it is important to be able to measure whether or not one is making progress towards them.

  Both the CBD and the United Nations Millennium Development Goals have adopted analyses of IUCN Red List data for measuring progress towards biodiversity targets. The analyses produce a single statistic, or indicator, which can be tracked over time. This indicator is called the Red List Index.

  The Red List Index is based on overall trends in the extinction risk of species. It tracks species' movement through the Red List categories, from lowest to highest risk of extinction. Only Red List status changes resulting from genuine deterioration of, or improvement in, species status are used in the analysis; taxonomic changes or changes resulting from improvements in knowledge are excluded. Therefore, this index provides a reliable estimate of the success or failure of conservation actions in preventing species extinction.

  The Red List Index is, however, problematic in the sense that it demands complete Red List assessments of all species in a particular taxonomic group, as well as at least one reassessment of all species for a trend to be seen. Only a very small subset (about 2.7%) of the world's estimated 1.8 million described species has been assessed, and an even smaller proportion, mostly well-known groups such as birds and mammals, have been comprehensively assessed and reassessed to be used in the Red List Index. The Red List Index has therefore been criticized as being an insufficient representation of biodiversity, as the most diverse taxonomic groups, such as plants and invertebrates, have been excluded from the analysis due to a lack of comprehensive assessments.

  In response, a modified version of the Red List Index, the Sampled Red List Index (SRLI), was developed to achieve better representation of all taxonomic groups. This index is calculated in the same way as the standard Red List Index, but is based on a randomly selected sample of 1 500 species per taxonomic group, instead of comprehensive assessments.

### THE LAZARUS EFFECT

One of the main purposes of Red Lists has always been to indicate the effectiveness of biodiversity conservation. Initially, extinction rate[32] was used as the main indicator. However, analyses of extinct species lists showed a large turnover in species listed, and while lists of threatened species tended to grow, lists of extinct species often tended to shrink!

This phenomenon was named the 'Lazarus effect', and is the result of the incorrect classification of species as Extinct. Earlier Red List criteria for classifying a species as Extinct focused on the time that had lapsed since the last observation of the species. This caused many species that were merely undersurveyed to be listed as Extinct, only to be 'resurrected' when they were rediscovered. The latest South African Red List for plants, for example, records the rediscovery of 18 species that were formerly classified as Extinct.

Two important changes to the Red List system resulted from these findings:

1. Red List criteria for classifying species as Extinct became much stricter. While the Red List system allows for the classification of species as threatened as a precautionary measure when high-quality data are not available, listing a species as Extinct requires conclusive evidence. The current definition of extinction indicates that there must be "no reasonable doubt that the last individual has died". Species may only be classified as Extinct when repeated surveys of all available habitats at appropriate times have failed to record an individual. Such a strong evidence-based approach may however also result in an underestimation of the number of extinct species. For this reason, the current version of the Red List Categories and Criteria (IUCN 2001) allows for species to be listed as Possibly Extinct in the category Critically Endangered. Species classified as Critically Endangered (Possibly Extinct) are those that are highly likely to be extinct already, but a small chance remains that they may be rediscovered.

32 The number of species going extinct over a particular time frame

2. Reporting on the state of biodiversity is no longer based on extinction rate, as it cannot be reliably measured. Instead, the Red List Index uses trends in the changes of the Red List status of species to measure the success of conservation efforts.

When ***Babiana blanda*** was not seen for more than 50 years, it was believed to be extinct. Most of this species' wetland habitat on the lowlands north of Cape Town had been transformed or severely degraded by agricultural and urban expansion, as well as alien invasive plants. There was little hope of its survival, and it was classified as Critically Endangered (Possibly Extinct). Then in 2006 a number of *Babiana blanda* plants were discovered growing under a dense thicket of alien acacias on a farm north of Cape Town. *Babiana blanda*'s status remains Critically Endangered according to Criteria B and C.

- **National reporting on the state of biodiversity within South Africa**
  - One of SANBI's obligations in terms of NEMBA is to report to the Minister of Water and Environmental Affairs on the state of South Africa's biodiversity. The Red List data are used in the calculation of statistics for this reporting. These include analyses of changes in the Red List status of species, as well as analyses of major threats affecting species in South Africa.
  - The National Spatial Biodiversity Assessment (NSBA) is a spatial report on the state of biodiversity across South Africa. This assessment analyzes spatial data in the form of electronic maps of habitats, ecological processes, and the distribution of threatened and other species of concern, as well as information on existing protected areas and patterns of land use, to identify areas within South Africa where conservation is a high priority. The results of the NSBA guide the formulation of national policies on conservation and the sustainable use of South Africa's biodiversity, such as the National Biodiversity Strategy and Action Plan.
  - Red List data are also used in state of the environment reporting at provincial and municipal levels.
- **Conservation legislation and policy**
  - Red List data on the status and distribution of threatened species are used to classify threatened terrestrial ecosystems. Ecosystems can be classified as threatened based on a set of quantitative criteria similar to those for species. One such criterion considers the number of threatened species occurring within an ecosystem. Threatened ecosystems are protected by law, preventing further habitat loss, and promoting effective management in terms of NEMBA. The listing of threatened ecosystems is an important legislative tool for the protection of species threatened by habitat loss.
  - The National Environmental Management Act (NEMA) requires Environmental Impact Assessments (EIAs) to be conducted for proposed developments in order to ensure sustainable development. In terms of the principles of sustainable development, degradation or loss of biodiversity should be avoided if possible, or otherwise minimized or mitigated.[33] EIAs must therefore report on any threatened species that occurs at a proposed development site, as the development is likely to cause a loss of biodiversity, either by increasing the extinction risk, or by directly leading to the actual extinction of the species. If a site survey finds a threatened species, the EIA report should include clear recommendations on how further decline in the threatened species and its habitat should be prevented, based on an understanding of the Red List status of the species, and the reasons why it is threatened. The recommendations should provide guidelines to conservation authorities evaluating the EIA report on whether or not the development should be approved, or on specific mitigation conditions under which the development application could be approved.

33 To try and lessen the seriousness or impact of a negative occurrence

- **Informing conservation planning**
  Systematic conservation planning is the process of analyzing spatial biodiversity data to identify high-priority areas for conservation. The aim of conservation planning is to ensure that viable, representative samples of species, habitats and ecosystem processes are maintained by producing maps to guide land-use planning[34] and decision making at various scales, from municipal to provincial and national level.

  Representivity and viability are achieved by setting particular quantitative conservation targets for habitat areas or a number of species subpopulations. To set such targets, a good understanding of the biological functioning of species and ecosystems is essential. Species targets should be set so that no threatened species' extinction risk increases, and to prevent species currently at low risk of extinction from becoming threatened. Species target setting should therefore not simply focus on those already at risk of extinction by only prioritizing species that have been Red Listed as threatened, but must also consider other species of conservation concern.

- **Guiding conservation actions for species**
  Red List assessments are the first step in identifying species that are in urgent need of conservation, and data assembled during assessments can provide guidance on the most appropriate conservation actions.

  Red List assessments can also assist in the development of species Biodiversity Management Plans (BMPs). BMPs are not required for all threatened species, but are rather developed for specific ones, particularly those that are important biological resources on which people rely for their livelihoods, or species that can only be conserved through multiple stakeholder co-operation.

- **Guiding scientific research**
  Many species are likely to be in danger of extinction, but are too poorly known for us to determine their extinction risk. Such species are classified as Data Deficient. Trends and patterns in these Data Deficient species help identify gaps in our knowledge, and can be used to guide field surveys, taxonomic and ecological studies, and research into specific threatening processes and their mitigation.

### SPECIES OF CONSERVATION CONCERN

The IUCN Red List system measures species' relative risk of extinction. However, species' Red List status alone is insufficient to determine priorities for conservation. While Red List status helps to identify species that most urgently need conservation, other factors, such as financial considerations, chances of conservation success, the cultural or economic value of species, as well as other biological and ecological characteristics of species, are equally important when determining how and where the limited available conservation resources should be directed in order to gain maximum biodiversity benefits.

South Africa is particularly rich in localized endemic species. However, owing to the Red List's focus on extinction risk, many species occurring only within small areas or highly specialized micro-habitats may be grouped together with very abundant and widespread species in the category Least Concern, because they are currently at low risk of extinction. Such species may be very important for the overall preservation of biodiversity, but can be overlooked if conservation prioritization or planning targets focus only on threatened species.

To help identify localized endemics among South Africa's more than 20 000 plant species, the national Red List of South African plants, for example, uses the additional categories Rare and Critically Rare to distinguish localized endemics from other widespread and abundant species also included in the category Least Concern. Localized endemics, threatened, Near Threatened and Data Deficient species are collectively called species of conservation concern, and are included in planning targets and other priority-setting exercises.

34 The way authorities attempt to order and regulate the way land is used

## Chapter 3:
# Local examples of Red List species

## BRENTON BLUE

SCIENTIFIC NAME *Orachrysops niobe*
STATUS Critically Endangered
CRITERIA B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v); C2a(ii)

The population of the Brenton Blue Butterfly is confined to a single small nature reserve covering only about 2 ha of fynbos – this species' habitat. Population monitoring recorded a steady decline between 2002 and 2006. Careful studies of the species as well as its host plant[35] and host ant[36] resulted in management recommendations to improve conditions in order to sustain the population in the Brenton Blue Butterfly Reserve. Since the management recommendations have been implemented, particularly those to increase the density of the Brenton Blue's host plant, the population has recovered slightly since 2007, but remains critically small.

DISTRIBUTION The only known colony of the Brenton Blue is the Brenton Blue Butterfly Reserve in Brenton-on-Sea near Knysna in the Western Cape.

HABITAT The habitat is a mixture of asteraceous[37] coastal fynbos and coastal thicket. On-site trees such as candlewood provide partial shade, which seems to be the butterfly's preferred location for laying eggs.

ECOLOGY The adult butterflies hatch in late October and November, living for only two to three weeks. The males establish and patrol territories, seeking and attracting females for mating. The females 'advertise' their presence by giving off pheromones[38], which attract the males. The fertilized female lays her eggs singly on the underside of the leaves of the host plant *Indigofera erecta*. The larva hatches after about ten days, and feeds on the leaflets of the food plant until after the larva's second moult[39] when it reaches the third instar stage.[40] It then crawls down the stem of the plant to the ground, and encounters the host ants, *Camponotus baynei*, which attend to the larvae, protecting them from predators. The larvae produce highly palatable and nutritious secretions from honey glands in their skin, on which the ants feed. The ants excavate a hole around the rootstock of the plant, and the larva crawls down onto the rootstock, on which it then starts to feed. The larvae have a final development stage, during which they grow to 15-20 mm in length, before pupating[41] in the hole alongside the rootstock. The host ants nest in dead wood lying on the ground. The ants that attend to the larvae are foraging ants that return to their own nest to share the nutritious exudations[42] of the Brenton Blue larvae with the young ants. From the eggs laid in October and November, adults hatch in the following January/February. If weather conditions are favourable, there could be a small third brood in April.

THREATS The piece of land where the butterfly breeds at Brenton-on-Sea was set aside for housing development in 1983. The Lepidopterists' Society[43] informed the developer of the presence of the butterfly, and began negotiations and a public awareness campaign to prevent its destruction. Eventually, the land was bought by the Green Trust (Nedcor), which forms part of the Brenton Blue Butterfly Reserve. The Brenton Blue Butterfly Reserve came into being in 1998, but was proclaimed as a special nature reserve in 2003. Small populations, like this one, will always be at great risk of random events, such as severe drought or uncontrolled fire. The reserve needs to be carefully monitored and managed to sustain the health and availability of the butterfly's host plant. In addition, viable colonies of the host ant species, to which the Brenton Blue's life cycle is strongly linked, need to be present. These ant colonies may be threatened by invasive (alien) ant species or vegetation changes. Furthermore, small breeding populations of any animal species are at risk of loss of genetic diversity due to inbreeding effects. If any genetic deformities are present, these will persist in future generations, and may lead to the deterioration of the species.

Further information www.brentonblue.org.za

35 A particular plant species preferred by a particular butterfly species for food, shelter or nesting sites

36 Many butterfly species have a mutually beneficial relationship with particular ant species. The butterfly larvae provide nourishing secretions to the ants, while the ants in turn protect the larvae from predators

37 Belonging to the daisy family

38 A chemical substance that influences the physiology or behaviour of others of the same species

39 Periodic casting off of the skin to allow the larva to grow

40 The stage between moults, when an insect is systematically undergoing a metamorphosis

41 Forming a protective cocoon or hardened case, called a pupa, in which the larva undergoes complete transformation to the adult (butterfly) stage

42 A substance that oozes out from larvae pores

43 An international society with branches across the world for those interested in and concerned about the conservation of Lepidoptera, namely moths and butterflies

## WESTERN LEOPARD TOAD

SCIENTIFIC NAME *Amietophrynus pantherinus*
STATUS Endangered
CRITERIA B1ab(ii,iii,iv,v)+2ab(ii,iii,iv,v)

The Western Leopard Toad has a small distribution range in the Western Cape. Only a few subpopulations remain and continue to decline due to ongoing loss and degradation of their habitat.

DISTRIBUTION The Western Leopard Toad occurs on lowlands from the Cape Peninsula along the coast to Cape Agulhas, never more than 10 km from the sea.

HABITAT Western Leopard Toads prefer deep water with floating plants in large wetlands, vleis, dams and sluggish water in lowland fynbos. Toads can also be found near wetlands and water bodies in transformed areas, such as urban gardens, farmlands and parks.

ECOLOGY The Western Leopard Toad breeds during winter in permanent water bodies. During this season, adults migrate to breeding sites, where breeding takes place over a very short period, a behaviour pattern known as 'explosive breeding'. Adults are vulnerable during migration, and many are killed crossing roads adjoining breeding sites. Tadpoles complete their metamorphosis in three months. Males reach reproductive maturity after one year, and females after two. Toads feed on a variety of prey, including crickets, moths and worms, and are most active at night.

THREATS Although this species survives in urban and agricultural areas, loss and degradation of habitat is a major threat, causing continued population decline. For more than 25 years, no breeding activity has been recorded at breeding sites between Pringle Bay and Kleinmond (Measey & Tolley 2009), an area of recent, rapid urban expansion and coastal development. It is possible that the Western Leopard Toad might be locally extinct in this area. Road kills of adult individuals are also concerning. Only a very small proportion of this species' habitat is currently protected in the Agulhas and Table Mountain National Parks. Most breeding sites are located on privately-owned or municipal properties, requiring the participation of multiple stakeholders to ensure its survival. Public awareness and participation in Western Leopard Toad conservation efforts around Cape Town has contributed to better knowledge and understanding of the toads' population structure, breeding and migration patterns, as well as to the alleviation of some threats to adult toads in urban areas. A BMP is being developed for the Western Leopard Toad. To become involved in Western Leopard Toad conservation, visit www.leopardtoad.co.za

## WHITE-HOT POKER

SCIENTIFIC NAME *Kniphofia leucocephala*
STATUS Critically Endangered
CRITERIA B1ab(iii)+2ab(iii)

*Kniphofia*, commonly known as Red-hot Pokers, is a genus of approximately 70 species that are closely related to aloes. When Dr Leslie Codd revised the genus in 1968, he noted that two specimens of a white-flowered *Kniphofia*, collected from unknown sites near Richard's Bay, did not match any other known species. However, it was only after a wild population was discovered in 1990 at the Langepan Wetland, that *Kniphofia leucocephala* could be formally described. By then, the coastal plains around Richard's Bay had been extensively transformed. Despite extensive searches, no other populations could be located. Although recently implemented conservation actions have resulted in the recovery of the only known population, the status of Critically Endangered is maintained as per the IUCN's five-year waiting rule for downlisting species after successful conservation efforts.

DISTRIBUTION The White-hot Poker is known from a single wild population occurring in a wetland surrounded by forestry plantations north of Richard's Bay in Northern KwaZulu-Natal. It may have been more widespread, but by the time the population was discovered, less than 2% of the natural grasslands of the coastal plain between Richard's Bay and St Lucia remained. With no historical record in the form of herbarium specimens, it is however impossible to say what the initial extent of its range had been.

HABITAT The White-hot Poker occurs in and around wetlands in grasslands on low-lying coastal plains.

ECOLOGY White-hot Pokers are adapted to survive fires and droughts by resprouting from underground rhizomes.[44] Plants can remain dormant[45] underground for a number of years while unfavourable conditions persist. Fire appears to stimulate flowering and germination of seedlings. The faint scent and white colour of the flowers indicate that evening flying insects, such as moths, could be the pollinators. However, flies and bees have also been seen collecting pollen from this species.

THREATS This species' habitat has been extensively transformed by urban expansion, commercial forestry plantations, commercial sugarcane cultivation, overgrazing as well as subsistence farming. This has probably led to extensive population declines in the past. However, as the species remained overlooked until it was discovered in 1990, it is impossible to determine what the past range and population size had been, and how much of it has been lost.

The only known population had been almost completely destroyed before the species was even described. At the time of the discovery, the site was being prepared for the planting of new pine seedlings. After pressure was mounted on the then Department of Water Affairs and Forestry, the pine seedlings were removed, but with considerable disturbance to the site (Menne 1992). Through the years, the site was badly neglected, and forestry roads fragmented the sensitive wetland. The number of flowering individuals declined from 70 in 1991, to only 21 in 1998 (Scott-Shaw 1999), a decline of 70% in just seven years.

In 2001, SiyaQhubeka, a private forestry company, acquired 26 451 ha of the formerly state-owned forestry plantations bordering on the Greater St. Lucia Wetland Park. SiyaQhubeka introduced radically new forest management strategies, including a commitment to conservation (SiyaQhubeka Forests).

Langepan was declared a National Heritage Site, and considerable effort has been put into rehabilitating the wetland. These measures included closing off the roads that had cut through the wetland, removing herds of cattle grazing in the wetland, and moving the plantations bordering the wetland further away to increase the buffer zone between the plantations and the wetland. A conservation management plan for the site, including a regular burning regime[46] and population monitoring, was also implemented.

In just a few years since conservation management of the site was implemented, the White-hot Poker population has recovered remarkably, currently consisting of about 350 individuals.

However, the future survival of this population is by no means guaranteed. Former pine plantations around the wetland have recently been replaced by gumtrees (*Eucalyptus* spp.), and although the plantations are now further away from the wetland, the impact on the site may still be increased, as gumtrees are known to extract far more water from the underground water table than other plantation species. This may have a negative impact on the wetland in the future. The gumtrees are still small, and therefore, the White-hot Poker population appears to be thriving at present. However, the impact on the water resource is expected to intensify as the trees mature. Continued monitoring of the population will reveal whether the population will be sustainable in the future.

44 Horizontal, usually underground stems that act as reproductive structures, sending out roots and shoots from their nodes; also called 'rootstalk' or 'rootstock'

45 A condition of biological rest, but capable of being activated again

46 Systematic plan of controlled fires to stimulate plant growth and reproduction

## AFRICAN BLACK OYSTERCATCHER

SCIENTIFIC NAME *Haematopus moquini*
STATUS Near Threatened
CRITERIA C1

African Black Oystercatchers were classified as Near Threatened for the first time in 1988 due to their small population size and low breeding success on mainland beaches, where birds were disturbed during their summer breeding season. Population size was estimated at fewer than 5 000 birds in 1997 (Martin 1997), and is reported to be between 5 000 and 6 000 birds at present (BirdLife International 2009). While population declines were noted in some areas, population increases have been observed at a number of offshore breeding sites as well as mainland areas. These can be attributed to the introduction of conservation measures to prevent disturbance of breeding birds, as well as increasing food sources from an introduced Mediterranean mussel (Tjørve & Underhill 2006). The status of the African Black Oystercatcher has been maintained as Near Threatened due to uncertainty about the overall population trend (BirdLife International 2009), but increasing evidence of population growth and expansion indicates that it may soon be possible to reclassify the species as facing no immediate threat (Hockey 2009).

DISTRIBUTION The African Black Oystercatcher is found on the eastern and southern coast of Southern Africa, from Lüderitz in Namibia to Mazeppa Bay in the Eastern Cape. This species however appears to be expanding its range eastwards, with increasing reports of breeding pairs in KwaZulu-Natal in recent years.

HABITAT The African Black Oystercatcher occurs along rocky and sandy mainland beaches and on offshore islands, and less frequently around estuaries, lagoons and coastal pans.

ECOLOGY African Black Oystercatchers feed on limpets, mussels and other bivalves[47], polychaetes[48], whelks[49] and crustaceans[50] in rocky areas along the coast. Because their hard-shelled prey is fairly difficult to prise from rocks, young chicks remain dependent on their parents for much longer than other waders. African Black Oystercatchers breed above the high-tide line of sandy beaches, and eggs are laid on the ground in shallow hollows. Pairs breed only once a year, and normally manage to raise only one or two chicks. The breeding season coincides with the summer holiday season, which makes breeding birds vulnerable to disturbance by large numbers of beach visitors. African Black Oystercatchers are long-lived, form long-term pair bonds, and are territorial, which together with limited coastal habitat availability, accounts for the low densities of birds and small population size.

THREATS The major threat to African Black Oystercatchers is reduced breeding success due to disturbance during the summer breeding season. When birds are disturbed, they may leave the nest, leaving the eggs vulnerable to trampling, predation by Kelp Gulls and dogs, and overexposure to the sun, which causes embryos to die. Driving of off-road vehicles on beaches caused the destruction of nests, eggs and chicks, as chicks tend to hide in vehicle tracks. As a result of disturbance on mainland beaches, breeding success was too low to sustain the population, and it was suspected that the mainland population was sustained by birds migrating from offshore islands. Birds on offshore islands are threatened mainly by introduced mammalian predators and predation of chicks and eggs by Kelp Gulls, which have increased in numbers in the Western Cape due to increased food sources around harbours and rubbish dumps.

Conservation measures such as the banning of off-road vehicles from beaches, and raising public awareness have reduced disturbance of breeding birds. An alien species of mussel introduced from the Mediterranean has spread through most of the African Black Oystercatcher's range, and has become the bird's main food source in many areas. The introduced mussel is more accessible to the birds than native mussels, and has led to increases in African Black Oystercatcher populations. The cessation of guano[51] scraping has reduced the disturbance of birds on near-shore islands. Recent research however indicates that African Black Oystercatchers may be vulnerable to temperature increases brought about by climate change, which may reduce breeding success during hot summers (Hockey 2009).

47 Marine or freshwater molluscs with two hinged shells

48 A type of segmented worm, generally found in the marine environment; sometimes referred to as 'bristle worm'

49 Large marine snails

50 Any mainly aquatic arthropod, usually having several pairs of jointed legs and a hard protective outer shell

51 Accumulation of a substance composed mainly of the dung of sea birds or bats along certain coastal areas or in caves, to be used as fertilizer

## GEOMETRIC TORTOISE

SCIENTIFIC NAME *Psammobates geometricus*
STATUS Critically Endangered
CRITERIA A2acde

The Geometric Tortoise is South Africa's most threatened tortoise, with fewer than 5 000 individuals remaining. Its name is derived from the yellow geometric patterns on its shell. The Geometric Tortoise was feared to be extinct by the 1950s; however, in the 1960s, a few small populations were found in fragments of renosterveld[52] – the species' preferred habitat. Although much effort has been put into the conservation of the Geometric Tortoise, the population continues to decline due to ongoing habitat loss and isolation of small numbers of individuals on habitat fragments.

DISTRIBUTION The Geometric Tortoise is endemic to the Western Cape, where it has a restricted range from Gordon's Bay northwards along the coastal lowlands to Piketberg, and eastwards in the Upper Breede River and Ceres valleys.

HABITAT Geometric Tortoises occur in lowland areas between the Cape Fold Mountains and the coast, where they are restricted to renosterveld. Renosterveld occurs mainly on nutrient-rich clay soils, making it more suitable to agriculture than other types of fynbos, which occur on sandy soils. For this reason, renosterveld, which formerly had been a widespread vegetation type on the Cape Lowlands, is today one of South Africa's most threatened habitats. More than 90% of renosterveld has been irreversibly transformed, mainly into crop fields, and all that remains today are small fragments.

ECOLOGY Geometric Tortoises are attractive, medium-sized tortoises with a beautiful yellow starred pattern on a dark brown to black background on their shells. Females are larger than males, and after mating in early spring, the females lay three to five eggs in a hole in the ground in late spring and early summer, safeguarding the eggs against accidental runaway wildfires in their habitat. Usually, these eggs hatch during the next autumn, when the first winter rains have softened the soil, and act as cue for hatching. It is also at this time of year when the fire hazard in renosterveld has dropped significantly. Geometric Tortoises have a varied vegetarian diet, which comprises herbaceous plants, succulents and grass. Geometric Tortoises are long-lived, reach reproductive maturity at 7 to 8 years of age, and may live for over 30 years.

THREATS Habitat destruction has been the greatest cause of population decline and fragmentation, and the range and availability of tortoise habitat continue to reduce. As a result of habitat loss and fragmentation, ecological processes in small fragments, such as fires, have been disrupted. Fires are a natural part of fynbos ecology; however, maintaining optimal fire cycles in small fragments is very difficult, and requires intensive management. Too frequent fires have led to local extinctions of tortoise populations in isolated fragments, such as Harmony Flats near Gordon's Bay. Other threats include collecting wild tortoises for the pet trade, and alien invasive species. Attempts at captive breeding of Geometric Tortoises have had limited success, and conservation efforts rather rely on the protection of wild populations and their habitat.

A recently completed survey in the Boland confirmed that Geometric Tortoises are still to be found on only a handful of properties, mostly privately owned. Good news is that most of the sites are either already signed up or in the process of being signed up as conservation stewardship sites. Private landowners hold the future of the Geometric Tortoise in their hands, and need all the available support from CapeNature to keep these remaining sites environmentally healthy. Geometric Tortoises enjoy complete legal protection, and nobody may collect or disturb, have in their possession, or export from the Western Cape any specimens without special permission.

52 A grey, shrubby, fynbos-type vegetation dominated by renosterbos (*Elytropappus rhinocerotis*)

## SPIDERS

Although it is estimated that there are about 170 000 species of spiders in the world, thus far only 29 species' Red List status has been determined. About 2 000 spider species occur in South Africa, but no species have been assessed as yet. The South African National Survey of Arachnida (SANSA) aims to bridge this gap by collecting data, documenting and describing the arachnid[53] fauna of South Africa, and ultimately completing Red List assessments for South Africa's spiders. Baboon spiders (from the family *Theraphosidae*) are South Africa's most threatened spiders, as they are targeted for the pet trade. The following two species are likely to be classified as threatened:

- **Paulseni Horned Baboon Spider** (*Ceratogyrus paulseni*). This spider is only known from a small area near Letaba in the Kruger National Park. Spiders live in subterranean burrows of up to 60 cm deep. Burrows are found in clay soils in clearings in Acacia-Mopane woodland. This species is likely to be threatened due to its restricted range and its popularity in the international pet trade.
- **African Purse-web Spider** (*Calommata simoni*). A Purse-web Spider was first collected in South Africa in 1916, and described as a new species, *Calommata transvaalensis*. However, no more spiders were seen again, and the species was later synonymized with *Calommata simoni*, which also occurs in Central Africa. However, SANSA surveys have again found Purse-web Spiders in South Africa for the first time since 1916, with specimens collected in Gauteng, Limpopo and the Free State. These spiders differ from the Central African Purse-web Spiders, and the results of SANSA's work indicate that there are at least three species of Purse-web Spiders in South Africa. Purse-web Spiders live permanently in closed, silk-lined burrows. The top part of the burrow is crater-like and completely sealed off with silk. The spider lies on her back, and bites through the silk structure when prey lands on it. These rare spiders have restricted ranges, and are likely to be threatened by collectors.

53 Pertaining to spiders and spider-like creatures, being members of the class *Arachnida*

## Definitions of specific terms used in Red List criteria

**Area of occupancy**
Area of occupancy is the area in km2 within a species' extent of occurrence which is physically occupied by the species. This measure considers the fact that a species will not usually occur throughout the area of its extent of occurrence, which may contain unsuitable or unoccupied habitats (see Figure 2). In some cases, for example, irreplaceable colonial nesting sites or crucial feeding sites for migratory species, the area of occupancy is the smallest area essential at any stage to the survival of existing population of a species.

**Continuing decline**
A continuing decline is a recent, current or projected future population decline that is liable to continue unless remedial actions are taken.

**Extent of occurrence**
Extent of occurrence is the area in $km^2$ that is encompassed by a minimum convex polygon (see Figure 2) containing all the current sites of occurrence of a species, but excluding vagrancy.

**Extreme fluctuations**
Extreme fluctuations are large, rapid and frequent variations in population and range size, typically more than one order of magnitude (namely, a tenfold increase or decrease).

**Generation length**
Generation length is the average age of mature individuals in the population. It is intended to reflect the turnover rate of breeding individuals in the population, and is therefore neither the age of reproductive maturity, nor the age of the oldest breeding individuals, except for species that breed only once.

**Location**
A location is a geographically or otherwise distinct area where a single threatening event can rapidly affect all individuals of a species present. The size of the location is therefore based on the size of the impact of a threatening event. Location is therefore not the same as subpopulations or 'localities', as it may incorporate a number of subpopulations or just part of a subpopulation, depending on the size of impact. If more than one threat is affecting a species, the most severe threat should be used to define locations. For some threatening processes it may not be possible to determine locations, and in such instances other appropriate criteria should be tested.

**Mature individuals**
Mature individuals are those individuals that are known, estimated or inferred to be capable of reproduction.

**Population**
Within the Red List criteria, the term population is used in a very specific sense that is different from its normal biological use. The Red List's definition of population is *the total number of individuals of a species.*

**Population and subpopulation size**
The population size, as is used in Criteria C and D, always is a count of only the *number of mature individuals in the population or in a subpopulation.*

**Population reduction**
This term, used in Criterion A, refers to a decline in the number of mature individuals in the population as a percentage of the original population size. Therefore, if a population of 10 000 mature individuals declined to 2 000 mature individuals, there has been a population reduction of 80%.

**Quantitative analysis**
A quantitative analysis is any form of analysis which estimates the probability of extinction of a species based on known life history, habitat requirements, threats and any specified management options.

**Severely fragmented**
The term severely fragmented refers to a situation where a species' risk of extinction is increased due to the fact that more than half of its individuals occur in small, isolated subpopulations. These small subpopulations may easily become locally extinct due to stochastic processes, with a limited possibility of recolonization of sites of local extinctions. Poor dispersers are more easily severely fragmented than species capable of long-distance dispersal.

**Subpopulations**
Subpopulations are geographically or otherwise distinct groups of individuals within the population between which there is little demographic or genetic exchange.

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## Further reading


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- To get information on species listed on the Global IUCN Red List visit: www.iucnredlist.org
- To access information about a South African species' IUCN Red List status, CITES Appendix listing or NEMBA TOPS status visit: http://sibis.sanbi.org
- To find out more about the IUCN Red List Categories and Criteria visit: www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria
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