Species Environmental Assessment Guideline

Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa.

Produced for the Department of Environment, Forestry and Fisheries by the South African National Biodiversity Institute and BirdLife South Africa
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Left to right, top to bottom: Smaug giganteus (Luke Verburgt); Cercopithecus albogularis schwarzi (Luke Verburgt); Heleophyne rosei (Luke Verburgt); Aloides rossouwi (André Coetzer); Aquila verreauxii (Duncan McKenzie); Cheilanthes deltoidea silicicola (Lukas Niemand).

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### Glossary of terms and acronyms

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<th>Abbreviation</th>
<th>Meaning</th>
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<tr>
<td>ADU VM</td>
<td>Animal Demography Unit Virtual Museum</td>
</tr>
<tr>
<td>AEWA</td>
<td>Agreement on the Conservation of African-Eurasian Migratory Waterbirds</td>
</tr>
<tr>
<td>AZE</td>
<td>Alliance for Zero Extinction</td>
</tr>
<tr>
<td>BGIS</td>
<td>Biodiversity Geographic Information System (SANBI)</td>
</tr>
<tr>
<td>BI</td>
<td>biodiversity importance</td>
</tr>
<tr>
<td>BMP</td>
<td>biodiversity management plan</td>
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<tr>
<td>CA</td>
<td>competent authority</td>
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<tr>
<td>CAR</td>
<td>Coordinated Avifaunal Roadcounts</td>
</tr>
<tr>
<td>CBA</td>
<td>Critical Biodiversity Area</td>
</tr>
<tr>
<td>CI</td>
<td>conservation importance</td>
</tr>
<tr>
<td>CITES</td>
<td>Convention on International Trade in Endangered Species of Wild Fauna and Flora</td>
</tr>
<tr>
<td>CMS</td>
<td>Convention on the Conservation of Migratory Species of Wild Animals</td>
</tr>
<tr>
<td>CPE</td>
<td>centres of plant endemism</td>
</tr>
<tr>
<td>CR</td>
<td>Critically Endangered (IUCN)</td>
</tr>
<tr>
<td>CSIR</td>
<td>Council for Scientific and Industrial Research</td>
</tr>
<tr>
<td>dB</td>
<td>decibel</td>
</tr>
<tr>
<td>DD</td>
<td>Data Deficient (IUCN)</td>
</tr>
<tr>
<td>DEA</td>
<td>Department of Environmental Affairs (now DEFF)</td>
</tr>
<tr>
<td>DEFF</td>
<td>Department of Environment, Forestry and Fisheries</td>
</tr>
<tr>
<td>DWA</td>
<td>Department of Water Affairs (now DWS)</td>
</tr>
<tr>
<td>DWAF</td>
<td>Department of Water Affairs and Forestry (now separated into DWS and DEFF)</td>
</tr>
<tr>
<td>EA</td>
<td>environmental authorisation</td>
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<tr>
<td>EAP</td>
<td>environmental assessment practitioner</td>
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<tr>
<td>EIA</td>
<td>environmental impact assessment</td>
</tr>
<tr>
<td>EMF</td>
<td>environmental management framework</td>
</tr>
<tr>
<td>EMPr</td>
<td>environmental management programme</td>
</tr>
<tr>
<td>EN</td>
<td>Endangered (IUCN)</td>
</tr>
<tr>
<td>EOO</td>
<td>extent of occurrence</td>
</tr>
<tr>
<td>EW</td>
<td>Extinct in the Wild (IUCN)</td>
</tr>
<tr>
<td>EWT</td>
<td>Endangered Wildlife Trust</td>
</tr>
<tr>
<td>EX</td>
<td>Extinct (IUCN)</td>
</tr>
<tr>
<td>FI</td>
<td>functional integrity</td>
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<tr>
<td>GBIF</td>
<td>Global Biodiversity Information Facility</td>
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<tr>
<td>GDARD</td>
<td>Gauteng Department of Agriculture and Rural Development</td>
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<tr>
<td>GIS</td>
<td>geographic information system</td>
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<tr>
<td>GPS</td>
<td>global positioning system</td>
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<tr>
<td>ha</td>
<td>hectares</td>
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<tr>
<td>I&amp;AP</td>
<td>interested and affected party</td>
</tr>
<tr>
<td>IBA</td>
<td>Important Bird and Biodiversity Areas (previously Important Bird Areas)</td>
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<tr>
<td>IEM</td>
<td>integrated environmental management</td>
</tr>
<tr>
<td>IFC</td>
<td>International Finance Corporation</td>
</tr>
<tr>
<td>IUCN</td>
<td>International Union for Conservation of Nature</td>
</tr>
<tr>
<td>KBA</td>
<td>Key Biodiversity Area</td>
</tr>
<tr>
<td>KZN</td>
<td>KwaZulu-Natal</td>
</tr>
<tr>
<td>LC</td>
<td>Least Concern (IUCN)</td>
</tr>
<tr>
<td>LDP</td>
<td>low detection probability</td>
</tr>
<tr>
<td>MEC</td>
<td>Member of the Executive Council</td>
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<tr>
<td>MTPA</td>
<td>Mpumalanga Tourism and Parks Agency</td>
</tr>
<tr>
<td>NDA</td>
<td>non-disclosure agreement</td>
</tr>
<tr>
<td>NEMBA</td>
<td>National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)</td>
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Definitions

alien invasive species – plants or animals that are introduced by humans, accidentally or intentionally, outside of their natural geographic range into an area where they are not naturally present. They are often introduced as a result of the globalisation of economies, for instance by ships, shipment of ornamental plants that then establish themselves into the wild and spread in a manner that modifies ecosystems, habitats or species and is difficult to control e.g. Lantana camara. Not all introduced alien species are invasive and not all invasive species are necessarily alien. South Africa’s National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) has defined ‘invasive species’ to mean any species whose establishment and spread outside of its natural distribution range:

(a) threaten ecosystems, habitats or other species or have demonstrable potential to threaten ecosystems, habitats or other species; and

(b) may result in economic or environmental harm or harm to human health;

alien species – (a) a species that is not an indigenous species; or (b) an indigenous species translocated or intended to be translocated to a place outside of its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention;

Alliance for Zero Extinction (AZE) – a joint initiative of over 90 biodiversity conservation organisations around the world that aims to prevent extinctions by identifying and safeguarding key sites where species are in imminent danger of disappearing. The goal of the Alliance is to create a frontline of defence against extinction by eliminating threats and restoring habitat to allow species populations to rebound;

anthropogenic – an activity originating due to human activity;

apterous – an invertebrate species without functional wings;

aquatic – for the purposes of this guideline, aquatic species are considered to represent species that are not exclusively marine and occur in fresh water (at least for a portion of their life cycle). This includes fish, diatoms, aquatic macro-invertebrates and aquatic plants. This definition is not an accurate biological definition but rather applied in this manner to align with the Protocol on Aquatic Biodiversity;

avifauna – taken to mean the birds (class: Aves) of a specific area (region, habitat etc.) or time period;

biodiversity corridor – a geographically defined area which provides connectivity between landscapes, ecosystems and habitats, natural or modified, and ensures the maintenance of biodiversity and ecological and evolutionary processes;

biodiversity management plan (BMP) – plan adopted in terms of NEMBA to provide for the long-term survival of a species in the wild and to provide a platform for an implementing organisation or responsible entity, as appointed by the Minister, to monitor and report on the progress regarding the implementation of the BMPs;

biodiversity specialist – there is no one ‘biodiversity specialist’. Rather, the term is used to cover a range of specialists in the field of biodiversity, from broad areas of expertise (e.g., terrestrial/marine/freshwater ecologist) to specialised expertise (e.g., botanist, mammalogist, herpetologist, avian specialist, ichthyologist etc.);

biological diversity or biodiversity – the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species, and of ecosystems;

biomes – groupings based on dominant forms of plant life and prevailing climatic factors. Biomes have plants and/or animals living together with some degree of permanence, and one can observe large-size patterns in global plant communities.
cover. Biomes broadly correspond with climatic regions as moisture and temperature strongly influence plant establishment and survival, although other environmental controls are sometimes important;

bioregional plan – plan adopted in terms of NEMBA, highlighting protected areas, Critical Biodiversity Areas, Ecological Support Areas and other natural areas accompanied by land and resource-use guidelines. They are developed in line with the Guidelines for Bioregional Plans published in terms of NEMBA. They are the biodiversity sector’s input into a range of multi-sectoral planning and assessment processes. They are based on systematic biodiversity plans developed using best available science, and are intended to inform land-use planning, environmental assessments and natural resource management by a range of sectors whose policies and decisions impact on biodiversity, and to support and streamline environmental decision-making. Bioregional plans also frequently incorporate species locality information that drives the identification of priority areas;

CapeNature – a public institution with the statutory responsibility for biodiversity conservation in the Western Cape. It is governed by the Western Cape Nature Conservation Board Act, 1998 (Act No. 15 of 1998) and mandated to: promote and ensure nature conservation; render services and provide facilities for research and training; and generate income;

catchment – in relation to a watercourse or watercourses or part of a watercourse, means the area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points;

centres of plant endemism – broad areas important for plant diversity based on expert opinion defined by Van Wyk and Smith (2001) for South Africa;

CITES – the Convention on International Trade in Endangered Species of Wild Fauna and Flora is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival;

class – a principal taxonomic grouping that ranks above order and below phylum, such as Insecta;

competent authority - in respect of a listed or specified activity, means the organ of state charged by the National Environmental Management Act, 1998 (NEMA) with evaluating the environmental impact of an activity and, where appropriate, with granting or refusing environmental authorisation in respect of that activity;

congregatory species – are defined as ‘species whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis’, e.g. species that form colonies for breeding purposes and/or non-breeding purposes (e.g. foraging and roosting);

demand – (a species that is) active at dawn or dusk;

crepuscular – (a species that is) active at dawn or dusk;

Critical Biodiversity Area (CBA) – an area that must be maintained in a good ecological condition (natural or semi-natural state) in order to meet biodiversity targets. CBAs collectively meet biodiversity targets for all ecosystem types, as well as for species and ecological processes that depend on natural or semi-natural habitat that have not already been met in the protected area network. CBAs are identified through a systematic biodiversity planning process in a configuration that is complementary, efficient and avoids conflict with other land uses where possible;

cumulative impact – in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities;

ecosystem – a dynamic complex of animal, plant and micro-organism communities and their non-living environment interacting as a functional unit;

ecosystem type – an ecosystem unit, or set of ecosystem units, that has been identified and delineated as part of a hierarchical classification system, based on biotic and/or abiotic factors. Ecosystems of the same type are likely to share broadly similar ecological characteristics and functioning;

ecotone – a transition area between two habitat types or where two communities meet and integrate. It may be narrow or wide, and it may be local or regional (the transition between forest and grassland ecosystems);

ectotherm – any animal whose regulation of body temperature depends on external sources, such as sunlight or a heated rock surface. Ectotherms include the fishes, amphibians, reptiles and invertebrates;

endemic – a species that is naturally restricted to a particular, well-defined region. This is not the same as the medical definition, which is ‘occurring naturally in a region’;

environmental authorisation (EA) – the authorisation by a competent authority of a listed activity or specified activity in terms of NEMA, and includes a similar authorisation contemplated in a specific environmental management Act;

environmental impact assessment (EIA) – a systematic process of identifying, assessing and reporting environmental impacts associated with an activity and includes basic assessments and scoping and environmental impact reporting (S&EIR) (see below for definition);

epigaeic – organisms that live on the soil surface; in addition, the term can also be applied to animals that cannot burrow, swim or fly;

euthanise – the act of inducing humane death in an animal by a method that induces rapid loss of consciousness and death with a minimum of pain, discomfort or distress;
extent of occurrence (EOO) – the area contained within the shortest continuous imaginary boundary that can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy; and in short is the species’ contemporary distribution range;

Ezemvelo KZN Wildlife – a governmental organisation tasked to direct the management of nature conservation within KwaZulu-Natal, including protected areas (PAs). This includes the development and promotion of ecotourism facilities within the PAs;

fatal flaw – in the context of EIA, is a problem, issue or conflict (real or perceived) that could result in the application for a proposed development being rejected or modified by the competent authority. When related to biodiversity, a fatal flaw is usually due to an anticipated impact that would result in irreplaceable and/or irreversible loss of biodiversity and this should ideally be identified during the screening stage (Brownlie, 2005);

fossorial – an animal adapted to burrowing which spends at least a portion of its life underground;

GDARD – the Gauteng Department of Agriculture and Rural Development (GDARD) is the provincial department responsible for natural resource management and sustainable development within Gauteng;

generalist – a species that is able to thrive in a wide variety of environmental conditions and can make use of a variety of different resources;

guilds – a group of species that have similar ecological requirements and play a similar role within a community;

herpetofauna – the reptiles (class: Reptilia) and amphibians (class: Amphibia) of a specific area (region, habitat etc.) or time period;

heterogeneity – the difference or diversity in kind or arrangement of component elements or constituents that occur across both space and time. In the context of habitat these elements can be topography, soil chemistry, temperature, moisture, and biological factors;

indigenous – occurring naturally in a defined area (contrast with endemic) – the area must be specified, and is normally taken to be the historical range of a species, notwithstanding the effects of naturally initiated range expansions/contractions; e.g. the baobab (Adansonia digitata) is indigenous but not endemic to South Africa, but it is not indigenous to KwaZulu-Natal;

indigenous species (NEMBA definition) – a species that occurs, or has historically occurred, naturally in a free state in nature within the borders of the Republic of South Africa, but excludes a species that has been introduced in the Republic as a result of human activity; e.g. the bontebok (Damaliscus pygargus pygargus) is indigenous to only South Africa, but according to previous definition would only be indigenous to the Western Cape;

invertebrate – an animal without a vertebral column (backbone), such as an arthropod, mollusc or annelid;

IUCN Red List Categories and Criteria – the threatened species categories used in Red Data Books and Red Lists have been in place for almost 30 years. The IUCN Red List Categories and Criteria provide an easily and widely understood system for classifying species at high risks of global extinction, so as to focus attention on conservation measures designed to protect them;

IUCN Red List status – the conservation status of species, based on the IUCN Red List categories and criteria;

Key Biodiversity Areas (KBA) – sites contributing significantly to the global persistence of biodiversity. They represent the most important sites for biodiversity conservation worldwide, and are identified nationally using globally standardised criteria and thresholds, in terrestrial, freshwater and marine ecosystems;

landowner – a person or authorised representative of such a person, that is the owner of the land, is in control of the land or that has the right to use the land;

migratory species – these are defined as per NEMBA to mean the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant portion of whose members cyclically and predictably cross one or more national jurisdictional boundaries. Furthermore, this includes all species that are native to South Africa and are listed under the Convention on the Conservation of Migratory Species of Wild Animals (CMS) or the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA), with the exception of those species in respect of which South Africa has entered reservations;

Minister – the Minister of Environment, Forestry and Fisheries;

mitigation – means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible;

Mpumalanga Tourism and Parks Agency (MTPA) – a government organisation which is responsible for the management and promotion of responsible tourism and nature conservation in Mpumalanga and ensures sustainable utilisation of natural resources for the benefit of everyone in that province;

NEMA EIA Regulations – Environmental Impact Assessment Regulations, 2014 (as amended), in terms of Chapter 5 of NEMA;

nocturnal – an animal behaviour characterised by being active during the night and sleeping during the day;
order – a principal taxonomic category that ranks below class and above family, such as Coleoptera (beetles);

permit – a permit issued in terms of Chapter 7 of NEMBA; or in terms of any other legislation;

phylum – a principal taxonomic category that ranks above class and below kingdom;

protected area – any of the protected areas referred to in section 9 of the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (NEMPA);

provincial conservation authority – the provincial department or provincial organ of state responsible for the conservation of biodiversity in a province;

quarter-degree grid cells – a way of dividing the longitude latitude degree square cells into smaller squares of 15’ × 15’ (roughly 24 × 27 km), forming in effect a system of geocodes;

Ramsar site – a wetland site designated to be of international importance under the Ramsar Convention on Wetlands of International Importance. The Convention on Wetlands, known as the Ramsar Convention, is an intergovernmental environmental treaty, which was adopted in 1971 and entered into force in 1975;

rapid biological assessments – a cost-effective solution for reliable, standardised and replicable methodologies for quickly assessing key ecosystem values that typically requires at least one week per site;

receptor – in the context of impact assessments on biodiversity, receptors are environmental components (e.g. flora/fauna species/communities or habitat type) that may be affected, adversely or beneficially, by the proposed project activities within the project areas of influence (PAOI);

rehabilitation – in the context of EIA, this means the repairing of a habitat/ecosystem so that processes and productivity remain functional, but it does not specifically imply that the original condition of the habitat/ecosystem will be restored (see restoration). Rehabilitation of a habitat/ecosystem is easier to achieve than restoration; e.g. an opencast mining pit established on pristine rocky grassland in the Highveld can be rehabilitated after mine closure to serve as grazing pastures for cattle, but cannot be fully restored to the pre-mining ecological state;

restoration – in the context of EIA, this means recovering a habitat/ecosystem that has been degraded or destroyed by an activity/action to its pre-existing condition prior to the activity/action that caused the degradation or destruction. See also ‘rehabilitation’ above for a distinction between these terms;

 riparian habitat – includes the physical structure and associated vegetation of the areas associated with a water-course which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas;

S&EIR – the scoping and environmental impact reporting process contemplated in regulation 21 to regulation 24 of the NEMA EIA Regulations;

scavenger species – an animal that feeds on carrion as well as dead plant material or refuse;

scoping – the scope of an environmental impact assessment is defined by the range of issues and alternatives to be considered, and the approach towards the assessment that will follow. Through scoping, priorities are set, efficiency is improved and focus for advice to decision-makers is provided by limiting the environmental assessment procedure to significant issues and reasonable alternatives (scoping may well be considered the critical stage in the integrated environmental management (IEM) procedure. The success of a proposal will largely be determined by the adequacy of the scoping exercise);

screening – in the context of IEM, screening determines whether or not an individual development proposal requires further environmental assessment and, if so, what level of assessment is appropriate. Screening is thus a decision-making process that is initiated during the early stages of the development of a proposal;

specialist – a person who is generally recognised within the scientific community as having the capability of undertaking, in conformance with generally recognised scientific principles, specialist studies or preparing specialist reports, including, inter alia, due diligence studies and socio-economic studies;

species – a kind of animal, plant or other organism that does not normally interbreed with individuals of another kind, and includes as subsets, any subspecies, cultivar, variety, geographic race, strain, hybrid or geographically separate population;

species distribution model (SDM) – a probability surface representing relative habitat suitability for a species based on known occurrence records for this species and a suit of environmental predictor variables reflecting the ecological requirements of the species. SDMs can therefore be considered to represent the potential geographic distribution of a species based on habitat suitability. The term ‘ecological niche model’ is often also used interchangeably with SDM;

species of conservation concern (SCC) – includes all species that are assessed according to the IUCN Red List Criteria as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Data Deficient (DD) or Near Threatened (NT), as well as range-restricted species which are not declining and are nationally listed as Rare or Extremely Rare (also referred to in some Red Lists as Critically Rare);

succession – a directional non-seasonal change of species that occupy a given area through time. It involves the processes of colonisation and establishment which act on the participating species;
**taxon** – (plural **taxa**) a taxonomic group of any rank, such as a species, family, or class;

**taxonomy** – referring to the classification of a species, especially the ‘arrangement’ of species among each other. It is a means of defining and naming groups of biological organisms on the basis of shared characteristics;

**terrestrial species** – for the purposes of this guideline, terrestrial species are considered to represent species that are not exclusively marine and occur on land (at least for a portion of their life cycle). This includes amphibians (frogs and toads) but excludes other freshwater aquatic species which are considered to be aquatic (e.g. fish, diatoms and aquatic macroinvertebrates). This definition is not an accurate biological definition but rather applied in this manner to align with the Protocol on Terrestrial Biodiversity;

**threatened ecosystem** – threatened ecosystems are listed in terms of NEMBA, using the following categories: critically endangered, endangered, or vulnerable. Threatened ecosystems may include those listed in province-level biodiversity assessments. The NEMBA-listed categories align with the IUCN categories of Critically Endangered, Endangered, or Vulnerable. The NEMBA list of ecosystems can also include listed protected ecosystems, which is not an IUCN ecosystem assessment category.

**threatened species** – species that are facing a high risk of extinction. Any species classified in the IUCN categories Critically Endangered, Endangered or Vulnerable is a threatened species. In terms of section 56(1) of NEMBA, ‘threatened species’ means indigenous species listed under the Act as critically endangered, endangered or vulnerable species;

**time-constrained search** – involves actively searching within a defined area for a fixed period of time;

**translocation** – a deliberate and mediated movement of wild individuals or populations from one location to another, sometimes also referred to as ‘assisted dispersal’;

**trophic** – to feed, and mainly refers to trophic levels, which refers to several hierarchical levels in an ecosystem, consisting of organisms sharing similar function in the food chain;

**watercourse** – a river/spring or a natural channel in which water flows regularly/interruptedly. Can also be a wetland, lake or dam into which, or from which water flows, as well as any collection of water which the Minister responsible for water affairs may, by notice in the Government Gazette, declare to be a watercourse;

**wetland** – land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.
The National Department of Environment, Forestry and Fisheries (DEFF) commissioned the South African National Biodiversity Institute (SANBI) and the Council for Scientific and Industrial Research (CSIR) to develop biodiversity-related assessment and reporting protocols. Protocols provide a minimum set of assessment and reporting criteria that must form the basis of specialist investigations required for the environmental authorisation (EA) process.

The need for the development of protocols arose because there is, currently, no standardised approach or requirements for specialist studies in environmental impact assessments (EIAs) in South Africa and competent authorities (CAs) expressed concern regarding the quality of some documents submitted for decision making. Often, documents did not contain adequate information needed for decision making, and the specialist assessments were conducted using different sets of minimum information requirements. These shortcomings add to challenges faced by CAs when reviewing and making decisions based on specialist studies and EIA reports.

In addition, the lack of readily available spatial information on the contemporary location of species of conservation concern (SCC) to support the decision making process has made it difficult for CAs to make well-informed decisions. Consequently, there is a need to standardise the approach and requirements to allow the specialist to assess the impact of a development on species and their associated habitat in a manner that would be useful to the CAs for decision making. This standardised approach and set of requirements will assist CAs to assess the information presented in specialist studies and interpret the implications for SCC.

The relevant protocols that the applicant needs to comply with are identified through the national web-based environmental screening tool1 (hereafter called the ‘screening tool’), which supports the pre-screening for environmental sensitivities in the landscape before an application for EA is lodged. The Plant and Animal Species Protocols aim to standardise species-level aspects of EIAs and the reporting of potential impacts from proposed developments on SCC. The protocol describes the type of assessments that should occur for each sensitivity level4 represented in the screening tool for a particular theme5.

The Plant and Animal Species Protocols provide the minimum information requirements for species specialist studies, and the guidelines developed in this document provide guidance and recommendations for undertaking specialist studies in order to meet the minimum requirements of the protocols.

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2 See Glossary of terms and acronyms.
3 https://screening.environment.gov.za/
4 Sensitivity levels are determined for the Plant and Animal Species Protocols based on the level of conservation concern and the likelihood of that species occurring within the area proposed for development.
5 Theme refers to each of the environmental and planning spatial datasets contained in the screening tool.
SANBI has partnered with BirdLife South Africa, the CSIR and commissioned species specialists to develop this Species Environmental Assessment Guideline to ensure that the detailed guidance for implementing the relevant species protocols is available to plant and animal specialists, environmental assessment practitioners (EAPs) and CAs.
The purpose of the Species Environmental Assessment Guideline is to provide background and context to the assessment and minimum reporting criteria contained within the Terrestrial Animal and Plant Species Protocols; as well as to provide guidance on sampling and data collection methodologies for the different taxonomic groups that are represented in the respective protocols. This guideline is intended for specialist studies undertaken for activities that have triggered a listed and specified activity in terms of the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA), as identified by the EIA Regulations, 2014 (as amended) and Listing Notices 1-3.6

2.1 How it relates to the Aquatic and Terrestrial Biodiversity Protocols

Terrestrial plant and animal SCC have been separated from ecosystem or landscape level data for the terrestrial and aquatic assessments in the screening tool due to significant complexities with the species geographic information systems (GIS) data. This is due to high numbers of SCC within South Africa that need to be processed for inclusion in the screening tool. As a megadiverse country, South Africa primarily adopts an ecosystem-driven approach to conservation, built on the premise that protecting an ecosystem will ensure that its associated species will be protected. However, while this approach works well for common and widespread species, SCC do not occur evenly throughout the landscape and there is no direct relationship between the occurrence of SCC and the presence of threatened ecosystems. As a result, the impact of a development may have negligible impacts on a particular ecosystem type but severe negative impacts on an SCC.

These guidelines will not discuss the assessment criteria of the Aquatic and Terrestrial Biodiversity Protocols. A separate guideline is under development for the Aquatic and Terrestrial Biodiversity Protocols, which differ in their assessment and minimum reporting requirements from the Plant and Animal Species Protocols.

2.2 How it relates to other species-related protocols

DEFF has developed other protocols for other themes besides the Terrestrial Animal and Plant Species Protocols and the above-mentioned Aquatic and Terrestrial Biodiversity Protocols. The other themes for which protocols have been developed include:

- Agriculture;
- Avifauna;
- Noise;

• Defence; and
• Civil Aviation.

None of the assessment and reporting criteria of the aforementioned protocols other than for Terrestrial Animal and Plant Species will be discussed in these guidelines. It must be noted that an Avifaunal Protocol has been developed to address the assessment and minimum reporting requirements for the impacts on avifauna by onshore wind energy generation facilities requiring EA (see Table 3.1). These guidelines focus on all other development types and their associated species impacts.

2.3 What the guidelines will not be addressing

It is important to note that for the EA process, the necessary permits for field collection of species in terms of the National Environmental Management: Biodiversity Act, 2004 (No.10 of 2004) (NEMBA), the National Forest Act, 1998 (No. 84 of 1998), and/or the relevant Provincial Ordinances need to be obtained. These guidelines will not address these other permitting requirements/processes. However, the aforementioned permitting requirements should still be fulfilled as part of the EA process. These guidelines are also not intended to create new requirements for the EA process, but rather to act as a guide for adhering to protocol requirements for species specialist assessments.

2.4 How these guidelines relate to provincial guidelines on biodiversity assessments in EIAs

In some provinces (e.g. Gauteng and KwaZulu-Natal), CAs have developed their own guidelines for specialist reports in relation to identified environmental sensitivities. These identify the minimum information that should be included in specialist reports and are designed to ensure a certain level of quality of reports submitted to the CA and to assist the officials of the relevant CA to make decisions on applications for EA.

Guidelines developed by the provinces may differ from the information requirements set out in the protocols. In the event that the provincial guidelines are not aligned with the information requirements described in a protocol, the protocol will take precedence. However, where the information requested by a province for a specific specialist report is not required by a protocol, it is recommended that the applicant and the specialist provide the requested information. The additional information provided by a specialist will assist the relevant CAs to reach a decision on an application for a development.

2.5 How these guidelines will be updated

This document will be available for download via the SANBI website at https://bgis.sanbi.org/ as a PDF document. It is served in this format to enable regular updates of the guideline when required. Specifically, any updates to the species layers of the screening tool will necessitate an update of the guideline document. EAPs and specialists are therefore advised to visit the SANBI website to ensure that they are operating according to the most recent version of the guideline. The applicable guideline version for a project seeking EA is the version that was the most recent on the date that the application for EA was received by the CA. In cases where specialist studies are performed prior to the EA application’s submission, as is recommended for studies that are heavily influenced by seasonality (see 9.2.1 Seasonality with specific reference to the EA process), these may require supplementation if an updated version of the guideline is introduced between the study and the application.

7 Portable Document Format (Adobe Inc.).
8 The date on which the application is considered to have been received by the CA is to be determined in accordance with the definition of ‘receipt’ in the EIA Regulations.
3.1 Screening tool report

Regulation 16(1)(b)(v) of the EIA Regulations provides that an applicant for an EA is required to submit a report generated by the screening tool as part of its application ‘once this tool is operational’. On 5 July 2019, the Minister of Environment, Forestry and Fisheries (Minister) published a notice in the Government Gazette, giving notice that the screening tool is now operational and that it would become compulsory for all applicants to submit a report generated by the screening tool from 90 days of the date of publication of that notice. The notice further states that the screening tool is available at: https://screening.environment.gov.za.

3.2 Legal provisions relating to protocols

Sections 24(5)(a) and 24(5)(h) of NEMA authorise the Minister to make regulations laying down the procedure to be followed in EA applications and to prescribe minimum criteria for report content for different types of reports prepared and submitted as part of the EA application process. On 20 March 2020, the Minister gazetted a set of protocols for the assessment and minimum report content requirements of environmental impacts for various environmental themes. Additional protocols have subsequently been published for terrestrial animal and plant species. The environmental themes for which protocols have been developed are provided in Table 3.1.

When the report generated by the screening tool identifies a theme, the relevant protocol for that theme, including the procedure that must be followed for site sensitivity verification and the information requirements for a relevant specialist report, must be applied.

3.3 Appendix 6 of the EIA Regulations

The protocols set out information requirements for theme-specific specialist reports. The general minimum requirements for specialist reports set out in Appendix 6 to the EIA Regulations are therefore replaced for specialist reports prepared when a protocol is applicable. For this reason, the notices under which the protocols have been published provide that Appendix 6 shall not apply to instances where a theme has been identified in the report generated by the screening tool. The first of these notices also provides for a specific site sensitivity verification process to be followed where no specific protocol has been identified in the report generated by the screening tool. Should the proposed development fall within an area where no data or protocol exists for a specific theme, then the assessment and reporting of impacts on that particular feature or proposed area of development should be done in accordance with Appendix 6.
3.4 The legal status of the screening tool, protocols and the Species Protocols Guideline

The screening tool and the protocols have the force of regulations made in terms of NEMA. Both of those instruments are therefore legally binding on CAs and applicants and must therefore be applied.

The protocols set the minimum legal requirements that have to be met by specialist reports when applying for EA and this guideline represents the manner in which compliance with the protocols by the sector (specialists and proponents who appoint specialists to conduct the assessments) can be ensured. The content of this guideline represents the most efficient and effective manner in which the Terrestrial Animal and Plant Species Protocols can be complied with.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>Protocol for the specialist assessment and minimum report content requirements for environmental impacts on agricultural resources.</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Protocol for the specialist assessment and minimum report content requirements for environmental impacts on agricultural resources by onshore wind and/or solar photovoltaic energy generation facilities where the electricity output is 20 megawatts or more.</td>
</tr>
<tr>
<td>Avifauna</td>
<td>Protocol for the specialist assessment and minimum report content requirements for environmental impacts on avifaunal species by onshore wind energy generation facilities where the electricity output is 20 megawatts or more.</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial biodiversity.</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Protocol for the specialist assessment and minimum report content requirements for environmental impacts on aquatic biodiversity.</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial animal species.</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Protocol for the specialist assessment and minimum report content requirements for environmental impacts on terrestrial plant species.</td>
</tr>
<tr>
<td>Noise</td>
<td>Protocol for the specialist assessment and minimum report content requirements for environmental impacts of noise impacts.</td>
</tr>
<tr>
<td>Defence</td>
<td>Protocol for the specialist assessment and minimum report content requirements for environmental impacts on defence installations.</td>
</tr>
<tr>
<td>Civil Aviation</td>
<td>Protocol for the specialist assessment and minimum report content requirements for environmental impacts on civil aviation installations.</td>
</tr>
</tbody>
</table>
4.1 Purpose of the screening tool and how it works

The screening tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas. Once the developer, EAP or specialist has uploaded the location of their chosen development footprint, a screening report will be generated which is to be submitted with the application for EA.

The screening tool report will indicate the environmental sensitivities that intersect with the proposed development footprint as defined by the applicant, as well as the relevant protocols that the applicant would need to adhere to. The specialist requirements linked to the different protocols – in this case the Plant and Animal Protocols – differ for areas identified as low, medium, high, or very high sensitivity.

4.2 Defining species of conservation concern (SCC)

Specialists are required to provide information on SCC, which are species and subspecies that are important for South Africa’s conservation decision-making processes. They include all species that are assessed according to the IUCN Red List Criteria as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT) or Data Deficient (DD), as well as range-restricted species which are not declining and are nationally listed as Rare or Extremely Rare\(^9\) (also referred to in some Red Lists as Critically Rare\(^10\)) (Figure 4.1).

It is important to note that the screening tool does not currently contain species that are NT or DD, as these do not trigger the necessity for a specialist study according to the Terrestrial Animal/Plant Species Protocols. Nevertheless, these species are considered to be SCC (Figure 4.1) and specialists are required to evaluate their presence and interaction with the proposed project and its activities. Specifically, the presence of NT species\(^11\) must be evaluated to allow determination of conservation importance (CI), which informs the site ecological importance (SEI) of a project’s areas of influence (see 8 Evaluation of site ecological importance [SEI]).

Species listed in terms of section 56 of NEMBA, and regulated by the Threatened or Protected Species (TOPS)
Regulations, 2007,\textsuperscript{12} include critically endangered, endangered, vulnerable and protected species. Specialists are not required to survey for, or specifically address species listed as ‘protected’ under this Act, unless:

\begin{itemize}
  \item a species has subsequently been evaluated as threatened (CR, EN or VU) during the most recent national assessment following the IUCN Red List Criteria; or
  \item a species has a defined biodiversity management plan (e.g. white rhino, see Appendix 4 – Biodiversity management plans for Species; as well as 9.3.4 Biodiversity management plans for specific species).
\end{itemize}

Because the red listing process is a dynamic one, with new species being assessed, as well as assessments being updated on an ongoing basis, the screening tool and this guideline document will of necessity also be dynamic and hence the latest version must always be consulted.

Spatial data for each species included in the screening tool, as well as on NT species, can be acquired from SANBI’s Biodiversity Geographic Information System (BGIS) website\textsuperscript{13}.

### 4.3 Assigning sensitivity rating to species data in the screening tool

Each of the themes in the screening tool consists of theme-specific spatial datasets which have been assigned a sensitivity level. Sensitivity in this context refers to the likelihood of negative impacts on features in the landscape from activities and infrastructure generated by a proposed development. A four-tiered sensitivity rating system has

\begin{itemize}
  \item Extinct (EX)
  \item Regionally Extinct (RE)
  \item Extinct in the Wild (EW)
  \item Critically Endangered Possibly Extinct (CR PE)
  \item Critically Endangered (CR)
  \item Endangered (EN)
  \item Vulnerable (VU)
  \item Near Threatened (NT)
  \item Data Deficient (DD)
  \item Extremely Rare / Critically Rare
  \item Rare
  \item Least Concern (LC)
\end{itemize}

\textsuperscript{12}Published in Government Notice No. R152 in Government Gazette 29657 of 23 February 2007.

\textsuperscript{13}BGIS will host a data package of all spatial information included in the screening tool. NT species (from the national Red List assessment) relevant to a proposed project area can also easily be acquired here by uploading the project areas of influence (PAOI). SANBI is currently in the process of developing this functionality. Specialists and EAPs are requested to access the BGIS website (https://bgis.sanbi.org/) and perform a search for the term ‘Environmental Authorisation Species of Conservation Concern.’
TABLE 4.1.—A description of the different screening tool sensitivity ratings. The methodology for creating the spatial data for each taxon for the respective sensitivity ratings is detailed in Appendix 1.

<table>
<thead>
<tr>
<th>Sensitivity rating</th>
<th>Description of sensitivity rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td>Habitat for species that are endemic to South Africa, where all the known occurrences of that species are within an area of 10 km². It is considered critical habitat¹⁴, as all remaining habitat is irreplaceable¹⁵. Typically, these include species that qualify under the CR, EN, or VU¹⁶ D criteria of the IUCN or species listed as Critically/Extremely Rare¹⁷ under South Africa’s National Red List Criteria. For each species reliant on a critical habitat, all remaining suitable habitat has been manually mapped at a fine scale.</td>
</tr>
<tr>
<td>High</td>
<td>Recent occurrence records for all threatened (CR, EN, VU) and/or Rare endemic species are included in the high sensitivity level. Spatial polygons of suitable habitat have been produced for each species by intersecting recently collected occurrence records (those collected since the year 2002) that have a spatial confidence level of less than 250 m with segments of remaining natural habitat. For birds, species distribution models (SDMs) and SABAP2 data (<a href="http://sabap2.birdmap.africa/">http://sabap2.birdmap.africa/</a>) were combined to delineate the ‘high’ sensitivity areas (Appendix 1).</td>
</tr>
<tr>
<td>Medium</td>
<td>Model-derived suitable habitat areas for threatened and/or rare species are included in the medium sensitivity level. Two types of spatial models have been included. The first is a simple rule-based habitat suitability model where habitat attributes such as vegetation type and altitude are selected for all areas where a species has been recorded to occur. The second is a species distribution model which uses species occurrence records combined with multiple environmental variables to quantify and predict areas of suitable habitat. The models provide a probability-based distribution indicating a continuous range of habitat suitability across areas that have not been previously surveyed. A probability threshold of 75% for suitable habitat has been used to convert the modelled probability surface and reduce it into a single spatial area which defines areas that fall within the medium sensitivity level.</td>
</tr>
<tr>
<td>Low</td>
<td>Areas where no SCC are known or expected to occur.</td>
</tr>
</tbody>
</table>

been applied to the data layers relevant to the Terrestrial Animal and Plant Species Themes, namely, ‘low’, ‘medium’, ‘high’ and ‘very high’ sensitivity. The different sensitivity ratings pertaining to the Terrestrial Animal and Plant Species Protocols are described in Table 4.1. Detailed metadata of how each data layer for each taxonomic group was produced is included in 12.1 (Appendix 1 – Metadata for terrestrial animal and plant spatial layers served via the screening tool).

Data on areas known to be occupied by SCC, as well as predicted suitable habitat areas for SCC, have been included in the screening tool for the following taxonomic groups: birds, mammals, reptiles, amphibians, plants and selected invertebrates. The number of taxonomic groups included in the screening tool will increase as additional groups are assessed using the IUCN’s Red List System. Data included in the screening tool comprise four levels of sensitivity (Table 4.1.). Very high and high sensitivity are areas of confirmed occupied habitat for SCC species, medium sensitivity are areas of suitable habitat where species may occur based on spatial models, low sensitivity are areas where no SCC are known or expected to occur. The inclusion of modelled areas of suitable habitat is due to the large size of the country and the high levels of species diversity meaning that for all taxonomic groups, many under-surveyed areas of suitable habitat remain. Recognising the development imperative of South Africa, and the costs associated with including a specialist survey in the EA process, SANBI, in partnership with the Endangered Wildlife Trust (EWT) and BirdLife South Africa, has developed spatial models only for threatened, Rare and Critically/Extremely Rare SCC that are most at risk from development, and not for all SCC. In the process of modelling areas of potential suitable habitat, the amount of habitat that would trigger the need for specialist surveys has been minimised. The spatial data files used in the screening tool can be acquired through the BGIS website.

4.4 Submission of screening tool report

The report produced by the screening tool must be submitted along with the application for EA to ensure consistency with specialist studies done for the EA and what the CA is expected to review.

¹⁴ The term ‘critical habitat’ is a new term, defined here for South Africa to refer to the habitat of any species with a global extent of occurrence of less than 10 km². It is important to note that South Africa does not apply this term in the same way as the International Finance Corporation (IFC).
¹⁵ All remaining habitat for these species is required for their persistence. There is nowhere else in the world that they occur and this is the only place to manage and protect their wild populations.
¹⁶ In the Vulnerable category, the D criteria encompass species with less than 1 000 individuals, or area of occurrence of less than 20 km².
¹⁷ The terms Critically Rare and Extremely Rare are synonymous and have each been used in different Red List publications. They refer to species that are known from only one location that are not currently threatened.
4.5 **Addressing sensitive species**

The screening tool report includes lists of bird, mammal, reptile, amphibian, invertebrate and plant SCC known or expected to occur on the proposed development footprint/PAOI. Some of these SCC are sensitive to illegal harvesting. Such species have had their names obscured and are listed as: sensitive plant unique number/sensitive animal unique number. Should such species appear in the screening tool report, the EAP is required to email eiadaterequests@sanbi.org.za listing all sensitive species with their unique identifier. SANBI will release the actual species name after the details of the requester have been documented. The actual name of the sensitive species may not appear in the final EIA report or in any of the specialist reports released into the public domain. It should be referred to as a sensitive plant or animal and its IUCN extinction risk category should be included (e.g. Critically Endangered sensitive plant or Endangered sensitive butterfly\(^\mathrm{18}\)).

\(^{18}\) The taxon group should be provided, e.g. reptile, mammal etc.
Should any part of the proposed development footprint/PAOI intersect with an environmental sensitivity as identified in the screening tool, the applicant must follow the requirements of the relevant protocol and associated sensitivity depending on the theme when undertaking their specialist assessments for any activity requiring EA.

5.1 Site sensitivity verification (SSV) step

As the screening tool comprises a database that contains datasets that are mapped at a national scale, there may be areas where the screening tool erroneously assigns or misses environmental sensitivities because of mapping resolution. The purpose of the site sensitivity verification step is to address potential inconsistencies (if any) between the screening tool data and the current status quo or current use of land. This step can be done by an EAP or a specialist at desktop level, followed by a necessary site visit. Here, the EAP or specialist must identify features that are not currently in the screening tool and areas that have been irreversibly modified since the data were published/collated, e.g. built infrastructure such as parking lots and malls. The EAP or specialist must provide evidence for any difference to the data presented in the screening tool and submit this evidence in the scoping report to motivate for a change in the sensitivity rating of the proposed development footprint/PAOI. Should the outcomes of the ISSV indicate that an area is of low sensitivity, then a compliance statement can be completed and submitted to CAs.

5.2 Assessment protocols and compliance statement

Where the sensitivity indicated in the screening tool is ‘very high’ or ‘high’ for the proposed development footprint/PAOI, then as indicated in the protocol, an assessment must be conducted by a relevant taxon-specific specialist. Where the sensitivity indicated in the screening tool is ‘medium’ for the proposed development footprint/PAOI, then as indicated in the protocol, the presence or likely presence of the SCC identified by the screening tool must be investigated through a site inspection by a specialist registered with the South African Council for Natural Scientific Professions (SACNASP) with a field of practice relevant to the taxonomic groups (‘taxa’) for which the assessment is being undertaken to confirm the presence, likely presence or confirmed absence of an SCC identified within the site identified as ‘medium’ sensitivity by the screening tool. Where SCC are found on site or have been confirmed as likely to be present, an assessment must be submitted in accordance with the requirements specified for ‘very high’ and ‘high’ sensitivity in the protocol. However, if the ISSV step indicates that the proposed development footprint/PAOI consists of a ‘low’ sensitivity and that the screening tool incorrectly classified the area as ‘very high’, ‘high’ or ‘medium’, then taxon-specific specialists are not required to perform an assessment and the EAP/specialist must submit a Terrestrial Animal/Plant Species Compliance Statement. The minimum requirements for such a compliance statement are captured in section 5 of the Terrestrial Animal/Plant Species Protocols (under ‘LOW SENSITIVITY RATING’). An example
The following section is a reproduction of certain (but not all) specific sections of the Terrestrial Animal/Plant Species Protocols that require guidance, using the numbering presented in the final gazetted version of the protocols. Since the protocols for plants and animals have the same requirements, the guidance provided below applies to both protocols. The requirements are ordered here, linking all similar requirements together, and the numbering is kept consistent with the numbering used in the published protocols. For those requirements in respect of which the numbering in the Terrestrial Animal Species Protocol differs from that in the Terrestrial Plant Species Protocol, the numbering of the latter is reflected in square brackets.

Several terms and concepts were developed for these protocol guidelines which have not been mentioned or defined yet at this point. Comprehensive description and guidance are, however, provided in the sections following this step-by-step guide and the reader is also referred to the appropriate sections providing additional information and necessary clarification.

Each protocol requirement or group of requirements that need guidance is provided below in numbered italicised text, followed by a set of minimum requirements and, where possible, reference to additional guidance provided in this document.

### Protocol requirements

<table>
<thead>
<tr>
<th>Protocol provisions</th>
<th>Minimum requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7 The Terrestrial [Animal/Plant] Species Specialist Assessment and the Terrestrial [Animal/Plant] Species Compliance Statement must be undertaken within the study area.</td>
<td>- SACNASP registration in relevant field.</td>
</tr>
<tr>
<td></td>
<td>- Previous experience required for the relevant taxon.</td>
</tr>
<tr>
<td></td>
<td>- The practice where unqualified or inexperienced persons conduct unsupervised fieldwork and reporting which is then underwritten or ‘signed off’ by a qualified and/or SACNASP-registered specialist is not acceptable.</td>
</tr>
</tbody>
</table>

For cases where a relevant taxon-specific specialist assessment is required (‘very high’, ‘high’ or ‘medium’ sensitivities), step-by-step guidance has been developed below.

### 5.3 Step-by-step guidance for the Terrestrial Animal/Plant Species Protocols

#### Protocol provisions

1.8 Where the nature of the activity is not expected to have an impact on species of conservation concern (SCC) beyond the boundary of the preferred site, the study area means the proposed development footprint within the preferred site.

1.9 Where the nature of the activity is expected to have an impact on SCC beyond the boundary of the preferred site, the project areas of influence (PAOI) must be determined by the specialist in accordance with the Species Environmental Assessment Guideline, and the study area must include the PAOI, as determined.

#### Minimum requirements

- Define the PAOI in relation to the proposed development footprint by taking into account the proposed development activities.
- The PAOI sets the minimum spatial extent of the study area and the specialist studies should be focused within this area.

#### Detailed guidance and additional information

- Detailed guidance on defining the PAOI is provided for both EAPs and specialists in 6 Defining the project areas of influence (PAOI).
- Worked examples for the definition of the PAOI are provided in 6.3 Worked examples, as well as Appendix 3 – Additional examples for defining PAOI.

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1. SACNASP registration.

Detailed guidance and additional information
See 9.1 Qualifications and limitations of specialist.

Protocol provisions

2.2 [2.3] The [Terrestrial Animal/Plant Species Impact Assessments] must be undertaken in accordance with the Species Environmental Assessment Guideline; and must;

2.2.1 [2.3.1] identify the SCC which were found, observed or are likely to occur within the study area;

2.2.11 [2.3.11] discuss the presence or likelihood of additional SCC including threatened species not identified by the screening tool, Data Deficient or Near Threatened Species, as well as any undescribed species; or roosting and breeding or foraging areas used by migratory species where these species show significant congregations, occurring in the vicinity;

3.1 This [Terrestrial Animal/Plant Species Specialist Assessment Report] must include as a minimum the following information:

3.1.7 details of all SCC found or suspected to occur on site, ensuring sensitive species are appropriately reported[.]

Minimum requirements

- A table in the report presenting all SCC that were predicted by the screening tool, expected and observed Near Threatened and Data Deficient species, as well as any additional SCC observed that were not predicted by the screening tool.
- Additional species that must be included in the table are:
  - undescribed species;
  - highly localised endemics; and
  - significant concentrations of migratory or congregatory species. Thresholds for 'significant' should follow those published by the IFC (2012), i.e. 'areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle'.
- This table must contain the following information:
  - taxonomic family;
  - common name;
  - scientific name;
  - current IUCN extinction risk category (most recent of either national or global);
  - habitat requirements (a brief description);
  - probability of occurrence on the site:
    - confirmed (if observed during the survey)
    - high
    - medium
    - low;
  - a short justification for the provided probability of occurrence.
- Expected SCC listed as having very low detection probabilities require additional information describing their probability of occurrence.

Detailed guidance and additional information

- SCC are described in 4.2 Defining species of conservation concern (SCC).
- The procedure for collating occurrence data and presentation thereof is described in detail in 9.3.6 Researching and presenting data for expected SCC.
- The procedure to identify and describe the probability of occurrence for expected SCC that have a very low probability of detection is provided in 9.3.7 Expected SCC with very low detection probabilities.

Protocol provisions

2.2.2 [2.3.2] provide evidence (photographs or sound recordings) of each SCC found or observed within the study area, which must be disseminated by the specialist to a recognised online database facility, immediately after the site inspection has been performed (prior to preparing the report contemplated in paragraph 3);

3.1.8 the online database name, hyperlink and record accession numbers for disseminated evidence of SCC found within the study area[.]

Minimum requirements

- Specialists are required to disseminate a minimum of one observation per SCC within the study area.
- Photographic evidence, video or sound recordings must be provided. It is acknowledged that this will not always be possible (e.g. bird/frog calling only once), but a concerted effort must be made by specialists to obtain such verifiable evidence. In the absence of such evidence, dissemination cannot occur, but the observation of this SCC must nevertheless be described and discussed in the specialist report.
• In cases where a single photograph is insufficient to confirm the identification of a species, multiple photographs showing the key identification features of the plant/animal SCC should be disseminated.

• In cases where photographs may be insufficient to confirm the identification of a species (e.g. small invertebrates), the acquisition number of the specimen and the details of the museum or other collection where it has been deposited must be supplied.

• The following information accompanying the observation of an SCC is the minimum requirement for dissemination:
  ▪ observer name;
  ▪ observation date;
  ▪ observation location (geographic coordinate with approximate accuracy, e.g. 10 m); and
  ▪ species name.

• The protocols do not require any information regarding the proposed development to be disseminated along with the observation of an SCC. This includes all information related to the development type, proponent, EAP or any other confidential or restricted information bearing relevance to the proposed development.

• The following information must be included in the specialist report for each SCC observation disseminated for a particular project, preferably in tabular format:
  ▪ name and URL of the recognised online database facility to which the observation was disseminated;
  ▪ SCC species name which was disseminated; and
  ▪ unique record or acquisition number for each SCC observation disseminated.

• iNaturalist is recommended as the platform where these data should be shared. Multiple photographs per observation can be posted. Instructions at: https://vimeo.com/167431843. Instructions for the app: https://vimeo.com/162581545). Sensitive species’ locations will be automatically obscured as SANBI has coded these into the iNaturalist dictionary. The specialists should therefore not manually obscure any records that they add. If specialists choose to disseminate sensitive species information to any other online platform, extreme care must be taken to ensure that the exact location of the observation is not revealed to members of the public.

• It is essential that specialists, EAPs and developers are aware of these requirements and their legal implications, as set out in Box 1, below.

Box 1.

Legal considerations of section 2.2.2 of the Terrestrial Animal Species Protocol and 2.3.2 of the Terrestrial Plant Species Protocol

• Sections 2.2.2 and 2.3.2 of the Terrestrial Animal/Plant Species Protocols respectively are legal requirements and must be complied with by specialists performing studies required for environmental authorisation.

• Developers, clients and EAPs may therefore not subject specialists performing such surveys to non-disclosure agreements that prevent them from executing this legal requirement.

• All other facets of industry standard non-disclosure agreements between specialists and developers, clients and EAPs remain applicable during the dissemination of SCC observations and the execution of the required surveys.

Detailed guidance and additional information

• Additional guidance on the dissemination of data is provided in 9.7 Data dissemination.

• Taxon-specific guidance on data dissemination is provided for each taxon in the following sections:
  ▪ 10.1 Flora
  ▪ 10.2 Herpetofauna
  ▪ 10.3 Avifauna
  ▪ 10.4 Mammals
  ▪ 10.5 Terrestrial invertebrates

Protocol provisions

2.2.3 [2.3.3] identify the distribution, location, viability and provide a detailed description of population size of the SCC, identified within the study area.

Minimum requirements

• Distribution and location of all SCC either confirmed on site or with a high probability of occurrence on site must be mapped in relation to the PAOI and planned infrastructure (care must be taken to not include the names of any sensitive species but rather to list the threat status of the species and its taxon group (e.g. Critically Endangered sensitive plant or Endangered sensitive butterfly).

• Viability of the population should be assessed directly where possible or inferred from suitable habitat patch size, connectivity to other populations and current impacts.
Population sizes of each SCC should be determined and reported where possible. In the absence of appropriate population size estimates, the proportion of the known geographic distribution intersecting with the PAOI should be calculated and reported for those species listed in Appendices 7 and 8.

Detailed guidance and additional information

- See the worked example for SEI: 8 Evaluation of site ecological importance (SEI).
- See 9.3.10 Population size estimates for selected expected SCC for guidance on how to present estimates of populations sizes within the PAOI.

Protocol provisions

2.2.4 [2.3.4] identify the nature and the extent of the potential impact of the proposed development on the population of the SCC located within the study area;

2.2.5 [2.3.5] determine the importance of the conservation of the population of the SCC identified within the study area, based on information available in national and international databases, including the IUCN Red List of Threatened Species, South African Red List of Species, and/or other relevant databases.

Minimum requirements

- Demonstration of the population sizes of each SCC found on site in relation to the global population size. In the absence of appropriate population size estimates, the proportion of the known geographic distribution intersecting with the proposed development footprint/PAOI should be calculated and reported in relation to the total area occupied by the species at a global level (this includes all of the sub-populations) for those species listed in Appendices 7 and 8.
- If possible, evaluate whether the population of each SCC on site is considered a ‘source’ or ‘sink’ population in a meta-population system.
- Assessment of whether the IUCN extinction risk status would change if the population of an SCC within the PAOI would be destroyed.
- Any other aspects of the population of each SCC within the PAOI that should be factored into the consideration of its importance (e.g. importance for tourism and/or job creation, cultural significance and/or importance for ecosystem function).

Detailed guidance and additional information

- See the guidance on how to perform an impact analysis (9.5 Impact analysis) and provide appropriate suggestions to mitigate potential impacts (9.4 Mitigation of impacts).
- Specialists are required to research recent scientific literature to acquire species-specific guidance for the above-described minimum requirements in relation to the importance of an SCC population (see 9.3.6 Researching and presenting data for expected SCC).

Protocol provisions

2.2.7 [2.3.7] include a review of relevant literature on the population size of the SCC, the conservation interventions, as well as any national or provincial species management plans for the SCC. This review must provide information on the need to conserve the SCC and indicate whether the development is compliant with the applicable species management plans and if not, include a motivation for the deviation.

2.2.6 [2.3.6] determine the potential impact of the proposed development on the habitat of the SCC located within the study area;

2.2.8 [2.3.8] identify any dynamic ecological processes occurring within the broader landscape that might be disrupted by the development and result in negative impact on the identified SCC, for example, fires in fire-prone systems.

Detailed guidance and additional information

- Guidance relevant to the national biodiversity management plans for SCC is provided in 9.3.4 Biodiversity management plans for specific species.
- A list of all the current national biodiversity management plans is provide in Appendix 4 – Biodiversity management plans for species.
- Additional guidance for obtaining relevant information for expected SCC is provided in 9.3.6 Researching and presenting data for expected SCC.
2.2.9 [2.3.9] identify any potential impact of ecological connectivity in relation to the broader landscape, resulting in impacts on the identified SCC and its long-term viability.

**Minimum requirements**

- An environmental impact analysis must be performed where the proposed project activities and infrastructure must be evaluated in terms of their impacts on carefully defined receptors.
- The impact analysis methodology must be clearly described and must evaluate at a minimum the following aspects of the anticipated activity/impact from which the final ‘significance’ can be determined:
  - status (positive, negative, neutral);
  - spatial extent;
  - duration;
  - severity; and
  - probability.
- The impact analysis must be performed twice:
  - Firstly, in the absence of any potential mitigation (pre-mitigation).
  - Secondly, if appropriate mitigation measures are applied (post-mitigation).
- A pre- and post-mitigation comparison of the impact significance on the receptor must be presented where any impact that cannot be mitigated sufficiently must be highlighted.
- Residual impacts (post-mitigation) on receptors that remain of high significance must be flagged as fatal flaws and discussed.
- Taxon-specific impacts affecting SCC during the time of site inspection that are not caused by project activities must be described and photographic evidence (or other, e.g. satellite imagery) must be provided. These impacts should be called ‘current impacts’ and are defined as those that are occurring in the absence of the proposed project activities (e.g. maize cultivation on a site where coal mining is planned).
- The description of current impacts must specify their intensity and the effect that they have on the populations of SCC observed and expected within the site.
- Current impacts on SCC must be taken into account when evaluating SEI.

**Detailed guidance and additional information**

- Guidance for the description of receptors is provided in 7 Description of impact receptors.
- The procedure for evaluating SEI is described in detail in 8 Evaluation of site ecological importance (SEI).

2.2.10 [2.3.10] determine buffer distances as per the Species Environmental Assessment Guidelines used for the population of each SCC.

**Protocol provisions**

2.2.10 [2.3.10] determine buffer distances as per the Species Environmental Assessment Guidelines used for the population of each SCC.

**Minimum requirements**

- All associated habitat (e.g. nesting, roosting, foraging etc.) for each SCC should be buffered according to the guidelines presented in the taxon-specific sections below. Where recommendations for buffers have been provided in provincial guidelines which exceed those recommended in the taxon-specific sections below, the provincial guidelines should be followed.
- Where precise buffers are not currently available for a particular SCC or group of SCC, the specialist is required to perform comprehensive literature research and consult with external species-specific specialists for guidance in this regard. Should this exercise not result in clearly definable buffer distances, the precautionary principle must be applied, and buffer sizes should be set at the maximum possible.
- Where defined SCC buffers are applied and include irreversibly modified habitat (e.g. existing major infrastructure) that cannot be rehabilitated or restored, these areas may be excised from the buffer as they are non-functional. Degraded habitat that falls within the buffer and may offer some ecological functionality must not be excised from the buffer.
- It is essential to demonstrate consideration of habitat connectivity during the application of buffers for SCC. If the recommended buffer distance for an SCC does not allow for appropriate habitat connectivity, the specialist should increase the recommended buffer distance accordingly in the area where habitat connectivity must be maintained.

**Detailed guidance and additional information**

- Taxon-specific guidance for the application of buffers for SCC is provided in the following sections:
  - 10.1 Flora
10.2 Herpetofauna
10.3 Avifauna
10.4 Mammals
10.5 Terrestrial invertebrates

The worked example for the determination of SEI (8.4 Worked example) provides additional guidance on how to apply buffers.

See also 9.3.2 Application of the precautionary principle and ‘absence data’.

Protocol provisions

2.2.12 [2.3.12] identify any alternative development footprints within the preferred site which would be of ‘low’ or ‘medium’ sensitivity as identified by the screening tool and verified through the site sensitivity verification.

3.1.13 a motivation must be provided if there were any development footprints identified as per paragraph 2.2.12 above that were identified as having ‘low’ or ‘medium’ terrestrial animal species sensitivity and were not considered appropriate.

Minimum requirements

- Demonstrate through the SSV that an alternative development footprint/PAOI only intersects with areas of ‘low’ sensitivity;
  OR
- Demonstrate through presentation of a screening tool report with an alternative development footprint/PAOI that only ‘low’ sensitivity is identified within this revised footprint;
  OR
- Propose an alternative development footprint/PAOI that comprises a combined SEI of only ‘very low’ and/or ‘low’. In certain cases, an SEI of ‘medium’ may also be acceptable (see Table 8.4).

Detailed guidance and additional information

- Guidance for conducting an SSV is provided in 5.1 Site sensitivity verification (SSV) step.
- Alternative development footprints/PAOI can be proposed based on the description of combined (i.e. all plants and animals) SEI, where an SEI of ‘low’ or ‘very low’ may be considered ideal for development. In certain cases, an SEI of ‘medium’ may also be acceptable (see Table 8.4). The Worked example in 8 Evaluation of site ecological importance (SEI) provides additional guidance.

Protocol provisions

3.1.3 a statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment[.]

Minimum requirements

- Seasonal timing of survey affects the detectability of a particular species. Specialist assessments must indicate for all SCC predicted by the screening tool to occur within the PAOI, whether the seasonal timing of the survey was appropriate for detection of that particular species.
- In cases where the survey timing was not optimal for the detection of a particular SCC, and where there is a high likelihood of occurrence of this species based on the habitat assessment, the precautionary principle must be applied and the particular species must be assumed to be present within the PAOI.

Detailed guidance and additional information

- Guidance for the consideration of seasonal limitations and surveys for SCC, with particular reference to the duration of the environmental authorisation process, is provided in 9.2.1 Seasonality with specific reference to the EA process.
- See also 9.3.2 Application of the precautionary principle and ‘absence data’.
- Additional guidance on seasonality is provided for each taxon in the following sections:
  10.1 Flora
  10.2 Herpetofauna
  10.3 Avifauna
  10.4 Mammals
  10.5 Terrestrial invertebrates

Protocol provisions

3.1.4 a description of the methodology used to undertake the site sensitivity verification, impact assessment and site inspection, including equipment and modelling used where relevant;

3.1.5 [3.1.6] a description of the mean density of observations/number of sample sites per unit area and the site inspection observations[.]
Minimum requirements

- Impact assessment methodology must be clearly described and referenced according to a published literature source (book, scientific paper etc.). Customised impact assessment methods which cannot be referenced in this manner may not be used.
- For each taxonomic group, equipment and methods applied during the site inspection must be sufficiently described for it to be reproduced.
- A map showing the sample sites/transects and GPS tracks of the taxon specialist on site is required to verify sampling adequacy and site coverage.
- Sample site density per unit area (ha or km²) of the PAOI is to be explicitly stated.
- All third-party spatial data used must be referenced appropriately.
- Any GIS procedures applied (e.g. modelling, spatial analyses) must be described appropriately and referenced where possible.

Minimum requirements

- Evaluation of SEI for each taxon-specific receptor within the PAOI, accompanied by a map showing SEI in relation to the proposed development infrastructure.
- A separate map with reclassified SEI to show suitable and non-suitable areas for development in relation to the proposed development site and infrastructure.

Detailed guidance and additional information

- The procedure for evaluating SEI is described in detail in 8 Evaluation of site ecological importance (SEI).
- A worked example on how to present SEI information and combine different taxa is presented in 8.4 Worked example.
- Detailed guidance on how to present maps and what data to include is provided in 9.3.12 Mapping standards.

Protocol provisions

3.1.6 [3.1.5] a description of the assumptions made and any uncertainties or gaps in knowledge or data[

Detailed guidance and additional information

- Comprehensive guidance on evaluating impacts is provided in 9.5 Impact analysis.
- See 9.3.1 General layout of a specialist report.
- See 9.3.9 Description of sampling effort.
- All maps to be produced according to guidance provided in 9.3.12 Mapping standards.

Minimum requirements

- Current impacts, anticipated project-related impacts and additional potential impacts from other proposed developments within the region must be considered in combination and described in a cumulative impact assessment.

Protocol provisions

3.1.10 a discussion on the cumulative impacts[

Detailed guidance and additional information

See 9.3.8 Description of sampling limitations.
- Consideration must be given to the seasonal timing of the survey: 9.2.1 Seasonality with specific reference to the EA process.
- See minimum requirements for 3.1.4 above regarding mapping of sample sites and indication of sampling coverage and intensity.

Minimum requirements

- Actions by the developer to avoid, minimise, restore or offset impacts (i.e. ‘mitigation measures’) must be proposed, taking into consideration all relevant stages of development (i.e. construction to decommissioning).
- Mitigation measures must be translated into practically implementable ‘impact management actions’ that should be incorporated into an environmental management programme (EMPr).
‘Impact management outcomes’ must be defined to provide a benchmark against which the effectiveness of impact management actions in mitigating the anticipated impacts can be measured.

Specify if monitoring surveys are required to evaluate compliance with the impact management outcomes and to allow for appropriate environmental auditing.

Protocol provisions
3.1.12 a reasoned opinion, based on the findings of the specialist assessment, regarding the acceptability or not of the development and if the development should receive approval or not, related to the specific theme being considered, and any conditions to which the opinion is subjected if relevant.[…]

Detailed guidance and additional information
- Comprehensive guidance on evaluating impacts is provided in 9.5 Impact analysis.
- See 9.4 Mitigation of impacts.

Detailed guidance and additional information
- See 9.6 Suitability of the proposed project and its activities.
6

Defining the project areas of influence (PAOI)

Appropriate consideration of the important ecosystem processes and functions (e.g. habitat connectivity) that could potentially be affected by the proposed development may necessitate specialist investigations outside of the boundary of the proposed development footprint. For example, a chemical spill washed into a nearby wetland by rain, or a runaway fire caused by a carelessly discarded cigarette could negatively impact on the environment far beyond the boundaries of the project footprint. Therefore, the Species Protocols require that EAPs and specialists define the taxon-specific PAOIs, based on the spatial location of the project (footprint) and the potential extent of the impacts of the anticipated activities of the project.

Essentially, the PAOI is defined according to the important ecosystem processes and functions that may be plausibly affected by the proposed development and its associated activities. Evaluation of the PAOI must necessarily occur in three stages as follows:

1. Firstly, the EAP must evaluate an appropriate PAOI based on the proposed project footprint and the intended activities of the development. This is because the potentially impacted SCC (as evaluated by the screening tool), and therefore the required specialist studies, are defined according to their spatial interaction with the PAOI.

2. Secondly, appointed specialists must evaluate an appropriate PAOI based on the identification of taxon-specific impact receptors (see 7 Description of impact receptors), and the intended activities of the development and their potential impacts. This PAOI defines the taxon-specific study area and should be defined at the project inception and immediately communicated with the EAP, because it has implications for the contacting of landowners and the arrangement of access for fieldwork.

3. Finally, the EAP must consolidate all specialist-defined PAOIs (by merging them into a single spatial entity) and perform a final check on the screening tool to make sure that no SCC are triggered which would require any additional specialist study. This step is necessary to safeguard against a potentially erroneous initial definition of the PAOI by the EAP during step 1 above.

Definitions of PAOI by the EAP or a specialist should always include a short justification, as well as a map indicating the PAOI in relation to the project footprint. It is important to note that the PAOI can potentially be very large in relation to the actual project footprint (especially for cases involving potential water pollution) and in such cases, sample sites must be appropriately selected for subsets of the PAOI representing all habitat types.

6.1 Guidance for EAPs

Because EAPs are required to appoint and manage the specialists required for specialist studies during the EA process, it is important that due consideration is given to the PAOI. Figure 6.1 provides an illustrative example for three hypothetical scenarios that could arise from the same project footprint. In this example, the underlying sensitivity layers of the screening tool are shown to facilitate interpretation.
**Species Environmental Assessment Guideline**

**FIGURE 6.1**—Defining the PAOI (purple areas) in relation to the project footprint and SCC.

**Scenario A:** No expectation of impacts outside of proposed development footprint
PAOI > development footprint. No specialist studies required.

**Scenario B:** Potential toxic runoff towards river
PAOI > development footprint. Amphibian specialist studies required.

**Scenario C:** Uncertainty of impacts beyond footprint -> apply 500 m buffer
PAOI > development footprint. Amphibian & botanical specialist studies required.
A. The most typical scenario that occurs is where the PAOI would be confined to the development footprint, and therefore have the exact same spatial extent (Figure 6.1 Scenario A). This situation occurs when there are no plausible potential impacts expected outside of the development footprint area and is most often associated with relatively small development footprints from low-impact developments. In this case, the screening tool should be given the original development footprint to evaluate, which in Scenario A will trigger no specialist studies because the footprint does not overlap with any known or predicted (modelled) occurrences of SCC.

B. In this scenario (Figure 6.1 Scenario B), potential toxic runoff can be expected from the proposed development, which would extend beyond the boundaries of the development footprint. The area outside of the development footprint where the toxic runoff is predicted to occur and spread towards is defined and then added to the original development footprint to produce a PAOI that is larger than the original development footprint. If the screening tool were to evaluate the original development footprint, no specialist studies would be triggered (as described in scenario A above). However, in this case the screening tool should be given the PAOI and not the original development footprint to evaluate, which will trigger a specialist study by a herpetologist because the PAOI overlaps with the predicted (modelled) occurrences of an amphibian SCC.

C. The final scenario (Figure 6.1 Scenario C) represents a case where the EAP cannot be sure of the extent of potential impacts outside of the development footprint. This may be due to poorly defined activities of the developer, uncertainty regarding the placement of certain infrastructure or limited understanding by the EAP of the potential receptors. In such cases, the precautionary approach is advised, where a minimum buffer of 500 m should be applied to the development footprint and used to define the PAOI, which is then given to the screening tool for evaluation. In this scenario, the screening tool will trigger two specialist studies because the PAOI overlaps with the predicted (modelled) occurrences of an amphibian and a plant SCC.

6.2 Guidance for specialists

Specialists should aim to distinguish between potential direct (primary) influence and areas of potential indirect (secondary and tertiary) influences. An appropriate definition of areas of influence is provided in Section 8 of the IFC Performance Standards (IFC, 2012). These delineations are important for selecting sites for baseline surveys and long-term monitoring. Areas of direct influence are appropriate for baseline surveys when the generation of a species inventory is a primary objective, but these areas are often unsuitable for long-term monitoring because they can become too heavily modified due to the project infrastructure and activities. Care must therefore be taken to not limit baseline data collection to these areas only. However, areas expected to have tertiary influences are often some distance from the project footprint and likely to be affected by other additional influences outside of the proposed projects’ control, which complicates interpretation of long-term monitoring data. The optimal location for both baseline surveys and subsequent long-term monitoring is therefore usually within the potential zone of secondary influence. Finally, it is necessary to select at least one control site located outside the zone of tertiary influence for comparative purposes during monitoring.

6.3 Worked examples

Table 6.1 provides a worked hypothetical example of the basic steps for determination of the PAOI by a specialist. This example considers a proposed upgrade of an existing dirt/gravel road to a tar road with a car parking lot to enhance access to the beach and potentially allow for some additional future developments. The evaluation of the PAOI in this example is conducted by the botanist.

Two additional illustrative examples are provided in Appendix 3 – Additional examples for defining PAOI where the PAOI is larger than the development footprint due to wind-blown pollution and noise from blasting, respectively.
TABLE 6.1.—Example of the procedure to determine the taxon-specific (flora) PAOI.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Example</th>
<th>Key references and resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>How will the project and its associated activities interact with the flora of the region?</td>
<td>Map the project footprint (primary PAOI), including auxiliary activities (e.g. construction laydown areas), in relation to natural features/satellite imagery/other relevant data layers. South African National Land-Cover 2014 (<a href="http://bgis.sanbi.org/Projects/Detail/44">http://bgis.sanbi.org/Projects/Detail/44</a>) NFEPA Rivers 2011 (<a href="http://bgis.sanbi.org/SpatialDataset/Detail/397">http://bgis.sanbi.org/SpatialDataset/Detail/397</a>) NFEPA Wetlands 2011 (<a href="http://bgis.sanbi.org/nfepa/project.asp">http://bgis.sanbi.org/nfepa/project.asp</a>) Google Earth satellite imagery</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>How far around the features identified in Step 1 could the flora community be influenced by the project activities?</td>
<td>Project activities confined to the project footprint (6 m wide road) may impact on the surrounding area for up to 700 m. Nearby aquatic habitats could be impacted by accidental hydrocarbon spills and improper storm water management, leading to erosion and siltation. Increased levels of dust production along the roads during construction is expected to result in compromised capacity of plants to photosynthesise, which may cause die-off, resulting in potential colonisation by alien and invasive species. Increased traffic on the upgraded road is expected to negatively impact the flora communities for at least 50 m on either side of the road, due to aided dispersal of wind-dispersed alien and invasive plants, which may easily colonize patches of dead or compromised natural vegetation. The combined primary, secondary and tertiary PAOI is therefore much larger than the project footprint (Figure 6.3). Description and justification for the PAOI areas, as well as the area calculations for each are provided in Table 6.2. Van Der Ree et al. (2015)</td>
</tr>
</tbody>
</table>

TABLE 6.2.—Area calculations for the taxon-specific (flora) PAOI.

<table>
<thead>
<tr>
<th>PAOI</th>
<th>Area (ha)</th>
<th>Description</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary (footprint)</td>
<td>1.26</td>
<td>Confined to the actual road surface (5 m wide) and parking lot with 0.5 m of cleared vegetation on either side (6 m road width in total).</td>
<td>Definite</td>
</tr>
<tr>
<td>Secondary</td>
<td>12.40</td>
<td>A 40 m buffer on either side of the primary PAOI where dust, rainwater runoff and construction activities (moving of vehicles, temporary storage of materials etc.) can be expected to negatively impact on the natural vegetation.</td>
<td>Likely</td>
</tr>
<tr>
<td>Tertiary</td>
<td>78.58</td>
<td>A 200 m buffer on either side of the primary PAOI with modified larger area in the aquatic habitats (due to potential dilution and spread) where extreme impacts such as major hydrocarbon spills and fire (e.g. from staff cigarettes or cooking fires) can potentially occur.</td>
<td>Unlikely but possible</td>
</tr>
<tr>
<td>Total</td>
<td>92.24</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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FIGURE 6.2.—Hypothetical project footprint and associated infrastructure.

FIGURE 6.3.—Defined PAOI from the proposed development.
To appropriately evaluate potential impacts from the proposed development, it is essential to carefully define the potential impact receptors in relation to a specific species/group of species and its/their use of/reliance on a particular habitat. SCC should be one of the main factors (but not the only factors) influencing the description of habitat/vegetation/structural units to serve as receptors to potential impacts, e.g. ‘Bald Ibis breeding habitat’ or ‘Frithia humilis quartzitic rocky outcrop hilltop’. The receptor therefore includes both the habitat/vegetation type and the important species reliant on it for a particular purpose (breeding, refugia, foraging etc.). Therefore, when evaluating SEI (see below) for the receptor and describing potential impacts from the proposed development, the species or group of species of concern have been specifically taken into account.

Where possible, the impact receptors must be defined spatially and mapped appropriately (see 9.3.12 Mapping standards). In cases where mapping cannot easily be performed (e.g. specific trees used as nesting sites), the general area containing these receptors should be mapped. As required by section 2.2.10 of the Terrestrial Animal Species Protocol and section 2.3.10 of the Terrestrial Plant Species Protocol, taxon-specific buffers described in section 10 of this guideline must be applied for all mapping exercises.
8.1 Motivation

The screening tool identifies species and ecosystem spatial triggers likely to indicate environmental sensitivity associated with a particular proposed development site, which in turn determines the necessity and requirements for particular specialist studies, for which guidelines have been developed in this document.

The Terrestrial Animal/Plant Species Protocols require specialists to identify:

- the nature and the extent of the potential impact of the proposed development on species of conservation concern occurring on the proposed development site;
- the potential impact of the proposed development on the habitat of the species of conservation concern; and
- any alternative development footprints within the preferred development site which would be of ‘low’ sensitivity as identified by the screening tool and verified through the site sensitivity verification.

In order to spatially identify the different areas of importance for a species for a proposed development site and to facilitate transparent and comparable reporting of the potential impacts of development, a standardised metric for identifying site-based ecological importance for species, in relation to a proposed project with a specific footprint/PAOI and suite of anticipated activities, is presented here. It allows for rapid spatial inspection and evaluation of impacts of proposed developments within the context of on-site habitats and SCC, and also facilitates integration of inputs from different specialist studies. This process is necessary because the screening tool evaluates ‘environmental sensitivity’ at a larger scale than that of a proposed development site and frequently includes modelled data that require field verification. This assessment relies on the data collected during the necessary specialist surveys to provide a current evaluation of the on-site habitat conditions. This assessment does not replace the output of the screening tool but is more specific to the proposed development footprint/PAOI and proposed project activities. Where the site-specific assessment produces lower or higher SEI classification than the ‘environmental sensitivity’ output of the screening tool for that particular site, it is the responsibility of the specialist to provide a clear and defensible justification for the difference.

8.2 Method for the determination of SEI

SEI is considered to be a function of the biodiversity importance (BI) of the receptor (e.g. species of conservation concern, the vegetation/fauna community or habitat type present on the site20) and its resilience to impacts (receptor resilience [RR]) as follows:

20 Note that the habitat type may be independent of the vegetation community and that it may even be artificial, e.g. excavated rock quarries that provide crucial breeding habitat for cliff-nesting species such as Bald Ibis.
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BI in turn is a function of conservation importance (CI) and the functional integrity (FI) of the receptor as follows:

\[ \text{BI} = \text{CI} + \text{FI} \]

Conservation importance (CI) is evaluated in accordance with recognised established internationally acceptable principles and criteria for the determination of biodiversity-related value, including the IUCN Red List of Species, Red List of Ecosystems and Key Biodiversity Areas (KBA; IUCN [2016]).

Conservation importance is defined here as:

‘The importance of a site for supporting biodiversity features of conservation concern present, e.g. populations of IUCN Threatened and Near Threatened species (CR, EN, VU and NT), Rare species, range-restricted species, globally significant populations of congregatory species, and areas of threatened ecosystem types, through predominantly natural processes.’

These criteria are defined as follows:

- IUCN threatened and Near Threatened species (CR, EN, VU and NT) are defined as either the global or national assessments of the risk of extinction as evaluated by a dedicated panel of species specialists according to the criteria of the International Union for The Conservation of Nature (www.iucnredlist.org). Where the global and national assessments differ for the same taxon, the national evaluation of status\(^{21}\) should be used in calculating SEI unless the global assessment is both more recent and of a more threatened category. It is important to note that the specialist is required to have a firm understanding of the IUCN Red List Categories and Criteria (IUCN 2012) in order to appropriately apply these for the evaluation of SEI. This criterion can be assessed using confirmed occurrences of species or the suitability of the habitat to support these species.

- Rare species are those included on South Africa’s National Red List as Rare or Critically Rare or Extremely Rare. These are highly restricted species that are currently not declining. However, should any development impact on a population of these species they will immediately qualify under one of the IUCN categories of threat.

- Range-restricted species – the presence of terrestrial flora, vertebrate and invertebrate fauna with a global population extent of occurrence (EOO) of 10 000 km\(^2\) or less. Globally significant populations of congregatory species – a roughly estimated proportion (\%) of the global population of a fauna species that congregate for breeding/feeding/hibernation/other reasons.

- Significant areas of threatened vegetation types – this is a function of both the area (size) being considered in relation to the total extent of that vegetation type (i.e. proportion) and how threatened (CR, EN, VU) the vegetation types are.

- Natural processes – natural unmanaged areas with low levels of ecological disturbance have largely intact natural processes such as pollination, seed dispersal and migration, and thus have greater intrinsic conservation importance than those that are modified through ecological disturbance.

While most of the features that will be included in the CI will be provided by the screening tool, it is important to note that CI is evaluated at a much finer spatial scale and based on fieldwork data collection and comprehensive desktop analyses performed by the specialist during the EA process. As a minimum requirement, CI needs to be determined for each identified habitat within the project footprint/PAOI, but best practice recommendation is that it should be determined for all habitats within the entire PAOI\(^{22}\).

Fulfilling criteria to evaluate CI do not rely on a single specific threshold for each of the above defining characteristics but can act in combination or in isolation, providing a more robust evaluation of CI (Table 8.1). Furthermore, while CI is most likely to be assessed based on data collected during the fieldwork survey, it can also be an assessment of the suitability of the receptor to support populations conforming to the fulfilling criteria. As can be seen from the worked example below, each of these evaluations of the fulfilling criteria demand necessary justification.

Functional integrity (FI) of the receptor (e.g. the vegetation/fauna community or habitat type) is defined here as the receptors’ current ability to maintain the structure and functions that define it, compared to its known or predicted state under ideal conditions. Simply stated, FI is:

‘A measure of the ecological condition of the impact receptor as determined by its remaining intact and functional area, its connectivity to other natural areas and the degree of current persistent ecological impacts.’

These criteria can be defined as:

- Connectivity to other natural areas – connectivity, which can also be measured conversely as the degree of habitat fragmentation, refers to how connected habitat patches


\(^{22}\)Because CI needs to be assigned to a receptor (e.g. the vegetation/fauna community or habitat type), it is customary to use the flora community delineation developed for a PAOI by a botanical specialist. However, such delineation is often too fine scaled to define fauna-specific habitats, which are generally more structural than phytosociological in nature. Where this is the case, the fauna specialist should merge two or more relevant floral communities to correlate with the specific fauna habitat type that is characteristic of a particular taxon assemblage. In certain cases, the faunal specialist will have to demarcate habitats that have not been classified by the botanical specialist; a pertinent example is the presence of cliffs, which are frequently important breeding habitat for some bird SCC.
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TABLE 8.1.—Conservation importance (CI) criteria.

<table>
<thead>
<tr>
<th>Conservation importance</th>
<th>Fulfilling criteria</th>
</tr>
</thead>
</table>
| Very high               | Confirmed or highly likely occurrence of CR, EN, VU or Extremely Rare\(^{23}\) or Critically Rare\(^{24}\) species that have a global EOO of < 10 km\(^2\).
Any area of natural habitat\(^{25}\) of a CR ecosystem type or large area (> 0.1% of the total ecosystem type extent\(^{26}\)) of natural habitat of EN ecosystem type.
Globally significant populations of congregatory species (> 10% of global population). |
| High                    | Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO of > 10 km\(^2\). IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A. If listed as threatened only under Criterion A, include if there are less than 10 locations or < 10 000 mature individuals remaining.
Small area (> 0.01% but < 0.1% of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1%) of natural habitat of VU ecosystem type.
Presence of Rare species.
Globally significant populations of congregatory species (> 1% but < 10% of global population). |
| Medium                  | Confirmed or highly likely occurrence of populations of NT species, threatened species (CR, EN, VU) listed under Criterion A only and which have more than 10 locations or more than 10 000 mature individuals.
Any area of natural habitat of threatened ecosystem type with status of VU.
Presence of range-restricted species.
> 50% of receptor contains natural habitat with potential to support SCC. |
| Low                     | No confirmed or highly likely populations of SCC.                                                                                                   |
No confirmed or highly likely populations of range-restricted species. |
< 50% of receptor contains natural habitat with limited potential to support SCC. |
| Very low                | No confirmed and highly unlikely populations of SCC.                                                                                               |
No confirmed and highly unlikely populations of range-restricted species. |
No natural habitat remaining. |

are to each other, which has a significant influence on numerous ecological processes, such as migration and dispersal opportunities of biota and therefore genetic exchange between populations. Connectivity to other similar habitats becomes more important as the remaining intact and functional area of a habitat decreases, mainly because population sizes decrease and are therefore at greater risk from ecological perturbations and inbreeding effects. The degree of connectivity between habitat patches varies greatly with the dispersal ability of the taxon or taxon group (e.g. fossorial reptiles) in question.

- Degree of current persistent negative ecological impacts\(^{27}\) – persistent negative impacts such as uncontrolled spread of alien and invasive flora effectively decreases both the remaining intact area and ecosystem functioning of a particular habitat.
- Remaining intact and functional area – the proportion of the receptor that supports natural habitat with intact ecological processes – small areas are less likely to withstand ecological degradation compared to large areas, and the latter are therefore better able to maintain structure and function allowing for intact ecological processes.

\(^{23}\) For butterflies, as per Armstrong et al. (2013).
\(^{24}\) For plants, as per Raimondo et al. (2009).
\(^{25}\) This excludes areas of transformed habitat within a defined ecosystem even if these are partially restored, e.g. Highveld grasslands that have been converted to maize fields and then abandoned so that some form of functional grassland is restored; this is not natural habitat as it does not and will not in the future have species composition representative of the original natural habitat.
\(^{26}\) This can be calculated from the threatened ecosystem of South Africa shapefile available from the SANBI (current available version 2011: http://bgis.sanbi.org/Projects/Detail/49).
\(^{27}\) Persistent ecological disruptors must not include components that landowners are legally obliged to address or that should be addressed as norm for best practice. Wilful neglect of these legal obligations or the presence of invasive alien species that can practically be controlled through management actions should not negatively influence the FI score to a major extent.
Ecological processes can be considered to be mostly intact and functional if the receptor area has low levels of current ecological disruptors, has good connectivity to other areas and is a relatively large area. As for CI, the fulfilling criteria to evaluate FI do not rely on a single specific threshold for each of the above defining characteristics but can act in combination or in isolation (Table 8.2), and will require justification by the specialist (see worked example below).

Recalling that biodiversity importance (BI) is a function of conservation importance (CI) and the functional integrity (FI) of a receptor, BI can be derived from a simple matrix of CI and FI as follows:

<table>
<thead>
<tr>
<th>Biodiversity importance</th>
<th>Conservation importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td>Very high</td>
</tr>
<tr>
<td>High</td>
<td>Very high</td>
</tr>
<tr>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Very low</td>
<td>Low</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Functional integrity</th>
<th>Fulfilling criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td>Very large (&gt; 100 ha) intact area for any conservation status of ecosystem type or &gt; 5 ha for CR ecosystem types. High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches. No or minimal current negative ecological impacts with no signs of major past disturbance (e.g. ploughing).</td>
</tr>
<tr>
<td>High</td>
<td>Large (&gt; 20 ha but &lt; 100 ha) intact area for any conservation status of ecosystem type or &gt; 10 ha for EN ecosystem types. Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Only minor current negative ecological impacts (e.g. few livestock utilising area) with no signs of major past disturbance (e.g. ploughing) and good rehabilitation potential.</td>
</tr>
<tr>
<td>Medium</td>
<td>Medium (&gt; 5 ha but &lt; 20 ha) semi-intact area for any conservation status of ecosystem type or &gt; 20 ha for VU ecosystem types. Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches. Mostly minor current negative ecological impacts with some major impacts (e.g. established population of alien and invasive flora) and a few signs of minor past disturbance. Moderate rehabilitation potential.</td>
</tr>
<tr>
<td>Low</td>
<td>Small (&gt; 1 ha but &lt; 5 ha) area. Almost no habitat connectivity but migrations still possible across some modified or degraded natural habitat and a very busy used road network surrounds the area. Low rehabilitation potential. Several minor and major current negative ecological impacts.</td>
</tr>
<tr>
<td>Very low</td>
<td>Very small (&lt; 1 ha) area. No habitat connectivity except for flying species or flora with wind-dispersed seeds. Several major current negative ecological impacts.</td>
</tr>
</tbody>
</table>

Receptor resilience (RR) is defined here as:

‘The intrinsic capacity of the receptor to resist major damage from disturbance and/or to recover to its original state with limited or no human intervention.’

The fulfilling criteria to evaluate RR are based on the estimated recovery time required to restore an appreciable portion of functionality to the receptor (Table 8.3) and will require justification by the specialist. The specialist needs to bear in mind that resilience will often be linked to a particular disturbance or impact, or even time of year, and needs to be described in relation to these factors. For example, large birds of prey have different levels of resilience to noise disturbance depending on whether they are breeding or not; these species would have low resilience to noise disturbance such as construction of a road adjacent to a nest site during the breeding season but a higher resilience to lodge construction in an area with limited breeding habitat outside of the breeding season.

Receptor resilience needs to be evaluated by the specialist and justification for each evaluation must be provided in the report (see worked example below). Finally, after
the successful evaluation of both BI and RR as described above, it is possible to evaluate SEI from the final matrix as follows:

SEI should be described in the above manner for each impact receptor (see 7 Description of impact receptors) within the PAOI and clearly mapped in relation to the proposed development activities and infrastructure. Interpretation of SEI in the context of the proposed development activities (Table 8.4) must be provided by the specialist.

It is very important to note that SEI is specific to the proposed development activities and cannot be meaningfully compared between different proposed projects with different associated activities on the same spatial location. However, SEI for the same proposed development with multiple alternative layouts and/or locations may be compared within the same study.

### TABLE 8.3.—Resilience criteria.

<table>
<thead>
<tr>
<th>Resilience</th>
<th>Fulfilling criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td>Habitat that can recover rapidly (~ less than 5 years) to restore &gt; 75% of the original species composition and functionality of the receptor functionality, or species that have a very high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a very high likelihood of returning to a site once the disturbance or impact has been removed.</td>
</tr>
<tr>
<td>High</td>
<td>Habitat that can recover relatively quickly (~ 5–10 years) to restore &gt; 75% of the original species composition and functionality of the receptor functionality, or species that have a high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a high likelihood of returning to a site once the disturbance or impact has been removed.</td>
</tr>
<tr>
<td>Medium</td>
<td>Will recover slowly (~ more than 10 years) to restore &gt; 75% of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a moderate likelihood of returning to a site once the disturbance or impact has been removed.</td>
</tr>
<tr>
<td>Low</td>
<td>Habitat that is unlikely to be able to recover fully after a relatively long period: &gt; 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a low likelihood of returning to a site once the disturbance or impact has been removed.</td>
</tr>
<tr>
<td>Very low</td>
<td>Habitat that is unable to recover from major impacts, or species that are unlikely to remain at a site even when a disturbance or impact is occurring, or species that are unlikely to return to a site once the disturbance or impact has been removed.</td>
</tr>
</tbody>
</table>

### TABLE 8.4.—Guidelines for interpreting SEI in the context of the proposed development activities.

<table>
<thead>
<tr>
<th>Site ecological importance</th>
<th>Interpretation in relation to proposed development activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very high</td>
<td>Avoidance mitigation – no destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e. last remaining populations of species, last remaining good condition patches of ecosystems/unique species assemblages). Destructive impacts for species/ecosystems where persistence target remains.</td>
</tr>
<tr>
<td>High</td>
<td>Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.</td>
</tr>
<tr>
<td>Medium</td>
<td>Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.</td>
</tr>
<tr>
<td>Low</td>
<td>Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.</td>
</tr>
<tr>
<td>Very low</td>
<td>Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.</td>
</tr>
</tbody>
</table>
8.3 Combining multi-taxon SEI

The SEI evaluated for each taxon should be combined into a single multi-taxon evaluation of SEI for the PAOI, to allow the competent authority to evaluate the SEI for the entire PAOI of the proposed development rapidly and at a single glance. This task should be performed by the lead biodiversity specialist or by the EAP. Combined SEI can be achieved in the following two ways, which will yield identical combined results.

Firstly, \textit{post hoc} combination of the maximum SEI for each receptor should be applied in cases where specialist studies were conducted individually and/or at different times. For example, if a particular habitat with an EN species present was evaluated by the mammal specialist to be of medium SEI and that same habitat with a CR invertebrate species present was later evaluated by the invertebrate specialist to be of high SEI, then the final combined SEI for that particular habitat would be high, if no other specialist studies were performed that evaluated SEI for this habitat within the project footprint/PAOI to be higher.

Alternatively, SEI may be evaluated only once per receptor but for all necessary taxa simultaneously. In this case, justification of the SEI for each receptor must be based on the criteria that conforms to the highest CI and FI, and the lowest RR across all taxa.

Note that it is possible for the impact receptors of different taxa to differ in spatial extent because species or groups of species of conservation concern must be considered when defining receptors. For example, the botanical specialists may map an entire woodland savanna as a single impact receptor while the ornithologist may map a portion of this habitat as ‘White-backed Vulture breeding habitat in tall trees within woodland savanna’. In cases where the spatial extent differs between taxa, combing the SEI into a single map requires that the spatial entity with the greatest SEI must take priority. This example is illustrated in Figure 8.1.

---

There is currently no consensus on the selection of appropriate restoration endpoints, which vary greatly between habitat types, type of habitat degradation and opinion of the restoration scientists. We suggest here a relatively generic endpoint of three quarters of the original species composition and functionality, as it is likely to be a good middle ground based on the available literature. Specialists should bear in mind that data of restoration times for all habitats is not available and therefore, for some habitat types, resilience should be assessed based on a conservative estimate of habitat restoration time. For this reason, a relatively high proportion of the original species composition and functionality is used to estimate resilience as it assumes a precautionary approach and should result in lower resilience estimates in the face of uncertainty.
8.4 Worked example

A developer considers utilising a portion of the inner area of the Kenilworth Racecourse\(^29\) for the development of an exclusive housing estate. The developer proposes several development footprint alternatives (as is required). For this example, we consider only the preferred development footprint alternative (Figure 8.2)\(^30\). The screening tool reports that several threatened fauna and flora species are highly likely and/or known to occur within the PAOI and confirms the necessity for specialist studies. This example covers the herpetofauna and botanical studies and shows how these should be combined.

8.4.1 Flora

A habitat map (Figure 8.3) is created based on satellite imagery (including historical imagery) and published spatial data. The botanist performs a desktop survey and confirms that subpopulations of 18 threatened species are known to occur on Kenilworth Racecourse. A fieldwork survey results in a number of these threatened species being located and confirms suitability of the habitat for other SCC within the proposed development area (considered as the PAOI).

A buffer of 200 m is then applied to each threatened species subpopulation, as recommended by Raimondo et al. (2009). Where these buffers overlap with unsuitable habitat for the species, the buffers are then adjusted in shape and size to only include suitable habitat. In addition, buffers are assigned to natural habitat in the PAOI as follows:

- Wetlands containing SCC – the recommended minimum buffer for high density urban, resort and hotel developments for river, wetland and estuary habitats is 15 m (Macfarlane and Bredin, 2017) and is considered sufficient for plant species occurring in wet soils at the edge of these wetlands.
- Sandy Fynbos – the proximity of severely/moderately modified or degraded habitat along the border of Sandy Fynbos in the PAOI has resulted in some degradation in habitat quality through edge effects. A buffer of 15 m is considered necessary to ensure that these edge effects are not exacerbated if development takes place right at the boundary of Sandy Fynbos.

\(^{29}\) This example is based on an actual application for the development of a hotel, high-rise residential units and retail developments on the Kenilworth Racecourse property (https://www.sportingpost.co.za/2018/08/kenilworth-development-goes-ahead/).

\(^{30}\) Occasionally, a developer that is aware of potential sensitive areas within a property may not specify a footprint and first seek the guidance of specialist studies to identify low sensitivity locations within the proposed development area for the development footprint.
No buffers are considered necessary for irreversibly modified or degraded habitats. However, where subpopulations of threatened species occur adjacent to degraded habitat, the buffers applied to these subpopulations are allowed to overlap with the degraded habitat if it is potentially suitable for these species if properly restored.

The habitat map is then updated by the botanist to reflect these species buffers (Figure 8.4). The calculation of SEI for each of the vegetation communities/habitats is described in Table 8.6 and the interpretation is given in Table 8.5. The SEI of each vegetation community/habitat is illustrated in Figure 8.5. Degraded fynbos and degraded natural areas are assessed as having medium SEI in Table 8.6. However, these habitats fall within the buffers of known subpopulations of highly threatened plant species and have the potential to be restored to habitat that could support these species. The SEI of these habitats has been increased to very high by the specialist, using the precautionary principle, to ensure that they do not fall within the development footprint.

8.4.2 Herpetofauna

The herpetologist performs a fieldwork survey and locates some of the target species and confirms suitability of the habitat for other SCC within the proposed development area (considered as the PAOI).

Based on the findings from the herpetofauna survey, the herpetologist applies herpetofauna-specific buffers to the habitat map as follows:

- Wetlands with SCC – the recommended minimum buffer for high density urban, resort and hotel developments for river, wetland and estuarine habitats is 15 m (Macfarlane and Bredin, 2017). Please note that the terrestrial area required to protect biodiversity associated with a water resource is much larger than the buffer needed for water quality alone. This example uses the Macfarlane and Bredin (2017) buffers for illustrative purposes only. The reader is referred to the herpetofauna-specific section for a discussion on appropriate buffers (10.2.5 Buffers for SCC).
- Sandy Fynbos – given that edge effects (resulting in degradation of habitat quality) are apparent at the boundary between this habitat type and transformed habitats, an additional 15 m buffer is considered necessary to ensure that these edge effects are not exacerbated if development takes place right at the boundary.
- It is not considered necessary to buffer any of the other habitat types.

The updated habitats with applied herpetofauna buffers are mapped and presented in Figure 8.6. Note:
- Where the herpetofauna buffers caused the wetland or Sandy Fynbos habitats to extend over the irreversibly modified areas with permanent infrastructure, the
FIGURE 8.4.—Habitat map for the proposed development area with applied flora-specific buffers.

FIGURE 8.5.—SEI of the vegetation communities and other habitats in the PAOI of a hypothetical proposed housing development.
irreversibly modified area was reinstated here (excised from the buffer). However, temporary infrastructure (e.g. shipping containers; see arrow in Figure 8.6) was excluded from this exercise.

- Updated area calculations are provided for the adjusted habitat delineation with buffers.

Table 8.7 and Table 8.8 provide a worked example of how SEI should be determined in this situation.

### 8.4.3 Combining flora and herpetofauna SEI

The post hoc method for combination of multi-disciplinary SEI relies on selection of the maximum SEI for each receptor. This exercise must be performed as indicated in Table 8.9 where the maximum assigned SEI per receptor is selected, taking into account any SCC buffers that have been applied and assigned an SEI. Consequently, the ‘degraded fynbos (Acacia)’ and ‘degraded natural areas’ habitats are evaluated as both of medium and very high SEI for flora because the botanist assigned a medium SEI to these habitats but then applied an SCC buffer of very high SEI, which did not completely cover these habitats (see Figure 8.5). The final combined SEI should be mapped. In this case, the combined SEI map is identical to the botanical SEI map (Figure 8.5).

### 8.4.4 Alternative development footprints

It is clear from the above example that the originally proposed development footprint intersects with several areas considered to be of ‘very high’ combined SEI (Figure 8.5 and Figure 8.7), which are not suitable for development. In such a case, it is recommended that alternative development footprints within the development site should be suggested which exclusively comprise areas considered to be of ‘very low’ and ‘low’ combined SEI. If it is not possible to reconfigure or reshape the proposed development footprint in this manner, the specialist must indicate that the proposed development and its associated activities are not suitable for the selected development site (see 9.6 Suitability of the proposed project and its activities).
TABLE 8.6.—Evaluation of SEI of vegetation communities and other habitats in the PAOI for a hypothetical proposed development. BI = biodiversity importance, RR = receptor resilience.

<table>
<thead>
<tr>
<th>Habitat</th>
<th>Conservation importance</th>
<th>Functional integrity</th>
<th>Receptor resilience</th>
<th>Site ecological importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy Fynbos</td>
<td><strong>Very high</strong></td>
<td><strong>Very high</strong> &gt; 5 ha of CR ecosystem type with no or minimal current negative ecological impacts and no signs of major past disturbance.</td>
<td>Low</td>
<td><strong>Very high</strong> BI = Very high RR = Low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sandy Fynbos is prone to rapid invasion by alien and invasive flora that prevents the restoration of this habitat following major disturbance. It requires active management and restoration attempts are not always successful. Flora endemic to this vegetation type are unlikely to adapt to major change, even after a long period.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wetland</td>
<td><strong>Very high</strong></td>
<td><strong>High</strong> Some invasion by alien plants at wetland edges, but no signs of major past disturbance.</td>
<td>Very low</td>
<td><strong>Very high</strong> BI = Very high RR = Very low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wetlands are not easily restored without significant intervention. Wetland habitat specialist flora are unlikely to survive in any other habitat in the development area and are thus highly dependent on functional wetland habitat.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degraded fynbos (Acacia) &amp; Degraded natural areas</td>
<td><strong>Very high</strong></td>
<td><strong>Low</strong> Small (&gt; 1 ha but &lt; 5 ha) area(^{35}) with several minor and major current negative ecological impacts.</td>
<td>Medium</td>
<td><strong>Medium</strong> BI = Medium RR = Medium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Degraded Sandy Fynbos has the potential to be restored over time, particularly the areas that have been invaded by alien trees.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open water (dam)</td>
<td><strong>Low</strong></td>
<td><strong>Medium</strong> Mostly minor current negative ecological impacts with some major impacts (established population of alien and invasive flora) and a few signs of minor past disturbance. Has moderate rehabilitation potential.</td>
<td>High</td>
<td><strong>Very low</strong> BI = Low RR = High</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Because these are not fully natural systems (have been excavated and managed in the past), their ability to recover is good because they would not need to recover to a fully natural state.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modified (including roads and infrastructure)</td>
<td><strong>Very low</strong></td>
<td><strong>Very low</strong> Several major current negative ecological impacts.</td>
<td><strong>Very high</strong></td>
<td><strong>Very low</strong> BI = Very low RR = Very high</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Because this is a severely modified system, its ability to return to a modified state is high.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{33}\) Although not a requirement to present the triggers for 'high' if CI is already evaluated as 'very high', it is useful to provide the competent authority with further substantiating reasons for CI.

\(^{34}\) Although not a requirement to present the triggers for 'high' if CI is already evaluated as 'very high', it is useful to provide the competent authority with further substantiating reasons for CI.

\(^{35}\) Each habitat type is evaluated separately for area. The two different habitat types are, however, presented together as they have the same functionality from a flora perspective.
TABLE 8.7.—Worked example of how to determine SEI for herpetofauna within the PAOI.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Example</th>
<th>Key references</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Where is the project area located, what is its development footprint area and in what ecosystem types is it situated?</td>
<td>‘The proposed development has an undetermined footprint within a proposed development area of ~ 41 ha and is situated in the Kenilworth Racecourse property. The proposed development area is situated entirely in the ‘Cape Flats Sand Fynbos’ ecosystem type (SANBI National list of threatened terrestrial ecosystems, 2011; Vegetation Unit FFd 5; Mucina and Rutherford, 2006).’</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>What are the habitat types within the PAOI that are relevant to the taxon of investigation (herpetofauna)?</td>
<td>‘The PAOI contains six habitat types relevant to herpetofauna (Figure 8.3) of which two represent relatively undisturbed natural habitat of importance for herpetofauna namely, wetlands and Sandy Fynbos.’</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>What is the SEI of the different habitat types within the PAOI that are relevant to the taxon of investigation (reptiles)?</td>
<td>‘The PAOI (and therefore footprint) of the proposed housing development comprises habitats with either low, medium, or very high SEI (Table 8.8 and Figure 8.7). According to the guidelines for interpretation of SEI (Table 8.4), avoidance mitigation should be exercised for the very high SEI areas and no destructive development activities should be considered within this SEI. For development to occur, it is strongly advised that the development footprint should be adjusted and confined to the low SEI areas. Minimal and temporary disturbances (such as construction laydown areas etc.) during the construction phase are allowed within the medium SEI areas, provided that appropriate restoration takes place after construction has been completed.’</td>
</tr>
</tbody>
</table>

36 http://bgis.sanbi.org/Projects/Detail/49
37 Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa.
### TABLE 8.8.—Evaluation of SEI of herpetofauna habitats in the PAOI for a hypothetical proposed development. BI = biodiversity importance, RR = receptor resilience.

<table>
<thead>
<tr>
<th>Habitat</th>
<th>Conservation importance</th>
<th>Functional integrity</th>
<th>Receptor resilience</th>
<th>Site ecological importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy Fynbos</td>
<td>Very high</td>
<td>Very high</td>
<td>Low</td>
<td>Very high</td>
</tr>
<tr>
<td></td>
<td>Any area of a CR ecosystem type.</td>
<td>&gt; 5 ha of CR ecosystem type with no or minimal current negative ecological impacts and no signs of major past disturbance.</td>
<td>Sandy Fynbos is prone to rapid invasion by alien and invasive flora that prevents the restoration of this habitat following major disturbance. It requires active management and restoration attempts are not always successful. Herpetofauna reliant on this habitat are unlikely to adapt to major change, even after a long period.</td>
<td>BI = Very high, RR = Low</td>
</tr>
<tr>
<td>Wetland</td>
<td>Very high</td>
<td>High</td>
<td>Very low</td>
<td>Very high</td>
</tr>
<tr>
<td></td>
<td>Any area of a CR ecosystem type.</td>
<td>Only minor current negative ecological impacts with no signs of major past disturbance.</td>
<td>Herpetofauna community is unable to recover from major impacts, particularly if the surrounding fynbos is also disturbed. This is an isolated community (no connectivity) and therefore resilience is diminished.</td>
<td>BI = Very high, RR = Very low</td>
</tr>
<tr>
<td>Degraded fynbos (Acacia) &amp; Degraded natural areas</td>
<td>Very high</td>
<td>Low</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Any area of a CR ecosystem type.</td>
<td>Small (&gt; 1 ha but &lt; 5 ha) area with several minor and major current negative ecological impacts.</td>
<td>Degraded Sandy Fynbos and its associated herpetofauna community can be expected to recover to this state (after disturbance) much faster and with greater likelihood due to its already degraded nature.</td>
<td>BI = Medium, RR = Medium</td>
</tr>
<tr>
<td>Open water (dam)</td>
<td>High</td>
<td>Medium</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Confirmed occurrence of EN (criterion B) species (Xenopus gilli) that has a global EOO of &gt; 10 km²</td>
<td>Mostly minor current negative ecological impacts with some major impacts (established population of alien and invasive flora) and a few signs of minor past disturbance. Has moderate rehabilitation potential.</td>
<td>Because these are not fully natural systems (have been excavated and managed in the past), their ability to recover is good because they would not need to recover to a fully natural state.</td>
<td>BI = Medium, RR = High</td>
</tr>
<tr>
<td>Modified (including roads and infrastructure)</td>
<td>Very low</td>
<td>Very low</td>
<td>Very high</td>
<td>Very low</td>
</tr>
<tr>
<td></td>
<td>No longer representative of a CR ecosystem type and not suitable for herpetofauna SCC.</td>
<td>Several major current negative ecological impacts.</td>
<td>Because this is a heavily transformed system, its ability to recover is virtually certain because it would need to recover to a transformed state.</td>
<td>BI = Very low, RR = Very high</td>
</tr>
</tbody>
</table>

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38 Although not a requirement to present the triggers for ‘high’ if CI is already evaluated as ‘very high’, it is useful to provide the competent authority with further substantiating reasons for CI.
39 Although not a requirement to present the triggers for ‘high’ if CI is already evaluated as ‘very high’, it is useful to provide the competent authority with further substantiating reasons for CI.
40 The area for each habitat type is evaluated separately. The two different habitat types are however presented together as they have the same functionality from a herpetofauna perspective.
FIGURE 8.7.—SEI of the herpetofauna habitat types in the PAOI of a hypothetical proposed housing development.

<table>
<thead>
<tr>
<th>Habitat</th>
<th>Flora</th>
<th>Herpetofauna</th>
<th>Combined SEI</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sandy Fynbos</td>
<td>Very high</td>
<td>Very high</td>
<td>Very high</td>
<td></td>
</tr>
<tr>
<td>Wetland</td>
<td>Very high</td>
<td>Very high</td>
<td>Very high</td>
<td></td>
</tr>
<tr>
<td>Degraded fynbos (Acacia) &amp; Degraded natural areas</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
<td>Majority of these habitats include flora SCC buffer designated as ‘very high’ SEI.</td>
</tr>
<tr>
<td>Open water (dam)</td>
<td>Very high</td>
<td>Low</td>
<td>Very high</td>
<td>Flora SCC buffer designated as ‘very high’ SEI entirely covers this habitat.</td>
</tr>
<tr>
<td>Transformed (including roads and infrastructure)</td>
<td>Very low</td>
<td>Very low</td>
<td>Very low</td>
<td></td>
</tr>
</tbody>
</table>
The following guidelines are applicable to all species specialists and their respective studies. In a few selected cases, where the general guidelines in this section are only applicable to a subset of the taxa and/or specialists, this is clearly indicated.

9.1 Qualifications and limitations of specialist

- SACNASP registration in relevant field, where such exists. Note that, in terms of the Natural Scientific Professions Act, 2003 (Act No. 27 of 2003), it is illegal to practice in a professional (paid) consulting capacity without appropriate SACNASP registration. Registration with SACNASP further ensures adherence to their code of conduct.

- Previous experience required for the relevant taxon – e.g. an experienced aquatic ecology specialist cannot be considered as an avifauna specialist without demonstrated experience in this regard. Relevant experience is to be clearly highlighted in the specialist’s curriculum vitae attached to the specialist report.

- It is important to also note, that the specialist performing the required field survey and the reporting must be experienced and qualified to do so. The practice where unqualified, inexperienced persons conduct unsupervised fieldwork and reporting which is then underwritten or ‘signed off’ by a qualified and/or SACNASP-registered specialist is not acceptable. It is, however, acceptable for Candidate Natural Scientists (Cand.Sci.Nat.) to work under the supervision of a Professional Natural Scientist (Pr.Sci.Nat) who signs off on their work, but only if the person qualified as Pr.Sci.Nat is present on site during the field survey and appends a signed declaration to the report stating that all facets of the work performed by the Cand.Sci.Nat. were appropriately supervised.

- A person should not act in the capacity as a specialist for more than two of the six recognised biodiversity disciplines for the same environmental authorisation project that triggers an EIA process. This will ensure that there are sufficiently experienced specialists deployed to elevate the likelihood of SCC being located. This limitation does not apply for basic assessments (BAs).

9.2 Fieldwork

9.2.1 Seasonality with specific reference to the EA process

The presence, behaviour and detectability of the majority of fauna and flora are profoundly influenced by the prevailing climatic conditions of the season. For wetlands with SCC, the wet season is the most suitable time to perform

41 www.sacnasp.org.za/code-of-conduct

42 1) flora, 2) avifauna, 3) herpetofauna, 4) mammals, 5) terrestrial invertebrates, and 6) freshwater aquatic species (fish, invertebrates and plants).
surveys as hydrological and vegetation signatures are more pronounced at this time of year. For rivers with SCC, the dry season is often more suitable as access to aquatic habitat is not hindered by high water levels or flooding and aquatic fauna are more concentrated and easier to sample. For some terrestrial groups, both a winter and summer survey is required to allow detection of all SCC. For flora in particular, a strict definition of dual seasons across all habitat types is not optimal to encounter all flowering species due to the variation in phenology across plant families and the general variation in phenology between biomes. Section 10.1.3.1 provides recommended survey periods for each of South Africa’s biomes. In addition, the seasonality of surveys should cover the optimal flowering period of all highly threatened species (CR, EN) and the optimal number of VU species. Similarly, some butterfly surveys should be directed to a particular taxon based on the outcome of a desktop survey. For these reasons, more than one site visit could be required per season to detect specific SCC.

Note that the above has major implications for the timing of specialist surveys in relation to the initiation of a BA or scoping and environmental impact reporting (S&EIR) process. Furthermore, if surveys are not appropriately planned and actually conducted prior to the initiation of the EIR/BA phase of the EA process, it is simply not possible to complete necessary dual season surveys within the timeframes made available for the S&EIR and BA processes in South Africa (Figure 9.1). Proponents and EAPs are often not aware of this limitation in the EA process, and this often results in the execution of unseasonable surveys since the EA application process is already running. Specialists are responsible for counselling proponents and EAPs in this regard and in the absence of appropriate seasonal studies for the detection of SCC must indicate this appropriately in the limitations section of the report and discuss whether this represents a fatal flaw based on the precautionary principle or not (see below). For reasons stated above, it is strongly recommended that the fieldwork should be initiated prior to the commencement of the application for EA via the BA process or prior to the commencement of the EIR phase of the S&EIR process, for projects that are likely to require detailed or dual season surveys. Note, however, that the specialist should clearly indicate the age of base data used for compiling the report, so that this can be taken into consideration by the CA.

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**FIGURE 9.1.**—The 300-day scoping and environmental impact reporting (S&EIR) and 197-day basic assessment reporting (BAR) timeframes in South Africa with the usual but insufficient timeslot for the execution of biodiversity studies indicated. All numbers represent duration in days.

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Note that some biodiversity specialist studies are conducted during the scoping phase of S&EIR, which can serve as one of the necessary dual season studies, but that this is not the norm. Furthermore, it is usually customary for the biodiversity studies to be completed (including reporting) prior to the initiation of the public participation process, further reducing the available time for execution and reporting of the biodiversity studies to 76 days for S&EIR and 60 days for BAR respectively (excluding reporting and collation time required by the EAP). Furthermore, following the public participation process the EAP usually requires several days to address and include the comments from the public into the reports to be submitted, further limiting the actual time available for biodiversity studies if they are confined to the periods indicated in the figure.

Note that in many instances, surveys cannot be conducted prior to the initiation of an EA process because in order to gain access to the study area, an EA process must be initiated to circumvent landowners which have refused access to their property. Therefore, some specialist studies should already be executed during the scoping phase.
9.2.2 Preparation for fieldwork surveys

Appropriate preparation for field work is essential prior to specialist deployment. The following are considered important aspects of this preparation:

- For terrestrial species, habitat types should be determined beforehand by carefully studying recent satellite or aerial imagery and topographical maps, as well as regional vegetation types (latest version to be found at http://bgis.sanbi.org), which will guide the selection of appropriate sample sites. For species that have some dependence on aquatic environments, watercourses that fall within the PAOI should be identified using recent satellite or aerial imagery, as well as topographical maps and other spatial data, including that in the screening tool. Particular emphasis should be placed on attempting to identify wetland habitats that may not necessarily be indicated on available desktop resources (historic Google Earth imagery covering different years and seasons are very useful in this respect). Aquatic sampling sites should ideally be located directly upstream and downstream of the proposed development.
- The proximity to protected areas must be taken into consideration, as survey activities may trigger an anti-poaching response by protected area management (especially nocturnal surveys). Furthermore, buffers surrounding protected areas have potential high conservation value and should be targeted for sampling.
- Selected samples sites should be loaded onto a GPS or alternative electronic device (e.g. smartphone) for easy location in the field.
- Landowners of the properties on which surveys are to take place (based on pre-emptively selected sample sites) should be contacted to obtain permission to access or undertake surveys on their properties.
- Appropriate health and safety considerations should be in place such as:
  - necessary personal protective equipment (PPE);
  - proposed daily fieldwork plan; and
  - required medical and/or safety induction certification.
- Local communities (settlements etc.) within the PAOI should be duly informed of survey methods prior to inception of fieldwork, especially if methods may:
  - cause fear, concern or disturbance (e.g. mammal predator call-ups);
  - utilise baits of any kind;
  - utilise specialised equipment that may present possible danger (e.g. trapped spitting cobras);
  - utilise specialised equipment that may be considered suspicious (e.g. camera traps); and
  - utilise equipment of significant monetary value.

9.2.3 Permitting considerations

Note that obtaining the required permits can take a long time and as such, EAPs and proponents should plan for this process (where necessary) during the early screening stage (where possible) of an EA process.

- Permits to capture, collect and transport (in preservative) sampled species should be obtained from the relevant authorities prior to commencement of a field survey.
- Permits to conduct surveys within or adjacent to formally protected areas may have to be obtained from the relevant authorities prior to commencement of a field survey.
- Permits will be required if live animals or parts of dead or sampled animals (particularly mammals) that hold a protected status are transported across provincial boundaries.
- Some provincial authorities have online permit application facilities that expedite the process and should be used wherever applicable, e.g. NIPAS: https://nw.nipas.co.za.
- The following link provides a list of provincial authority contacts for permit applications: https://www.sanbi.org/wp-content/uploads/2018/03/permittingcontactsjuly2015_0.pdf.

9.2.4 Prevention of the accidental translocation of species

Invasions by alien species and the spread of introduced pathogens are major threats to global biodiversity. Because species specialists travel frequently and interact with a wide range of species on a regular basis, particular care must be taken in order to avoid the accidental translocation of species (including pathogens). Specifically, washing and disinfection of all equipment used in the field must occur immediately after fieldwork has been completed and according to best practice guidelines. This includes the removal of plant material from boats and boating equipment, as well as seeds from clothing used in the field where the majority should be removed prior to leaving the project site. Any remaining seeds detected thereafter must be disposed of with care to prevent possible germination. In cases where fauna (e.g. insects in fieldwork vehicles) have been accidentally transported and only noticed after the project area has been vacated, they should be humanely euthanised and preserved (if of taxonomic or educational value) or disposed of (preferably incinerated, if possible, to prevent the spread of pathogens).

9.2.5 Health and safety considerations

During fieldwork, specialists are required to adhere to the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993), as well as best practice health and safety procedures, which vary between taxa because the fieldwork requirements for appropriate surveying of a taxon differ. South Africa does not currently have a specific set of best practice health and safety guidelines for researchers or specialists engaging in fieldwork as these aspects are usually addressed by taxon-specific methodological references (e.g. McDiarmid et al., 2012). However, general information on
fieldwork safety provided by several well-known international universities is recommended as a primer, such as that provided by the Arizona State University safety guidelines45.

It is important to recognise that health and safety considerations should apply to fauna too, usually captured under the ethical considerations that govern fieldwork with animals. These considerations must include potential disease or pathogen transfer to the animal from trapping and/or handling by specialists. Taxon-specific guidance in this regard is provided in section 10 Taxon-specific guidelines.

9.3 Data interpretation, presentation and reporting

9.3.1 General layout of a specialist report

- Title page indicating:
  - Name of the proposed development
  - Type of study
  - Date
  - Main author
  - Details of the company responsible for the report
- Table of contents, including list of figures and tables
- Glossary of terms and definition of abbreviations and acronyms
- Non-technical summary46
- Introduction
  - Brief description of the project details and background
  - Study area location
- Methods
  - Desktop studies performed in addition to the data provided by the screening tool, including description of any analyses (e.g. spatial, statistical etc.).
  - Fieldwork studies indicating methods, procedures and equipment used for data acquisition.
  - Impact analysis, describing how impact significance was calculated and information/receptors informing the execution and timing of the fieldwork.
- Results
  - Sampling limitations47
  - Regional context
  - Local context and fieldwork results
    - General sampling conditions (e.g. weather, flooding etc.)
    - Description of sampling effort
    - Predicted and observed species, highlighting species of conservation concern
  - Current impacts
  - Site ecological importance
  - Impact analysis, including mitigation measures and management recommendations
  - Discussion and conclusion
    - Brief interpretation of results
    - Suitability of the proposed project and its activities
  - Appendices
    - Relevant raw data
    - Specialist curriculum vitae highlighting relevant experience, and proof of SACNASP registration and highest qualification
    - Specialist declaration of independence

9.3.2 Application of the precautionary principle and ‘absence data’

The precautionary principle is defined by Raffensperger and Tickner (1999) as follows:

‘when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.’

Species specialists operating within the EA process often do not have the time and resources available to provide definitive answers regarding the presence or absence of a particular SCC or the potential impacts on sensitive habitats. In such situations, the precautionary principle must be applied so that preventative action is taken in the face of uncertainty and the burden of proof is shifted to the proponent.

For species that are difficult to detect, it is not always possible to provide compelling evidence that a species does not occur in a particular PAOI. Consequently, if the habitat conditions appear suitable and there is data to suggest that the species did or could occur within the PAOI (such as confirmed records on adjacent properties), then the precautionary approach is to assume that the species does indeed occur there and mitigation and management decisions need to be made accordingly. Known SCC with very low detection probabilities are indicated in the taxon-specific sections below and for these species, additional information is required as described in 9.3.7 Expected SCC with very low detection probabilities.

9.3.3 Project context

While the screening tool provides some information regarding landscape-level context of the proposed development

46 Ideally, this should be a short, bullet-point list containing only text describing major limitations, important findings and project suitability.
47 Must include an evaluation of whether these limitations are considered too severe to provide an appropriate impact assessment report.
footprint/PAOI, all specialists participating in an EA process should nevertheless contextualise their findings within the landscape context and take into account the location of the project footprint/PAOI and its proposed activities in relation to the following:

- protected areas (proclaimed and private);
- threatened ecosystems;
- bioregional plans;
- Important Bird and Biodiversity Areas (IBAs; Marnewick et al., 2015);
- Ramsar Wetlands of International Importance;
- provincial or local conservation plans; and
- environmental management frameworks (EMFs).

The majority of this spatial information is available through the Biodiversity GIS website platform hosted by SANBI (https://bgis.sanbi.org). In addition, provincial management authorities may also be contacted with specific information requests.

### 9.3.4 Biodiversity management plans (BMPs) for specific species

A BMP for a species is a management plan developed to assist in achieving the objectives of NEMBA for a particular species or priority species of a particular genus (e.g. *Encephalartos* priority species).

There are currently several BMPs for South African species that must be taken into account during the EA process. Species specialists should consult all existing BMPs to determine if any are applicable to the proposed project. For ease of reference, a list of all current BMPs for South Africa that are either already implemented or planned is provided in Appendix 4 – Biodiversity management plans for species.

Evaluation of a proposed project, for which one or more BMP applies, must take the following into account:

- It is imperative that any proposed project activities do not impede on a particular BMP’s objectives.
- Specific directives contained within a BMP must take precedence as mitigation measures. For example, the BMP currently in development for the IUCN Vulnerable sungazer (*Smaug giganteus*) specifically states that: ‘Destruction of intact habitat with extant Sungazer populations is not permitted’. Therefore, avoidance mitigation and not minimisation mitigation would be applicable in such a case.
- All other species-specific information contained within a BMP must be evaluated and referenced in the specialist report.
- Lead/implementing agents of a particular BMP must be notified if a species for which a BMP exists is observed outside of its known geographic distribution (see also 9.7 Data dissemination).
- EMPRs need to be congruent with BMPs, where applicable species are concerned. A synthesised management plan must be developed through an interactive workshop in cases where management recommendations for a particular species or group of species conflicts with that of another (e.g. recommendations for burning of a particular habitat to stimulate a particular plant SCC may be at odds with requirements for a bird SCC).

### 9.3.5 Previous studies

An often-overlooked source of information for informing biodiversity studies for the EA process is previous EIA or BA studies performed within or adjacent to the PAOI. Searching for and acquiring copies of these studies is, however, not always possible because such studies typically only remain publicly available (and therefore searchable) during the public participation process period. It is therefore worthwhile to seek information in this regard from the competent authority and/or recent developments in close proximity to the PAOI.

### 9.3.6 Researching and presenting data for expected SCC

The specialist should provide a complete list of expected SCC for the proposed development footprint (obtained from the screening tool and national Red Lists [for NT and DD species]) and the defined PAOI, taking into account the regional vegetation types and the macro-habitat features present within the PAOI. The expected list of SCC should be derived from information obtained from a comprehensive review of output from the screening tool, existing recently published literature sources (e.g. geographic distribution data in BMPs, books and journal publications), reliable and scientifically verified online databases (see taxon-specific sections below), provincial authority specifications (e.g. GDARD, 2014), and any other reliable sources of information (e.g. communication with taxon specialists). In cases where an expected SCC is either not listed in the screening tool report or it erroneously lists an SCC highly unlikely to occur within the proposed development footprint/PAOI, the specialist must highlight this aspect and provide an explanation/motivation for this discrepancy, as well as the effect of this discrepancy on the impact analysis for the proposed project.

The expected list of SCC should clearly indicate the following:

- Habitat preference (if known) – derived from a combination of relevant literature, communication with taxon specialists and the specialists’ own knowledge of the species.
9.3.7 Expected SCC with very low detection probabilities

Several fauna SCC cannot be detected reliably enough during specialist investigations for EA, despite the application of optimal searching/trapping methods during optimal seasonal timing. These are typically very cryptic, elusive and/or fossorial species. The likelihood of detection for such SCC is extremely low, which raises the likelihood of a false negative result (incorrectly stating the absence of an SCC). The potential for false negative results to occur is greatly exacerbated by the short survey durations and often unseasonal nature of biodiversity surveys associated with EA in South Africa.

The taxon-specific sections below indicate for which species the above applies. In addition, specialists must consult the relevant provincial requirements for specific reporting requirements on certain SCC during EA. For these SCC, specialists are required to evaluate the habitat suitability from their understanding of the species and/or from the trap results of other species with similar ecology or reliance on specific food items or hosts (e.g. ant species for butterflies). Specialists are required to clearly indicate the habitat and other criteria evaluated during the assessment of the probability of occurrence of the species within the PAOI. These criteria will differ between species and specialists are therefore required to list the most relevant criteria (if not prescribed by a provincial guideline) for the species concerned and provide a description for each criterion. This information is best presented in tabular format and an example is provided in Table 9.1 for an evaluation of the presence of Juliana’s golden mole (Neamblysomus julianae). The precautionary principle is then applied as follows: if suitable habitat exists in relatively close proximity to known locations for the particular SCC, and the screening tool modelling also predicts the occurrence of this SCC, then it is assigned a high probability of occurrence and assumed to be present.

9.3.8 Description of sampling limitations

Limitations to both the desktop and fieldwork studies must be carefully described in the specialist report and accompanied by photographic evidence wherever possible (e.g. impassable road preventing access to an important portion of the survey area). Limitations to surveys may include but are not limited to:

- lack of adequate time for the survey;
- absence of data/recent literature for poorly known species;
- suboptimal timing of the survey (although this must be avoided wherever possible);
- restricted access to the PAOI or topographically diverse and large study areas;
- adverse weather conditions; and
- security threats.

It is also important to describe the effect(s) that these limitations have on the data quality and to suggest corrective measures, e.g. ‘The survey took place in November, which is the optimal time of year for most breeding SCC, but additional fieldwork in winter (May–August) is recommended to search for Black Harrier (Endangered) which is a non-breeding winter visitor to the Wakkerstroom area.’

9.3.9 Description of sampling effort

Specialists are required to present information on the intensity of the survey. This should be quantified in some manner as the amount of effort spent according to the type of sampling performed, for example:

- number of sample sites per habitat and per unit area (ha or km²);
- duration of sampling time per sample site/transect/meander;
- number of trap days or trap nights (# traps deployed x # days/nights of deployment);
- distance walked/driven while sampling (e.g. for linear infrastructure such as pipelines); and
- number of rocks lifted during active searching.

Sampling sites/transects/meanders etc. should be mapped in relation to the proposed development footprint/PAOI. Where possible, GPS tracks of the specialist should be included on the map to show coverage of the PAOI.

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49 Necessary survey duration is often hampered by circumstance beyond the control of the specialist and in such cases, this must be described appropriately.

49 Driving in a vehicle can only be classified as sampling effort under special circumstances and will require detailed description in the methodology section of the specialist report, e.g. driving very slow speeds during the night to observe certain animals crossing the road and count/identify road kills.
9.3.10 Population size estimates for selected expected SCC

Accurate population size estimates are not available for most plant and animal SCC occurring in South Africa. Furthermore, survey durations required for environmental assessments are too rapid and not repeated across seasons and years to allow for accurate population size estimates within the proposed development footprint/PAOI. Consequently, surrogate measures for population sizes are most often required and this is usually achieved through estimating the proportion of the global population of an SCC (represented by its geographical distribution area) that intersects with a proposed development.

One acceptable surrogate method is to take the listed number of locations in the Red List assessment and determine the impact of the proposed development should it mean that one entire location of the SCC will be lost. In cases where a proportion of the population on site is expected to be lost then a simple GIS analysis of proportion of lost occupied habitat should be conducted. This can be done in the following two ways.

Firstly, Appendix 7 provides a list of important fauna SCC for which the known geographic area occupied by the species has been carefully calculated, while Appendix 8 includes the list of all plant SCC and their occupied area calculations. If the screening tool report indicates that the PAOI intersects with one or more of these species, then the specialist is required to present a proportion of the known geographic area that will be intersected by the PAOI for each of these species listed in Appendix 7 or 8. This is easily achieved by downloading the animal or plant species theme layers from the screening tool (Figure 9.2), which automatically clips the species layers to the provided PAOI. It is then a simple matter of calculating the area of the downloaded clipped

<table>
<thead>
<tr>
<th>Criteria</th>
<th>x/✓</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surveys must be undertaken in summer, after a sufficient rainfall event</td>
<td>✓</td>
<td>The survey took place in winter when conditions were not optimal. Fresh signs of Juliana’s golden mole activity are usually only seen after periods of rain, which softens the soil and makes it more cohesive. In addition, Juliana’s golden mole seldom exhibit regular sub-surface foraging in the winter months.</td>
</tr>
<tr>
<td>Soil properties: Sandy</td>
<td>✓</td>
<td>Partially to optimally suitable. The soil characteristics surrounding the PAOI were characteristic of optimal Juliana’s golden mole habitat. In addition, the topsoil within landscaping flower beds on the property can also be utilised and may serve as foraging habitat for the species.</td>
</tr>
<tr>
<td>Vegetation cover</td>
<td>✓</td>
<td>Partially to optimally suitable. The trees layer surrounding parts of the PAOI and within the PAOI provide cooler and moister microenvironment which is optimal for Juliana’s golden mole habitat. For the Bronberg, a lower level of herbaceous cover is usually present along with a large canopy cover (Jackson, 2007). Based on this, only sections of the northern, western and eastern boundaries of the PAOI would show optimal habitat in addition to the planted trees within the PAOI.</td>
</tr>
<tr>
<td>PAOI located on/close to known locations for the species (Bronberg Ridge)</td>
<td>✓</td>
<td>The PAOI is situated at the foot of the Bronberg Ridge, within the optimal geographic distribution area for the species in accordance with Jackson (2007).</td>
</tr>
<tr>
<td>Habitat connectivity</td>
<td>✓</td>
<td>The species is common in ridge-associated homesteads that exhibit well-irrigated suburban and rural gardens (sometimes supporting livestock). The PAOI is not disjunct from the Bronberg (main population location) and thus exhibits optimal connectivity. There are limited restrictions for the movement of the species surrounding and within the PAOI.</td>
</tr>
<tr>
<td>Suitable habitat (based on metapopulation studies and habitat modelling)</td>
<td>✓</td>
<td>Suitable habitat is present based on the presence of: • sandy soils within the particle parameters specified by Jackson (2007); • adequate tree cover for shade refugia; • wetland corridors promoting habitat connectivity; • limited rock cover (the more rock cover, the less optimal the habitat for movement); and • low densities of alien and/or invasive species. Only when signs of burrowing are evident (as seen during wet season) can the habitat suitability be known for certain. It should be noted that not all suitable habitat is always occupied by the species (refer to Jackson, 2007), which may result in a false positive observation. This can only be confirmed during a wet season survey.</td>
</tr>
<tr>
<td>Signs of burrowing are evident</td>
<td>✓</td>
<td>No signs were observed due to the aforementioned seasonal limitations.</td>
</tr>
</tbody>
</table>
shapefile, dividing that area by the total geographic area of occurrence of the species presented in Appendix 7 or 8, and multiplying by 100.

A second option is to manually perform this procedure, in particular for species not listed Appendix 7 or 8 where the PAOI is very large. This entails calculating the area of the global geographic distribution of a particular SCC (e.g. 6 500 ha), and then the area of this geographic distribution which intersects with the PAOI is calculated (e.g. 500 ha). The proportion of the geographic distribution within the PAOI is then reported, in this case 7.7% (500 / 6500 x 100). Specialists should then evaluate whether this represents a significant proportion of the global population.

This can be done in the following manner:
- Download the most recent updated geographic distribution information from SANBI (available through the BGIS website platform hosted by SANBI: http://bgis.sanbi.org).
- Obtain the most recent land cover dataset for South Africa (also available through the BGIS website platform hosted by SANBI: http://bgis.sanbi.org), reclassify this data set according to suitable habitats (appropriate natural habitats, e.g. grassland) and unsuitable habitats (all transformed or natural habitats where the species does not occur), and excise the unsuitable habitats from the geographic distribution of the SCC before performing the calculation (Figure 9.3).

There are two problems with the above approaches, which are:
- accurate spatial information on the geographic distribution of an SCC is often not available; and
- individuals of an SCC are not evenly distributed throughout their known geographic distribution.

These challenges need to be considered for each SCC and the result of the above analyses interpreted accordingly.

### 9.3.11 Photographic evidence

It is helpful to provide photographic evidence wherever possible for habitat types, species and current impacts observed during specialist studies. For taxa with exceptionally high diversity, only a subset of species with photographic evidence should be provided. However, for all taxa, specialists should attempt to provide photographic evidence of all SCC observed and wherever possible. Rare species. Photographic evidence that is provided in a report must be obtained from within the PAOI and originate from the fieldwork or historical images acquired from landowners/staff and verified to originate from within the PAOI. If a
photograph is included in the report which was not taken under the aforementioned circumstances, then this must be clearly stated in the caption and all relevant metadata for the image (e.g., date, location, photographer) must also be provided. If a particular species was observed during the fieldwork and positively identified, but no photographic evidence was obtainable, it is not acceptable to provide a photograph of this species in a photographic evidence collage. It is, however, acceptable to provide photographs of a species to aid in identification (for example, in comparison to another species or for identification purposes in an EMPr) as long as the photograph’s source and/or photographer is referenced.

The following guidelines are suggested for the presentation of photographic evidence of species in biodiversity specialist reports:

- It is useful to provide multiple photographs in a single photo collage, as long as the collage image is as large as possible (preferably covering an A4 page) and all individuals can be easily identified.
- Photographs of a particular species to be included in the report’s photo collage should be chosen on the basis of identification ease and not aesthetic beauty.
- Collage image sizes should be as large as possible in the report to facilitate identification verification of each species included therein.
- For projects with high species diversity, collage images should be separated according to taxonomic or other well-defined groups (e.g., small mammals, lizards, fish, SCC), if necessary.
- Species in a collage should preferentially be arranged so that closely related species (e.g., members of the same genus or other taxonomic group) are adjacent to each other to facilitate comparative identification.
- All species presented within the photographic collages must be appropriately identified (in the text of the report) using both the common name and the scientific name.

- Small examples of photographic collages conforming to the above are provided in Figure 9.4.

9.3.12 Mapping standards

Specific mapping requirements for biodiversity studies are usually provided in the applicable provincial guidelines for biodiversity studies. However, some basic guidelines are presented here. A map must always include the following:

- a directional indicator, usually provided as an arrow indicating north;
- a scale bar with suitable units and precision in metric scale for measuring distances and areas on the map;
- a legend with clearly identifiable colours and readable fonts for all of the displayed spatial information;
- tick marks in geographic coordinates (WGS84) of sufficient precision along the X (longitude) and Y (latitude) axes, preferably with markers inside the map area to assist in the evaluation of precise location; and
- a national and/or provincial context map.

All specialist studies should contain maps showing, at a minimum, the following information where relevant. Note that multiple maps must be provided in cases where too much information on a single map will obscure the ease of interpretation (e.g., multiple sensitive environments):

- proposed development footprint and defined PAOI;
- locality map showing the general location of the PAOI in relation to nearby features such as urban centres, roads, protected areas, provincial boundaries etc.;
- sensitive environments such as IBAs, protected areas, threatened ecosystems, National Freshwater Ecosystem Priority Areas (NFEPA), and Critical Biodiversity Areas. Key Biodiversity Areas can also be presented as an option, where relevant;
- location and type of sample sites and/or transects/sampling meanders (Figure 9.5);
- for terrestrial surveys, GPS tracks showing movement within the PAOI should be provided if possible. This
aspect is important as it allows verification of specialist coverage of the PAOI as ad hoc sampling along these tracks forms an important component of data acquisition and allows demonstration of access limitations (and therefore knowledge gaps) (Figure 9.5); • major terrestrial habitat or aquatic ecosystem (e.g. rivers and wetlands) delineations that fall within the PAOI; • location of SCC, if the species is not classified as a sensitive species which is sought-after by collectors for trade (see taxon-specific suggestions below and 4.5 Addressing sensitive species); • SEI of habitats (e.g. Figure 8.5); and • any recommended buffers (see taxon-specific recommendations in section 10) for habitats associated with the SCC and those of ‘very high’ and ‘high’ SEI and proposed design alternatives (see 8.4.4 Alternative development footprints) to mitigate anticipated impacts.

9.4 Mitigation of impacts

• Mitigation, in the context of EIAs, is the action taken to reduce the significance of negative environmental impacts. Effective mitigation of negative environmental impacts can only occur within the mitigation hierarchy, which involves the following four key actions, that should be selected in the following order of preference: ‘avoid,’ ‘minimise,’ ‘restore’ and ‘offset’ impacts (see Ekstrom et al., 2015; Phalan et al., 2018 and references therein for comprehensive treatment of this topic, and from which this summary has been synthesised). Specialists are expected to suggest appropriate mitigation measures to negate or limit the anticipated environmental impacts associated with a proposed development and, where possible, to identify and suggest mitigation measures which would allow for enhancement opportunities.
• Impact avoidance is the most important option in the mitigation hierarchy as it can reduce the need for ‘minimising’ and ‘restoring’ actions required to reduce impacts, which often have associated cost and time problems and are typically less effective in achieving the goals of environmentally responsible and sustainable development. Specialists should always seek to provide impact avoidance mitigation measures wherever practicable, particularly in areas of ‘very high’ and ‘high’ sensitivity as defined by the screening tool. For SEI, refer to mitigation options provided in Table 8.4. Examples include alternative site/infrastructure design and placement and appropriate scheduling of activities (e.g. seasonal: ‘only during winter’ or daily: ‘not at night’).
• If avoidance is not possible, or will not completely negate anticipated impacts, then minimisation of remaining impacts is appropriate. Minimisation measures are those that reduce the duration, intensity, significance and/or
extent of impacts that cannot be completely avoided. Such minimisation measures must be cost-effective and practically implementable in order to be feasible, and their effectivity in reducing impacts must be monitored and adjusted where necessary through adaptive management. In cases where it is predicted that significant residual impacts to defined impact receptors will remain despite application of all possible minimisation measures, it must be considered whether these represent fatal flaws for the proposed project and in cases where they do, this conclusion must be emphasised in the required reasoned opinion (required by Appendix 6 of the EIA Regulations and the Terrestrial Animal/Plant Species Protocols). While it is not possible to provide examples of all possible approved environmental impact minimisation measures, a commonly suggested mitigation measure that is not acceptable is briefly discussed below:

- ‘Search and rescue’ – this is a term often applied for the ex situ conservation of SCC and is often erroneously suggested as an environmental impact mitigation measure. Removal of SCC from their natural habitat through search and rescue operations followed by translocation of these subpopulations is unacceptable as a minimisation mitigation measure because it:
  - does not negate or decrease the net habitat and biodiversity loss within the PAOI;
  - is almost never truly successful because it is usually not possible to locate and translocate all individuals of an SCC;
  - may potentially erode the genetic integrity of the species; and
  - substantially increases risk to the receiving populations (where the 'rescued' species are being translocated to), through deleterious genes, parasite and pathogen introduction, and excessive competition for resources.

- It is important to note that under certain circumstances, ‘search and rescue’ operations can be valuable and should still be carried out where possible prior to the initiation of destructive development activities. For example, the translocation of certain species to rehabilitating portions of the same development to act as 'seed' populations can potentially have a positive effect on biodiversity. However, it is important to consider the following regarding ‘search and rescue’ operations:
  - translocation of species may only occur onto directly adjacent areas (including protected areas) considered to be part of the same original population and within the same home range;
  - translocation of particular species through search and rescue operations may not be considered as an impact minimisation mitigation measure during the significance calculation of anticipated post-mitigation impacts, to provide justification/motivation for the development to proceed.

- For developments with associated environmental impacts that cannot be completely avoided and/or minimised (e.g. opencast mining), restoration is required (see distinction between 'restoration' and 'rehabilitation' in the Glossary). This is typically achieved through the repair of biodiversity features or ecosystem services of concern that have been degraded or damaged by the development, and therefore occurs after the impact has taken place and can be considered as an attempted reversal of the impacts. However, restoration is a poorly understood mitigation option that is frequently misapplied. While it is possible to restore some habitats, it is very difficult and in some vegetation types impossible, to restore the impacted habitats to pre-project conditions (if these were untransformed habitats at project inception). In situations where restoration is not possible, rehabilitation is required. Note that post-mitigation impact significance assessments must appropriately evaluate the loss of habitat functionality in such areas as a residual impact. Therefore, it is important that the objectives of habitat restoration/rehabilitation are clearly described in the impact assessment and EMPr. If the objective is to restore functional habitat to what was previously disturbed habitat with medium to low SEI, then habitat restoration can be a feasible mitigation option, although it is a costly, long-term exercise with limited proven success. If the objective is to restore untransformed habitat that previously had high SEI, then it is unlikely that such a mitigation option will sufficiently mitigate the impact of habitat loss and it should not be applied. If restoration is a feasible mitigation option, then it requires long-term monitoring plans with an adaptive management strategy.

- If significant residual environmental impacts associated with a development would remain after avoidance, minimisation and restorative measures were to be taken, then biodiversity offsets may be required. Typically, biodiversity offsets are defined as conservation measures where actions are implemented to achieve measurable conservation outcomes which compensate for the significant negative residual impacts of the development. The application and effectiveness of offsets is highly contentious, and developments should be avoided wherever offsets would be required to address residual impacts. For South Africa, a national policy on offsets was drafted in 2012 and revised in 2016 but has not been promulgated to date (Brownlie et al., 2017). However, provincial guidelines exist for the Western Cape (DEA&DP, 2011) and KwaZulu-Natal (EKZN Wildlife, 2013), and a drafted but unreleased set of guidelines exists for Gauteng Province (Brownlie et al., 2017). Due to the draft nature of the national policy on offsets and uncertainty surrounding its development, additional development of provincial guidelines has been suspended. National guidelines exist for wetland offsets (MacFarlane et al., 2016). The available provincial and national guidelines for the implementation of offsets have largely been developed from the Business and Biodiversity Offsets Programme (BBOP, 2012). Species specialists should
Mitigation measures should be translated into practically implementable ‘impact management actions’, which are the responsibility of the developer to execute in order to avoid, minimise, restore, or offset the anticipated project-related impacts. These impact management actions should be recommended to be incorporated into an EMPr and may be applicable to the planning, construction, operation or decommissioning of a development.

9.5 Impact analysis

9.5.1 Description of current impacts

Mitigation actions and adjustment/improvement of impact management actions to ensure that the originally defined impact management outcomes are achieved.

Detailed guidance for the translation of mitigation measures to impact management actions and the careful development of impact management outcomes falls outside of the scope of these guidelines. However, the following, heavily simplified, example provides an overall conceptual framework for this process. Consider the development of a road across an aquatic habitat where a frog SCC occurs (either for breeding, foraging or migration purposes). A major anticipated impact of such a development would be road kills of migrating adults during the breeding season and of the young frogs during dispersal at the end of the breeding season.

- Mitigation measure:
  - Construct the road in such a way that frogs do not cross the surface of the road and come into direct contact with vehicles, thereby preventing a significant number of road kills.
- Impact management actions:
  - For 150 m beyond the wetland, on either side of the wetland, and at intervals of 50 m, construct a road underpass (culvert) of at least 1.5 m wide and 1 m high to allow frogs to pass underneath the road. Underpass must not be flooded with water (froglets require dry land to disperse).
  - Erect low, impassable fence (for frogs) on either side of the road along the stretch of road across the wetland and for 150 m beyond the wetland on either side of the wetland to prevent frogs crossing the road. Ensure that fence guides frogs to the opening of the underpasses (culverts).
- Impact management outcomes:
  - Underpasses must be utilised by frogs: monitor frog movements in underpasses using infrared video cameras.
  - Ensure < 5 adults and < 20 young frogs are killed during a breeding season through a roadkill monitoring programme.
  - Demonstrate persistence of viable frog populations on either side of the road following road construction for at least 15 years.

9.5.2 Description of anticipated project impacts

An environmental impact assessment (EIA) can be defined as: ‘The process of identifying, predicting, evaluating and mitigating the biophysical, social, and other relevant effects of a proposed development, prior to approval of the proposed development and any major decisions being taken or commitments being made’.

The ‘impact analysis’ forms the cornerstone of the EIA process and generally follows a procedure where:

1. the potential impacts are defined, based on the anticipated project activities affecting clearly defined receptors (see 7 Description of impact receptors).

Description of the major project activities allows for an understanding of the impact pathways and therefore refer to all existing provincial legislation/guidelines and internationally recognised guidelines.
improves the assessment of the impacts on the receptors;

2. the effects (positive/neutral/negative) of the impact on the environmental/social or other receptor are predicted and the significance/importance of the impact is calculated:
   a. in the absence of mitigation measures
   b. after the application of proposed mitigation measures; and

3. the significance/importance of residual impacts (i.e. impacts remaining after application of mitigation measures) are discussed and largely help to determine the suitability of a proposed project:

   If one or more anticipated impacts remain highly significant following the application of mitigation measures, then the residual impact is considered to be high and the suitability of the proposed development for the receptor is considered to be low.

Following definition of the receptors, care must be taken to appropriately describe impacts as follows, wherever possible:

• Receptor – defined above, e.g. ‘Bald Ibis breeding activity on rocky cliffs’;
• affected by – positive or negative, e.g. ‘negatively affected by’;
• mechanism – the manner/modality in which the project activity/infrastructure will interact with the receptor, e.g. ‘loud/disturbing noise’;
• from project activity/infrastructure – the proposed activity or infrastructure of the project that is the root cause of the impact, e.g. ‘from factory operation’.

The finally formulated impact description would then be: ‘Bald Ibis breeding activity on rocky cliffs negatively affected by loud/disturbing noise from factory operation.’

The ‘significance’ or importance of a potential impact is usually evaluated according to some combination of the following descriptor variables:

• Geographic scale of the impact (for broadly-defined receptors) or extent of the impact in relation to the extent of a well-defined SCC receptor.
• Duration or temporal scope of the impact.
• Frequency or re-occurrence of the impact.
• Probability or likelihood of occurrence of the impact.
• Magnitude or severity of the impact. This is usually the aspect that requires the most taxon-specific specialist input and should therefore be carefully justified.

Numerous methodologies exist for calculating the significance/importance of impacts based on the above-mentioned descriptor variables, each with its pros and cons. For stand-alone reports, specialists are encouraged to use the most appropriate methodology applicable to their taxon (that can be referenced50) and to provide justifications (where necessary) for the evaluation of the descriptor variables. For multi-disciplinary projects, which are the norm, it is important that the various taxonomic disciplines apply the same method across the different taxa so that meaningful comparisons can be made. Ultimately, however, the descriptor variables are combined (e.g. numerically or through a matrix) to produce a ranked estimate (e.g. from ‘very low’ to ‘very high’) of the significance/importance of the impact.

The purpose of evaluating the significance/importance of impacts is to develop a clear understanding of the influences and processes associated with each impact. In instances of uncertainty or lack of information (e.g. where the developer hasn’t provided infrastructure locations or a clear project description), the precautionary principle should be applied by assuming a ‘worst-case’ scenario (see 9.3.2 Application of the precautionary principle and ‘absence data’).

After the initial calculation of the impact significance/importance on a particular receptor, practically implementable51 mitigation measures must be proposed (if possible) which would avoid, minimise, restore or offset the impact. These four categories of measures are collectively known as the ‘mitigation hierarchy’, which is an internationally accepted method of approaching impact mitigation. The significance/importance of the impact must then be re-evaluated, assuming successful implementation of the proposed avoidance, minimisation and restoration mitigation measures. This is called the ‘residual impact’. The residual impacts should form the basis for discussion regarding the suitability of a proposed project. Furthermore, residual impacts should form the basis for the design of an offset, but only if there would be no irreversible negative impacts or loss of irreplaceable biodiversity.

9.5.3 Worked example

Consider the following two hypothetical proposed developments and the anticipated impact of noise on the Bald Ibis breeding habitat:

1. a crop (maize) agricultural farm – noise from agricultural machinery; and
2. a large industrial factory – noise from factory operations.

50 This methodology must be published in a book or scientific literature. A customised corporate version of an impact analysis may not be used unless this has been appropriately published in the public domain after subjection to peer review.

51 In cases where a developer is unwilling or unable to commit to the implementation of a particular mitigation measure, it must be removed from consideration during the post-mitigation evaluation of impact significance, and should be indicated in the text accordingly.
The impact analysis presented in Table 9.2 indicates that it is possible to mitigate noise impacts in relation to the receptor sufficiently for the agricultural development, but not for the industrial development. Consequently, discussion of development suitability based on the residual impacts would be in favour of supporting the agricultural development following appropriate implementation of mitigation measures, since the residual impacts from the agricultural development are expected to be very low. Conversely, discussion in this regard for the proposed factory should strongly advise the competent authority that such a development would be very detrimental for the continued persistence of the breeding activity, and the population existence of the Bald Ibis in that location, because the anticipated impacts cannot be sufficiently mitigated and the residual impact is therefore still very high.

### 9.6 Suitability of the proposed project and its activities

A reasoned opinion is required where the specialist must discuss the suitability of the proposed project and its activities in relation to the taxon of interest, taking into account:

- the impact assessment performed (including potential mitigation measures) – limit discussion to impacts evaluated to be of high and very high significance; and
- the SEI of the project footprint (and PAOI where possible) – limit discussion to impacts evaluated to be of medium and higher SEI.

For example: ‘In general, the proposed project appears to have limited potential to negatively impact on the expected avifauna populations, since all potential impacts were evaluated to be of medium and lower significance. Conversely, discussion in this regard for the proposed factory should strongly advise the competent authority that such a development would be very detrimental for the continued persistence of the breeding activity, and the population existence of the Bald Ibis in that location, because the anticipated impacts cannot be sufficiently mitigated and the residual impact is therefore still very high.

### TABLE 9.2

Example of impact analysis from two hypothetical proposed developments for the impact defined as: ‘Bald Ibis breeding activity on rocky cliffs negatively affected by loud/disturbing noise from factory/agricultural machinery operation’. Post-mitigation evaluations that changed from pre-mitigation evaluations are marked in bold.

<table>
<thead>
<tr>
<th>Geographic scale or spatial scope</th>
<th>Pre-mitigation</th>
<th>Post-mitigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Agricultural project</td>
<td>Local or project footprint</td>
<td>Local or project footprint</td>
</tr>
<tr>
<td>2. Industrial factory</td>
<td>Local or project footprint</td>
<td>Local or project footprint</td>
</tr>
<tr>
<td>Duration or temporal scope</td>
<td>Long-term (&gt; 20 years)</td>
<td>Medium-term (15 years)</td>
</tr>
<tr>
<td>Frequency or re-occurrence</td>
<td>Irregular</td>
<td>Very regular (daily)</td>
</tr>
<tr>
<td>Probability or likelihood</td>
<td>Low or unlikely</td>
<td>Definite or certain</td>
</tr>
<tr>
<td>Magnitude or severity</td>
<td>Medium</td>
<td>Very high</td>
</tr>
<tr>
<td>Justification for magnitude/severity</td>
<td>Low intensity disturbance of breeding activity possible from noise from nearby operation of machinery (tractors/harvesters).</td>
<td>Loud noise occurring in close proximity regularly throughout the day will disturb birds and disrupt breeding attempts, ultimately leading to population decline.</td>
</tr>
<tr>
<td>Significance or importance</td>
<td>Medium</td>
<td>Very high</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Very low</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Very high</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

53
9.7 Data dissemination

For the mandatory dissemination of observations of SCC (as per sections 2.2.2 and 2.3.2 of the Terrestrial Animal/Plant Species Protocols respectively), please refer to the minimum requirements stipulated in 5.3 Step-by-step guidance for the Terrestrial Animal/Plant Species Protocols.

Species specialists rely heavily on publicly accessible spatial databases for assistance with species identifications and updated geographic distributions of species. These same specialists collect large quantities of high-quality data on a regular basis, which has immense value if appropriately disseminated to the same publicly accessible spatial databases that the specialists utilise frequently. Furthermore, the screening tool relies heavily on these accurate datasets containing recent data in order to inform the EA process appropriately.

Data dissemination by species specialists would serve the following purposes:

- prevention of concealment of important observation data by the proponent/EAP;
- transparency and accountability of species identifications made by biodiversity specialist; and
- improvement of database integrity as a current and reliable source of biodiversity data for desktop studies, the screening tool and future conservation planning initiatives.

Specialists are therefore strongly encouraged to disseminate important subsets of their collected data (see taxon-specific suggestions below) in order to give feedback on relevant data into the system that they and the screening tool rely upon. Consideration must be given to the time and effort (and thus budget) required to collate the subset of collected data that should be disseminated by the specialists. Each database facility requires data to be prepared in a certain manner along with supporting evidence (photographs/recordings). Note that this process consumes considerable amounts of time and effort.

Specialists are encouraged to donate any specimens collected during biodiversity surveys to recognised museum facilities. Data dissemination requires cognisance of the legal implications for sharing this data, particularly with regard to non-disclosure agreements which may be enforced by the proponent.

9.8 A copy of the original specialist report as an appendix

Specialists should attempt to ensure that the original report they provide (to the EAP) is included in the final EIA product as an appendix. This allows direct verification of the original specialist work and prevents EAPs from erroneously/selectively representing specialist work without the necessary detail. Although the above is the responsibility of the EAP, specialists should request a signed statement from the EAP stipulating that the original specialist report has been appended to the application documentation submitted to the competent authority and that specialist findings and/or recommendations have been accurately incorporated into the EIaR/EMPt. In addition, it is recommended that the specialists register as an interested and affected party so that they can verify the integrity of the final compiled report submitted to the public and raise objection in cases where their findings have been misrepresented or incorrectly interpreted.
Please note:
The following taxon-specific guideline sections represent the minimum requirements to comply with the current version of the Terrestrial Animal/Plant Species Protocols.

10.1 Flora

10.1.1 Species included in the screening tool

The screening tool currently comprises a list of 4,363 flora SCC that are either Critically Endangered – Presumed Extinct (73 taxa), Critically Endangered (404 taxa), Endangered (883 taxa), Vulnerable (1,560 taxa), Rare (1,225) or Critically Rare (161). ‘Very high’ and ‘high’ sensitivities defined by the screening tool indicate known presence of SCC. ‘Medium’ sensitivity does not indicate the known presence of a threatened plant within the proposed development footprint/PAOI, but could indicate moderate likelihood of occurrence based on species distribution modelling, which relies on data such as habitat preferences and proximity to known locations of specific species. Methods for the detection of expected threatened flora should be applied by the specialist for ‘very high’, ‘high’ and ‘medium’ sensitivities defined by the screening tool.

10.1.2 Desktop study – Expected SCC

The screening tool report provides a list of all confirmed occurring and potentially occurring plant SCC within the vicinity of the proposed development footprint/PAOI. Information from provincial management authorities, recently published peer-reviewed literature, and online resources that are constantly updated with new observations should be checked for more current distributional data that may be relevant to the PAOI. These include, but are not limited to:
- iNaturalist
- Botanical Database of Southern Africa (NEWPOSA)
- Global Biodiversity Information Facility (GBIF) and

The above procedure will ensure that any very recent and new observations of SCC within the proposed development footprint/PAOI not already captured by the screening tool can be taken into account during the impact analysis.

Secondly, it is important to provide a list of any additional potentially occurring SCC taxa within the defined flora-specific

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52 Species distribution models (SDMs) are empirical methods that relate species occurrence data to environmental predictor variables based on statistically derived response curves that best reflect the ecological requirements of the species.

53 https://www.inaturalist.org

54 http://newposa.sanbi.org/

55 http://gbif.org

56 http://vmus.adu.org.za/
PAOI that are not already indicated by the screening tool report to occur within the proposed development footprint/PAOI. The impact analysis must consider the potential impacts from the proposed development on these additional SCC in the PAOI. See 9.3.6 Researching and presenting data for expected SCC for further guidance in this regard.

Available online resources should be used as a starting point only, since they are by no means complete. It is also important to note that some citizen science databases, such as iNaturalist, have not been thoroughly peer-reviewed and could contain identification errors. It is the responsibility of the specialist to carefully verify records from these databases, particularly if they include species not recorded in the screening tool for the PAOI. However, the use of these online facilities is encouraged as they include the latest verified publicly contributed data (when available).

New plant species are still being described almost annually in South Africa, particularly in the Succulent Karoo and Fynbos biomes, and the specialist needs to be aware of this, particularly since descriptions of new species in peer-reviewed journals are usually accompanied by a preliminary assessment of the new species' conservation status. Another frequently updated resource is SANBI’s ‘Red List of South African Plants’, which should be used when providing a table of the potentially occurring plant SCC in the PAOI. Finally, provincial authorities may be contacted to request a list of the SCC occurring within a particular quarter-degree grid cell (QDGC).

Where certain provinces have specific guidelines for surveys of threatened flora, such as the GDARD minimum requirements for biodiversity assessments (2014), these need to be incorporated into the specialist survey timing and methodology for the project development footprint/PAOI, particularly when the guidelines provide information on flowering times and/or optimal survey times for these species.

10.1.3 Field survey considerations

There are various methods for collecting floristic data for EA purposes and the method chosen will depend on factors such as size and shape of the proposed development footprint/PAOI, heterogeneity of vegetation/habitats, time and budget available for fieldwork, scale and magnitude of potential project impacts, etc. Given the restricted time frames in which specialist surveys have to be conducted, and the objective of accurately demarcating the most sensitive habitats in the PAOI, the method chosen needs to allow for rapid data collection and optimise time spent in habitats most likely to contain SCC. Survey methods that meet these requirements are known as rapid biological assessments (Larsen, 2016). These can either be plot-based, e.g. modified gentry plots (Monteagudo et al., 2016), or transect-based, e.g. timed-meander searches (TMS) (Goff et al., 1982). TMS is only one of numerous methods that could be used, but is recommended here (see 10.1.3.3 Timed-meander search method) as it allows for rapid data collection and subjective placement of TMSs in areas most likely to have SCC, and has been proven to be a very useful survey method for EIAs (Goff et al., 1982; Anon. 2018). TMSs also allow for extensive coverage of a PAOI, thus increasing the likelihood of encountering SCC, which often have very fragmented distributions.

10.1.3.1 Fieldwork timing and seasonality

Plants have a wide variety of flowering periods and strategies and it is critically important to take this into account when planning a survey. Certain plants can be impossible or extremely difficult to identify when sterile, since they lack diagnostic features (e.g. many forbs) or they may be impossible to detect in periods of dormancy when aerial parts have died back (e.g. some geophytes). Certain vegetation types have more than one distinct flowering period in a season, with different species guilds being identifiable in each period. For example, temperate Highveld grasslands have a noticeable peak in flowering in late winter/early spring when vegetation has been burnt or has died back, giving certain species of small forbs and geophytes an opportunity to flower before grass growth commences; many of these species will not be visible later in the season when overshadowed by taller grasses. When planning the timing of a floristic survey it is important to remember that the primary objective is not an exhaustive species list but rather to ensure that sufficient data are collected to describe all the vegetation communities present in the PAOI, optimise the detection of SCC and assess habitat suitability for other potentially occurring SCC. The timing of the survey therefore needs to coincide with the flowering periods of most, if not all, the SCC, with priority being given to the highly threatened species (CR, EN). This is particularly relevant in the arid and semi-arid parts of the country, as many of the species, and many of the SCC in these areas, will be only seasonally evident or identifiable. Figure 10.1 indicates the optimal plant collection times by biome for South Africa.

10.1.3.2 Size of survey area

The area surveyed needs to be extensive enough to cover a representative sample of all habitats in the PAOI and provide sufficient data to assess the suitability of habitats for SCC and determine the significance of direct and indirect project-related impacts. Adjacent properties might need to be included if potential impacts extend beyond the proposed development footprint (see 6 Defining the project areas of influence [PAOI]).

10.1.3.3 Timed-meander search method

In this method the specialist determines the route of each TMS, specifically targeting habitats with high species
diversity and reasonable likelihood of having SCC. The route taken should attempt to cover the full range of micro-habitats present in each vegetation community. A floristic inventory is compiled while walking slowly through a particular vegetation community, recording all taxa encountered, including those that cannot be immediately identified (see notes on voucher specimens below). A TMS should not overlap different habitats. The start and end times of the TMS are recorded, as well as a GPS track of the route walked, which is useful for quantifying search effort on each TMS. The TMS duration and length is determined by the rate at which species are being discovered; once no or very few species are being added the specialist ends the TMS and moves on to another site where a new TMS is started; once TMSs are not producing new species for a particular vegetation community then that community can be considered sufficiently sampled. An example map of TMSs and how the field data are recorded is provided in Figure 10.2.

10.1.3.4 Location of sample sites

There are different strategies for sampling vegetation communities, such as random sampling, stratified sampling or subjective sampling, and the method chosen will guide how sample sites are located within the PAOI. Random or stratified sampling methods tend to require more time in the field to locate the amount of SCC that can be located using subjective sampling methods (such as the TMS method). In the context of an EIA where time constraints and budgets are often restrictive, priority needs to be given to collecting data in the shortest time possible without compromising the efficiency of locating SCC.

10.1.3.5 Data collection

The following information should be recorded at each sample site:

- GPS coordinates of sample site or GPS track of TMS.
- Photographs of each vegetation community that are representative of typical vegetation structure of that community, as well as photographs of all TMSs or plots.
- Abiotic site data such as slope, aspect, landform, soil.
- Vegetation structure – the physical structure of the vegetation needs to be described in terms of strata, dominant growth forms, overall canopy cover and canopy height, and this should be translated into structural terms such as low closed woodland, tall thicket, short sparse shrubland, etc. This is useful when defining vegetation communities that have similar dominant species but different physical structure. There are different published definitions of structural vegetation types that are acceptable for use in an EIA context (e.g. Edwards, 1983; Kent and Coker, 1992), so the specialist needs to reference which system is being used and ideally provide a brief description of what defines the different structural types present in the PAOI.
- A list of all SCC observed on site with an indication of relative abundance (which can be in the form of an abundance code), as well as additional data collected for all SCC (see below).

57 http://posa.sanbi.org/
All SCC highlighted during the desktop study by the screening tool, or during desktop work as potentially occurring in the PAOI must be searched for during fieldwork and the fieldwork strategy for searching for these species should be clearly described in the report. The locations of all populations of threatened species (CR, EN, VU) and Critically Rare or Rare species should be recorded on a GPS; where plants occur in colonies then the boundaries of these colonies should be demarcated. The following data should be collected at each site where SCC are located:

- Number of adult plants.
- Evidence of any flowering or fruiting plants (may assist in establishing functionality of population and indicate if pollinators are present).
- Evidence of recruitment (number of juveniles).
- Overall health of population.
- Evidence of any current impacts on the plants (e.g. plants being harvested, impacted by fire, etc.).
- Photographs must be taken of all SCC recorded in the PAOI; the photographs need to indicate the diagnostic features that resulted in their identification. If identity is uncertain then a voucher specimen must be collected.
- Notes (where applicable) describing why a particular SCC may not have been observed (e.g. overgrazed or recently burnt).

10.1.3.6 Ecological condition

Evidence of habitat disturbance/degradation, as well as evidence of current impacts that are not project-related should be recorded for each vegetation community.

10.1.3.7 Voucher specimen collection

Correct identification of species provides the basis for a reliable baseline description of the vegetation communities present in a PAOI. While it is unreasonable to expect botanical specialists to recognise every plant they encounter in the field given South Africa’s extremely high level of species diversity, they need to ensure that the plants that are not immediately recognisable can be reliably identified once fieldwork has been completed. There are two ways in which this can be done:

- Specimen collection – this is the preferred method for ensuring that reliable identifications are made. Useful guidelines for methods of specimen collection are available (e.g. Victor et al., 2004) and should be consulted by specialists who have not been trained in collection techniques. Some important principles for the specialist to take note of include the following:
  - Ensure that collection permits have been obtained from the relevant authorities and that landowners have also given permission for specimen collection on their properties.
  - Wherever possible, do not collect a specimen if no other individuals of the same taxon are evident; rather take photographs until an additional individual can be located and then collected.
  - It is important that specimens are correctly labelled in the field so that data can be recorded for the relevant sample site.
  - Photographs – photographs can be extremely useful identification tools, but only if the correct diagnostic features are evident in the photos. If the specialist is confident of which diagnostic features need to be
photographed then these photos should be sufficient for reliable identification, but if there is any doubt then a voucher specimen should be collected to accompany the photos. Where possible, the specialist must collect environmental data from each sampling site. This information will assist in providing additional information on the ecological requirements of a particular species.

10.1.4 Reporting requirements

The following reporting requirements are required in addition to the general reporting requirements described in 9.3 Data interpretation, presentation and reporting.

10.1.4.1 SCC observations

This is the essential output of the specialist report and should ideally be dealt with in two parts as follows:

1. SCC that were confirmed to occur in the PAOI during fieldwork – each of these species should be dealt with in detail, including locations of sub-populations within the PAOI, approximate numbers, habitat preferences within the PAOI, current health of the sub-populations and any evidence of current impacts. Each account should also describe how project-related activities could impact each species, either directly (destruction of individuals or habitat) or indirectly through disruption of important ecological processes (such as exclusion of fire in fire-evolved systems) or fragmentation of important ecological corridors. The SANBI (Raimondo et al., 2009) guidelines for threatened species (Table 10.1) and other SCC (Table 10.2) should be incorporated into the recommendations later in the report or in the impact assessment. Each of these species accounts should be accompanied by at least one photograph taken in the PAOI in which diagnostic identification features are visible.

2. Additional SCC that were predicted to occur in the PAOI by the screening tool noting which ones are likely to be present but could not be confirmed during fieldwork – this is particularly relevant if fieldwork did not coincide with the flowering periods of certain species or if adverse climatic conditions (e.g. drought/late rains) resulted in certain species not flowering and thus

<table>
<thead>
<tr>
<th>Status</th>
<th>Criterion</th>
<th>Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critically Endangered</td>
<td>PE</td>
<td>No further loss of natural habitat should be permitted as the species is on the brink of extinction, and all other known subpopulations have been lost. The subpopulation in question is likely to be newly discovered and the only remaining subpopulation of this species.</td>
</tr>
<tr>
<td>Critically Endangered</td>
<td>A, B, C, D</td>
<td>No further loss of natural habitat should be permitted as the species is on the verge of extinction.</td>
</tr>
<tr>
<td>Endangered</td>
<td>B, C, D</td>
<td>No further loss of habitat should be permitted as the species is likely to go extinct in the near future if current pressures continue. All remaining subpopulations have to be conserved if this species is to survive in the long term.</td>
</tr>
<tr>
<td>Endangered</td>
<td>A</td>
<td>If the species has a restricted range (EOO &lt; 2 000 km²), recommend no further loss of habitat. If range size is larger, the species is possibly long-lived but widespread, and limited habitat loss may be considered under certain circumstances, such as the implementation of an offset whereby another viable, known subpopulation is formally conserved in terms of the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003) (NEMPA), and provided that the subpopulation to be destroyed does not occur (i) within a threatened ecosystem, or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan, or (iii) on a site associated with additional ecological sensitivities.</td>
</tr>
<tr>
<td>Vulnerable</td>
<td>D</td>
<td>This species either constitutes less than 1 000 individuals or is known from a very restricted range. No further loss of habitat should be permitted as the species’ status will immediately become either Critically Endangered or Endangered, should habitat be lost.</td>
</tr>
<tr>
<td>Vulnerable</td>
<td>B, C</td>
<td>The species is approaching extinction but there are still a number of subpopulations in existence. Recommend no further loss of habitat as this will increase the extinction risk of the species.</td>
</tr>
<tr>
<td>Vulnerable</td>
<td>A</td>
<td>If the species has a restricted range, EOO &lt; 2 000 km², recommend no further loss of habitat. If range size is larger, the species is possibly long-lived but widespread, and limited habitat loss may be considered under certain circumstances, such as the implementation of an offset whereby another viable, known subpopulation is formally conserved in terms of NEMPA, and provided that the subpopulation to be destroyed does not occur (i) within a threatened ecosystem, or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan, or (iii) on a site associated with additional ecological sensitivities.</td>
</tr>
</tbody>
</table>
potentially being overlooked in the field. This information should feed into the recommendations for further studies elsewhere in the report. SCC that are predicted to occur but based on the field visit are not suspected to occur in the proposed development footprint/PAOI need to be indicated and appropriate motivation must be provided.

10.1.4.2 Species-specific biodiversity management plans (BMPs)

If species that already have existing published BMPs are located within the PAOI (e.g. CR and EN Encephalartos species), then the recommendations for these species within the EIA report need to be aligned with the objectives and operational goals described in these BMPs. If any project activity potentially impedes any of these objectives or operational goals, then the specialist needs to describe this clearly in the report and make recommendations in this regard. For example, Objective 2 in the BMP for Encephalartos aemulans is ‘to reduce the loss of individuals, populations, pollinators and habitat critical for the survival of E. aemulans in the wild’. A hypothetical opencast mine would destroy a colony of 20 plants if the current position and extent of the pit were to be authorised and thus would impede Objective 2 being achieved. The specialist recommendations in this project could be to redesign the pit outline to avoid this colony, including a buffer of 300 m around the colony. Removing the cycads and planting them elsewhere would not be considered suitable mitigation and would be in conflict with SANBI guidelines for EIAs (Raimondo et al., 2009). See also 9.3.4 Biodiversity management plans for specific species.

10.1.4.3 Endemics and range-restricted species

The presence of endemic or range-restricted species in the PAOI should be documented and the vegetation communities that support the highest numbers of these species should be highlighted.
10.1.4.4 Presence of alien and invasive species

All plants in the PAOI that are on the gazetted National Alien and Invasive Species Lists\(^{58}\) should be documented, along with an indication of their abundance. Any vegetation communities that are sensitive to invasion by these species should be highlighted, as well as areas that have already been impacted. The specialist should also refer to the website (www.invasives.org.za) for updates and news on alien and invasive species.

10.1.4.5 Mapping

In addition to the guidance in \[9.3.12\] Mapping standards:
- vegetation communities/associations – each vegetation community described in the report needs to be indicated on a vegetation map;
- the location of all sample sites/transects must be included; and
- the location of SCC should be mapped and buffers included. In cases where SCC are known to be highly valued in trade, such as certain succulents or cycads, the precise location of these subpopulations should not be mapped.

10.1.5 Buffers for SCC

Buffers should be included for all populations of CR, EN, VU, Rare and Critically Rare species with a minimum distance of 200 m from the edge of a population. However, this distance should be increased by the specialist if consideration of the ecological requirements of the species in question (including the need for connectivity with adjacent suitable habitat) and type of potential impact indicates that a 200 m buffer would be insufficient. The specialist is required to justify all decisions made in this regard.

10.1.6 Data dissemination

All new records of SCC found must be disseminated on an online platform as per section 2.3.2 of the Terrestrial Plant Species Protocol. Please refer to the minimum requirements stipulated in \[5.3\] Step-by-step guidance for the Terrestrial Animal/Plant Species Protocols.

Data should also be shared with provincial conservation authorities if the province maintains a database of threatened species – e.g. MTPA has a threatened species database, which is used for queries from EIA consultants, as well as updates to the Mpumalanga Biodiversity Sector Plan.

Voucher specimens (where relevant as discussed above) are to be submitted to established herbaria such as the National Herbarium (Pretoria), Compton Herbarium (Kirstenbosch), and herbaria of provincial conservation authorities where these are still under curation.

10.2 Herpetofauna

10.2.1 Species included in the screening tool

The screening tool currently includes several herpetofauna SCC, which comprise 15 amphibian and 19 reptile species. These SCC, along with basic habitat preferences, known effective survey methods and optimal survey time periods\(^{59}\) are provided in Table 10.3. Additional details on survey methods and seasonal timing of surveys are provided below. All possible methods for the detection of expected SCC should be applied by the specialist for ‘high’ and ‘very high’ sensitivities defined by the screening tool. Although medium sensitivity, as evaluated by the screening tool, does not indicate the actual known presence of SCC within the proposed development footprint/PAOI, poor underlying sampling data for herpetofauna in South Africa (from which the presence of such a species has been modelled), requires verification through comprehensive fieldwork if the SSV indicates the presence of suitable habitat.

10.2.2 Desktop study – Expected SCC

The screening tool report provides a complete list of all confirmed occurring and potentially occurring herpetofauna SCC within the proposed development footprint/PAOI. Where necessary, this list should firstly be updated and confirmed against all very recently published literature sources, information from provincial management authorities, and online resources that are constantly updated with new observations, specifically:
- Reptile Atlas of Southern Africa (ReptileMAP, 2020)\(^{60}\);
- Frog Atlas of Southern Africa (FrogMAP, 2020)\(^{61}\); and
- iNaturalist\(^{62}\).

The above procedure will ensure that any very recent and new observations of SCC within the proposed development footprint/PAOI not already captured by the screening tool can be taken into account during the impact analysis.

Secondly, it is important to provide a list of any additional potentially occurring herpetofauna SCC within the defined

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\(^{58}\) Published in Government Notice No. 864 in Government Gazette 40166 of 29 July 2016. Note that on 1 March 2021, these lists will be repealed and replaced by the Alien and Invasive Species Lists published in Government Notice No. 1003 in Government Gazette 43726 of 18 September 2020.

\(^{59}\) The presented optimal survey times are not exclusive, for example shifting climate resulting in earlier or later rains must be considered.

\(^{60}\) http://vmus.adu.org.za/, formerly SARCA.

\(^{61}\) http://vmus.adu.org.za/, formerly SAFAP.

# Species Environmental Assessment Guideline

## TABLE 10.3.—Herpetofauna SCC included in the screening tool.

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common name</th>
<th>LDP&lt;sup&gt;63&lt;/sup&gt;</th>
<th>Basic habitat preferences</th>
<th>Survey methods</th>
<th>Optimal survey time</th>
<th>IUCN status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphibia</td>
<td><strong>Arthroleptidae</strong></td>
<td><em>Leptopelis xenodactylus</em></td>
<td></td>
<td>Wetlands and marshes in grassland, usually at 1 000–1 830 m.a.s.l.</td>
<td>Nocturnal searches, Acoustic surveys, Tadpole surveys</td>
<td>Late spring and summer</td>
<td>EN</td>
</tr>
<tr>
<td></td>
<td><strong>Bufonidae</strong></td>
<td><em>Capensibufo rosei</em></td>
<td>X</td>
<td>Small pools in undisturbed fynbos of the Cape Peninsula.</td>
<td>Nocturnal searches, Tadpole surveys, Trapping (pitfalls)</td>
<td>Late winter to mid-spring</td>
<td>CR</td>
</tr>
<tr>
<td></td>
<td><strong>Bufonidae</strong></td>
<td><em>Sclerophrys pantherina</em></td>
<td></td>
<td>Pans, vleis and dams with relatively deep water in fynbos and thickets. Utilises certain artificial habitats and in certain areas are reliant on these.</td>
<td>Nocturnal searches, Acoustic surveys, Tadpole surveys, Trapping (pitfalls)</td>
<td>Late winter to early spring</td>
<td>EN</td>
</tr>
<tr>
<td></td>
<td><strong>Bufonidae</strong></td>
<td><em>Vandijkophrynus amatolicus</em></td>
<td>X</td>
<td>Seepage areas and temporarily rain pools in moist high-altitude grassland.</td>
<td>Nocturnal searches, Acoustic surveys, Tadpole surveys, Trapping (pitfalls)</td>
<td>Late spring and summer</td>
<td>CR</td>
</tr>
<tr>
<td></td>
<td><strong>Heleophrynidae</strong></td>
<td><em>Heleophryne hewitti</em></td>
<td></td>
<td>Upper reaches of perennial mountain streams near grassy fynbos in the Elandsberg mountain range.</td>
<td>Nocturnal searches, Acoustic surveys, Tadpole surveys</td>
<td>Summer (September-November) for adults (peak breeding/calling), Year-round for tadpoles</td>
<td>EN</td>
</tr>
<tr>
<td></td>
<td><strong>Heleophrynidae</strong></td>
<td><em>Heleophryne rosei</em></td>
<td></td>
<td>Perennial rocky streams on eastern and southern slopes of Table Mountain in forested gorges and valleys and montane fynbos.</td>
<td>Nocturnal searches, Acoustic surveys, Tadpole surveys</td>
<td>Winter for adults, Year-round for tadpoles</td>
<td>EN</td>
</tr>
<tr>
<td></td>
<td><strong>Hyperoliidae</strong></td>
<td><em>Afrixalus knysnae</em></td>
<td></td>
<td>Vegetated ponds and pans in coastal fynbos and Afromontane forest.</td>
<td>Nocturnal searches, Acoustic surveys, Tadpole surveys</td>
<td>Summer (after first good rains) for the George area, October/November is optimal, whereas for the eastern population the peak activity is December/January/February</td>
<td>EN</td>
</tr>
<tr>
<td></td>
<td><strong>Hyperoliidae</strong></td>
<td><em>Hyperolius pickersgilli</em></td>
<td></td>
<td>Marshy areas with dense vegetation in coastal bushveld and grassland.</td>
<td>Nocturnal searches, Acoustic surveys, Tadpole surveys</td>
<td>Late spring and summer</td>
<td>EN</td>
</tr>
<tr>
<td></td>
<td><strong>Pipidae</strong></td>
<td><em>Xenopus gilli</em></td>
<td></td>
<td>Low-lying wetlands in coastal fynbos.</td>
<td>Baited traps</td>
<td>Winter and spring</td>
<td>EN</td>
</tr>
</tbody>
</table>

<sup>63</sup>Low detection probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
### Table 10.3.—Herpetofauna SCC included in the screening tool (continued).  

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common name</th>
<th>LDP&lt;sup&gt;63&lt;/sup&gt;</th>
<th>Basic habitat preferences</th>
<th>Survey methods</th>
<th>Optimal survey time</th>
<th>IUCN status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amphibia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pyxicephalidae</td>
<td><em>Anhydrophryne ngongoniensis</em></td>
<td>Mistbelt chirping frog</td>
<td></td>
<td>Dense vegetation along seepage channels in mistbelt areas of moist grassland and Afromontane forest.</td>
<td>Nocturnal searches Acoustic surveys Tadpole surveys (potentially)</td>
<td>Summer</td>
<td>EN</td>
</tr>
<tr>
<td>Pyxicephalidae</td>
<td><em>Anhydrophryne rattrayi</em></td>
<td>Hogsback chirping frog</td>
<td></td>
<td>Moist vegetation including grass-land-forest ecotone in the Katberg and Amatola mountains.</td>
<td>Diurnal and nocturnal searches Acoustic surveys</td>
<td>Summer</td>
<td>VU</td>
</tr>
<tr>
<td>Pyxicephalidae</td>
<td><em>Arthroleptella rugosa</em></td>
<td>Rough moss frog</td>
<td>X</td>
<td>Permanently wet mountains seeps with dense restio cover on the slopes of the Klein Swartberg.</td>
<td>Acoustic surveys</td>
<td>Mid to late winter up to mid spring</td>
<td>CR</td>
</tr>
<tr>
<td>Pyxicephalidae</td>
<td><em>Arthroleptella subvoce</em></td>
<td>Northern moss frog</td>
<td>X</td>
<td>Mountains seeps with dense restio and other vegetation cover on the slopes of the Groot Winterhoek mountains.</td>
<td>Acoustic surveys</td>
<td>Winter and early spring</td>
<td>CR</td>
</tr>
<tr>
<td>Pyxicephalidae</td>
<td><em>Cacosternum thorini</em></td>
<td>Hogsback caco</td>
<td></td>
<td>Small well-vegetated pools in montane grassland surrounding Hogsback.</td>
<td>Nocturnal searches Acoustic surveys Tadpole surveys</td>
<td>Summer</td>
<td>EN</td>
</tr>
<tr>
<td>Pyxicephalidae</td>
<td><em>Microbatrachella capensis</em></td>
<td>Cape micro frog</td>
<td>X</td>
<td>Undisturbed pools and vleis in coastal lowlands of the Cape Flats and Agulhas Plain.</td>
<td>Nocturnal searches Acoustic surveys Tadpole surveys</td>
<td>Winter and spring</td>
<td>CR</td>
</tr>
<tr>
<td>Pyxicephalidae</td>
<td><em>Natalobatrachus bonebergi</em></td>
<td>Kloof frog</td>
<td></td>
<td>Kloofs and rocky streams in coastal forests (never in open areas).</td>
<td>Nocturnal searches Acoustic surveys Tadpole and egg-clutch surveys</td>
<td>Late spring to early autumn</td>
<td>EN</td>
</tr>
<tr>
<td><strong>Reptilia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chamaeleonidae</td>
<td><em>Bradypodion caeruleogula</em></td>
<td>Eshowe dwarf chameleon</td>
<td></td>
<td>Restricted to three forest patches in KwaZulu-Natal (KZN) where it prefers the high canopy.</td>
<td>Nocturnal searches for sleeping individuals Diurnal searches for active individuals</td>
<td>Spring to early autumn but may be detected during winter also, although likelihood is lower</td>
<td>EN</td>
</tr>
</tbody>
</table>

<sup>63</sup> Low detection probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
### TABLE 10.3.—Herpetofauna SCC included in the screening tool (continued).

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common name</th>
<th>LDP6</th>
<th>Basic habitat preferences</th>
<th>Survey methods</th>
<th>Optimal survey time</th>
<th>IUCN status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reptilia (continued)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chamaeleonidae</td>
<td>Bradypodion caffer</td>
<td>Pondo dwarf chameleon</td>
<td></td>
<td>Coastal forest at a few localities of the north-eastern parts of the Eastern Cape.</td>
<td>Nocturnal searches for sleeping individuals Diurnal searches for active individuals</td>
<td>Spring to early autumn but may be detected during winter also, although likelihood is lower</td>
<td>EN</td>
</tr>
<tr>
<td>Chamaeleonidae</td>
<td>Bradypodion thamnobates</td>
<td>Natal Midlands dwarf chameleon</td>
<td></td>
<td>Mistbelt forest or other dense vegetation in the KZN Midlands.</td>
<td>Nocturnal searches for sleeping individuals Diurnal searches for active individuals</td>
<td>Spring to early autumn but may be detected during winter also, although likelihood is lower</td>
<td>EN</td>
</tr>
<tr>
<td>Cordylidae</td>
<td>Hemicordylus nebulosus</td>
<td>Dwarf crag lizard</td>
<td></td>
<td>Occurs in the mistbelt (1 200–1 500 m.a.s.l.) around the Landdroskop area of the Hottentots Holland Mountains.</td>
<td>Diurnal active searches</td>
<td>Spring to early autumn</td>
<td>VU</td>
</tr>
<tr>
<td>Cordylidae</td>
<td>Smaug giganteus</td>
<td>Sungazer</td>
<td></td>
<td>Highveld grassland of northern Free State and south-western Mpumalanga where soil conditions are suitable.</td>
<td>Diurnal active searches for individual and/or active burrows</td>
<td>Spring to early autumn</td>
<td>VU</td>
</tr>
<tr>
<td>Crocodylidae</td>
<td>Crocodylus niloticus</td>
<td>Nile crocodile</td>
<td></td>
<td>Large aquatic habitats (ponds, rivers, dams, etc.) north of the Zinkwazi River.</td>
<td>Nocturnal and diurnal searches</td>
<td>Year-round</td>
<td>VU</td>
</tr>
<tr>
<td>Elapidae</td>
<td>Dendroaspis angusticeps</td>
<td>Green mamba</td>
<td></td>
<td>Low altitude forest along the KZN coastline.</td>
<td>Diurnal active searches</td>
<td>Spring to early autumn</td>
<td>VU</td>
</tr>
<tr>
<td>Gerrhosauridae</td>
<td>Tetractylus Fitzsimonsi</td>
<td>FitzSimons’ long-tailed seps</td>
<td></td>
<td>Most likely grasslands between George and Port Elizabeth.</td>
<td>Diurnal active searches Trapping (funnels)</td>
<td>Spring to early autumn</td>
<td>VU</td>
</tr>
<tr>
<td>Pelomedusidae</td>
<td>Pelusios castanoides</td>
<td>Yellowbelly mud turtle</td>
<td></td>
<td>In aquatic habitats along the Mozambique coastal plain.</td>
<td>Nocturnal and diurnal searches Trapping (baited fyke nets)</td>
<td>Spring to early autumn</td>
<td>VU</td>
</tr>
<tr>
<td>Pelomedusidae</td>
<td>Pelusios rhodesianus</td>
<td>Variable hinged terrapin</td>
<td></td>
<td>In aquatic habitats along the coast from St Lucia southwards to Durban.</td>
<td>Nocturnal and diurnal searches Trapping (baited fyke nets)</td>
<td>Spring to early autumn</td>
<td>VU</td>
</tr>
</tbody>
</table>

63. Low detection probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common name</th>
<th>LDP</th>
<th>Basic habitat preferences</th>
<th>Survey methods</th>
<th>Optimal survey time</th>
<th>IUCN status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reptilia</td>
<td>Scincidae Scelotes bourquini</td>
<td>Bourquin’s dwarf burrowing Skink</td>
<td>X</td>
<td>High elevation (950–1 250 m.a.s.l) grassland in the KZN Midlands.</td>
<td>Diurnal active searches, Trapping (pitfalls)</td>
<td>Spring to early autumn</td>
<td>VU</td>
</tr>
<tr>
<td></td>
<td>Scincidae Scelotes inornatus</td>
<td>Durban dwarf burrowing skink</td>
<td>X</td>
<td>Prefers Berea red sand associated with coastal forest below 70 m.a.s.l. in the greater Durban area.</td>
<td>Diurnal active searches, Trapping (pitfalls)</td>
<td>Spring to early autumn</td>
<td>CR</td>
</tr>
<tr>
<td>Testudinidae</td>
<td>Chersobius boulenieri</td>
<td>Karoo dwarf tortoise</td>
<td></td>
<td>Rocky ridges at outcrops in the Karoo and also Albany thicket.</td>
<td>Diurnal active searches, Trapping (pitfalls), Sniffer dogs</td>
<td>Spring to early autumn</td>
<td>EN</td>
</tr>
<tr>
<td></td>
<td>Chersobius signatus</td>
<td>Speckled dwarf tortoise</td>
<td></td>
<td>Succulent Karoo along the west coast region of South Africa.</td>
<td>Diurnal active searches, Trapping (pitfalls), Sniffer dogs</td>
<td>Late winter to early autumn</td>
<td>EN</td>
</tr>
<tr>
<td>Testudinidae</td>
<td>Kinixys lobatsiana</td>
<td>Lobatse hinged-back tortoise</td>
<td></td>
<td>Savanna bushveld and thornveld habitats. Absent from grassland and subtropical lowveld. However, is known from small, wooded rocky ridges in certain grassland areas of Gauteng.</td>
<td>Diurnal active searches, Trapping (pitfalls)</td>
<td>Spring to early autumn</td>
<td>VU</td>
</tr>
<tr>
<td>Testudinidae</td>
<td>Kinixys natalensis</td>
<td>KwaZulu-Natal hinged-back tortoise</td>
<td></td>
<td>Rocky grassland and wooded grasslands, dry thickets and valley bushveld from KZN, through Swaziland (and adjacent Mozambique), along eastern parts of South Africa up to Hoedspruit. Avoids forests and deep sandy areas.</td>
<td>Diurnal active searches, Trapping (pitfalls)</td>
<td>Spring to early autumn</td>
<td>VU</td>
</tr>
<tr>
<td>Testudinidae</td>
<td>Psammobates geometricus</td>
<td>Geometric tortoise</td>
<td>X</td>
<td>Low-lying, undulating plains with a dominant low to medium-high shrub layer in the Renosterveld Bioregion (comprising several fynbos and renosterveld vegetation types).</td>
<td>Diurnal active searches, Trapping (pitfalls), Sniffer dogs</td>
<td>Spring to early autumn</td>
<td>CR</td>
</tr>
</tbody>
</table>

LDP = Low detection probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common name</th>
<th>LDP</th>
<th>Basic habitat preferences</th>
<th>Survey methods</th>
<th>Optimal survey time</th>
<th>IUCN status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reptilia</td>
<td>Viperidae</td>
<td><em>Bitis albanica</em></td>
<td>X</td>
<td>Occurs in bontveld vegetation and is associated with limestone and calcareous paleodunes.</td>
<td>Diurnal active searches</td>
<td>Spring to early autumn</td>
<td>EN</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Albany adder</td>
<td></td>
<td></td>
<td>Trapping (pitfalls)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viperidae</td>
<td><em>Bitis armata</em></td>
<td>Southern adder</td>
<td></td>
<td>Coastal fynbos associated with limestone geology along the southern coastline of the Western Cape.</td>
<td>Diurnal active searches</td>
<td>Spring to early autumn</td>
<td>VU</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Trapping (pitfalls)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LDPc Low detection probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
herpetofauna-specific PAOI that are not already indicated by the screening tool report to occur within the proposed development footprint/PAOI. The impact analysis must also consider the potential impacts from the proposed development on these additional SCC in the PAOI. See 9.3.6 Researching and presenting data for expected SCC for further guidance in this regard.

It is important to note that taxonomic changes are currently taking place at a rapid rate for herpetofauna in Africa and as a result newly separated species often acquire a revised extinction risk status (e.g. Barej et al., 2015). In addition, newly described species often have limited distributions and may therefore be of conservation concern. Consequently, herpetofauna specialists must ensure that any new taxonomic changes are considered during their evaluation of potentially occurring SCC within the proposed development footprint/PAOI as inclusion of this information into the screening tool facility will not be immediate.

10.2.3 Field survey considerations

Field survey techniques for herpetofauna are constantly evolving but generally rely on a few core methods which have proven to be successful and, importantly, repeatable. Herpetofauna specialists are directed to Dodd (2010) and McDiarmid et al. (2012) for a comprehensive treatment of field survey techniques for amphibians and reptiles, respectively.

10.2.3.1 Fieldwork timing and seasonality

Herpetofauna exhibit strong seasonal activity patterns because all are ectothermic, and their behaviour is therefore heavily influenced by temperature and/or the presence of rain. It is therefore essential that fieldwork surveys must consider this aspect and attempt to coincide with the optimal periods for peak activity of the target herpetofauna community and/or species.

In South Africa, the majority of herpetofauna exhibit peak activity between late spring and late summer. However, notable exceptions include the amphibian community of the winter rainfall regions of the Western Cape. Several amphibian SCC occur in this winter rainfall region and can only be reliably detected during fieldwork surveys coinciding with their main breeding activity, which occurs in the wet season (and therefore winter). This aspect is crucial for planning of the environmental authorisation process due to the time limitations associated with BA studies (see 9.2.1 Seasonality with specific reference to the EA process).

Furthermore, for particular habitat types (e.g. Afromontane grasslands), the applicable sampling method may differ depending on the season. This is because reptiles are more dispersed and active during mid-summer (and therefore more easily trappable) and tend to be more predictable in their refuge locations during the cooler early spring and autumn periods (and therefore more easily detectable through targeted active searches).

10.2.3.2 Active searching

The majority of herpetofauna can be detected through active searching practices by trained specialists. Detectability and likelihood of capture (when necessary for identification purposes) is greatly improved by the addition of an experienced assistant, and this is therefore strongly recommended. Positively identifiable signs of reptiles, such as shed skins, should be included as visual observation records.

For the detection of SCC, active searching should not be time-constrained at sample sites, since the goal is to optimise the probability of detection of such species. However, time taken to detect a particular SCC at a particular site should be recorded. The following two protocols are commonly employed and recommended:

1. Unconstrained point sampling – active searching is restricted to a particular location within a pre-defined radius in a well-defined habitat type (e.g. rocky outcrop) but is not limited in duration.
2. Search meanders/transects – similar to the above, but not restricted to a particular location. It is important to remain within a particular habitat type and record the track with a GPS (this method is particularly useful when searching for amphibian SCC e.g. in a stretch of mountain stream).

The following active searching methods are the most common and should be employed wherever possible:
- Visual observations – many species can be observed directly, and from a distance, without the need for capture. It is recommended that specialists carry a camera with a zoom lens in order to photograph observed species in this manner, for later identity verification and the presentation of evidence. This also allows for rapid inventorying of such species as it excludes the necessity for specimen capture, which can be a time-consuming process.
- Directed searches – this involves physically lifting up and searching under debris, rocks or logs (rocks and logs must always be returned to their original positions), raking through leaf litter and underlying soil, shining a torchlight into rock crevices and tree holes and excavating burrows.
- Dip-netting for tadpoles – using a suitably fine-meshed net (e.g. those used for the SASS invertebrates sampling protocol), tadpoles are captured by sweeping through aquatic vegetation and/or agitating the habitat (with one’s feet) and positioning the net downstream of this disturbance. Tadpoles are collected from within the net and temporarily stored in jars for later photography and/or identification.
• Nocturnal searches: Active searching on foot – a large proportion of reptiles and nearly all amphibians are strictly nocturnal, and should therefore be surveyed at night, regardless of whether trapping and sound recording sampling is also performed. In addition, several diurnal species are easier to detect at night using torchlight as they sleep in relatively exposed positions (e.g. chameleons and many arboreal snake species). Nocturnal searches should also follow the time-constrained point/meander sampling protocol described above for sites selected as potential future monitoring locations. Note that several health and safety considerations for working at night need to be considered (see below).

• Nocturnal searches: Night drives – a very effective method for sampling herpetofauna at night is to drive slowly on quiet roads and observe herpetofauna basking on or crossing the road. To improve detectability and for safety reasons, vehicles should travel at very slow speeds with the hazard lights on (for safety of other motorists) and the specialist and assistant should wear reflective vests (to improve visibility for other road users). Once a reptile or amphibian is detected, the vehicle must be rapidly but safely brought to a halt on the side of the road by the driver while the passenger rapidly exits the vehicle and attempts to capture the observed animal using torchlight for illumination. Note that it is possible for a single specialist (driver) to use this method, but safety and efficacy are likely to be compromised.

10.2.3.3 Acoustic surveys

Vocalisation sound recording – male amphibians vocalise to attract females during the breeding season. These vocalisations or calls are species-specific and can therefore be used to identify species without the necessity for visual observations, by referring to established acoustic libraries (see Du Preez and Carruthers, 2017). There are active and passive means to record amphibian vocalisations:

• Active acoustic surveys – during nocturnal active searches, vocalising males can be recorded with handheld recording equipment for later identification. Dedicated recording devices (e.g. Zoom H4n) may be used, but modern cellular phones possess the ability to record audio at high quality and can therefore also be used. Following the successful recording of a species or chorus, but before termination of the recording, the herpetofauna specialist should speak into the microphone and record important additional information related to the recording, such as date and time (not always accurately recorded by some devices), sample site name, general location, climatic conditions etc. This ensures that this information does not need to be recorded separately from the actual sound recording data file and can be retrieved directly from the file at a later stage.

• Passive acoustic surveys – the use of automated sound recorders (e.g. Songmeter SM1, Wildlife Acoustics), which allow recording of sounds at pre-programmed times and durations, are invaluable for sampling vocalising amphibians. Firstly, species diversity at a particular location can be obtained and secondly, relative abundances can be inferred. Devices should be set to record for relatively short durations (e.g. 10 minutes) but for multiple timeslots in an evening to ensure accurate capture of the full diversity of the amphibian chorus (peak calling activity of a particular species can differ). It is important to note and report on the sampling durations and time periods of the recordings for replication purposes during surveys and it is important to limit the total duration of all recordings because processing thereof is time-consuming (without expensive specialised software, a specialist will have to listen and evaluate the presence of species for a minimum of the same duration as the total duration of the recordings).

10.2.3.4 Trapping

• Baited trapping
  • *Xenopus* (platanna or clawed frogs) – *Xenopus* frogs are most easily trapped using partially submerged (frogs must be able to reach the surface in order to breathe) modified fyke nets or funnel traps (sometimes mounted singly on bucket lids) baited with chicken liver or tinned cat food contained within a mesh bag to prevent ingestion. Traps are best set at sunset and removed within two hours of dawn to prevent predation of trapped frogs (e.g. by birds and otters) (see Measey, 1998; Vogt et al., 2017). Such trapping is useful for the detection of the IUCN Endangered Cape platanna (*X. gilli*) and the invasive*64* common platanna (*X. laevis*).
  • Terrapins – while it is not always required to trap terrapins in South Africa (since there are alternative and sometimes easier sampling methods such as direct observation by a concealed/hidden observer), it may nevertheless be required to confirm the presence of SCC. In such cases, a similar trapping technique to that for *Xenopus* should be employed but with larger fyke nets.
  • Passive (intercept) trapping – this passive trapping technique is essential for detecting cryptic SCC that cannot easily be located through active searching. Furthermore, because it is a passive technique, it is relatively easy to standardise across different locations and time periods and therefore is very effective as a tool for monitoring changes. Consequently, trapping of this nature is strongly recommended for all projects where continued monitoring will be required. However, the following aspects

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64 Although this species is native to South Africa, in certain parts of the Western Cape it has been accidentally introduced where it is considered to be invasive as it displaces the Endangered Cape platanna (*X. gilli*).
of intercept trapping must be considered during the planning phase of the fieldwork:

- Site selection is very important for trap success and for appropriate comparisons during future monitoring work. To maximise the likelihood of trapping the focal SCC, trapping should be conducted in appropriate habitats (see Table 10.3). For future monitoring purposes, trap sites should be selected in or adjacent to habitats that are expected to experience some impacts from the proposed project activities, in order to assess the magnitude of these impacts on the population of herpetofauna SCC.

- Large mammals (particularly cattle and elephants) are inquisitive and often destroy intercept traps. Trap site selection should therefore take this aspect into account; and/or landowners/farm managers could be requested to move cattle to other camps.

- Construction and deployment of these traps is a laborious and time-consuming process. Up to 6 hours can be required to deploy a single trap with the assistance of two labourers, depending on the substrate and vegetation conditions. In soft, sandy conditions with limited vegetation, an experienced team of three people can deploy a trap array in approximately 1.5 hours.

- For these traps to be effective, high levels of herpetofauna activity are required since it is a passive trapping system. Consequently, traps should be deployed during optimal seasonal conditions for the target SCC (Table 10.3) and be allowed to operate for a minimum of four consecutive nights (but preferably for ten nights), to allow for variation in climatic conditions and therefore herpetofauna activity patterns. A minimum of five days is therefore necessary for appropriate trapping duration.

- Weather monitoring data (temperature and/or humidity as well as rainfall) must accompany trapping data results in order to interpret and compare these results (see below).

- Some safety considerations regarding trapping must be taken into account (see below).

The general pitfall trap design associated with drift fences is very effective in trapping lizards, small snakes and amphibians (Corn and Bury, 1990; Branch, 1998; Crosswhite et al., 1999; McDermid et al., 2012). However, trap efficacy is increased in general by replacing the three terminal pitfall traps with terminal funnels and by the addition of funnel traps along the drift fences (e.g. Masterson et al. 2009). The end funnels provide greater trapping success (diversity and abundance) compared to pitfall buckets and require less time to construct and can be deployed in rocky terrain. However, if the target group or SCC are tortoises or fossorial species (e.g. Scelotes inornatus) then pitfall traps are preferred. The funnel trap drift fence arrays can be arranged in a Y-shape which consists of a central pitfall bucket (usually 10–25 L), 30 m of drift fence with six dual-ended funnel traps placed along the drift fence and three large terminal funnel traps (Figure 10.3); a cross-shape (with four drift fences, eight dual-ended funnel traps and four terminal funnel traps/pitfalls); or a linear shape (with only two terminal funnel traps/pitfalls and six to eight dual-ended funnel traps). Y- and cross-shaped arrangements are usually preferred in more open and homogenous habitats whereas the linear configuration is preferred along linear features (e.g. a stream or base of a rocky ridge). While the configuration of the drift fences and traps is not critically important for a baseline survey where the goal is to detect an SCC, it is necessary for follow-up monitoring surveys to repeat the trap configuration of the baseline or preceding monitoring surveys in order to facilitate comparison between surveys. Funnel traps and pitfalls must be suitably covered (e.g. with vegetation and/or other suitable material) to prevent direct exposure to sunlight (overheating) and rain (drowning). If pitfall buckets require drainage holes, the holes should be small enough to prevent escape by the target species. Shelter (bark, leaves, etc.) and a thin layer of moist soil (or moist sponges) should be included in the pitfall bucket for refugia and to prevent desiccation, respectively. At a minimum, traps must be inspected daily in the early morning and all captured specimens should be released unharmed at least 50 m away from the traps (after photographs have been taken) to reduce the chances of immediate recapture. An example of trap deployment and removal is provided through a time-lapse video available here: https://youtu.be/KfPm8MYqsqk

10.2.3.5 Weather monitoring

As mentioned above, it is necessary to present weather data for a herpetofauna survey. Such weather data can often be obtained from local weather stations (e.g. most mines and other large industries have such facilities). It is, however, advisable to regularly record this data in the local context with appropriate instrumentation. One way to achieve this is by using relatively inexpensive Thermochron or Hygrochron iButtons®. These are small devices capable of recording temperature and/or humidity at pre-set intervals. iButtons should be placed at each of the deployed intercept trap arrays to record the temperature at 30-minute intervals. Each iButton must be placed inside an inverted ventilated polystyrene or paper cup to protect against the effects of rain and direct solar radiation and should be deployed at approximately head height in a place of maximum shade (Figure 10.4). An example of how to present collected weather data during a survey is provided in Figure 10.5.

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65 Note that this will often not be sufficient time to detect very cryptic species. The presence of other trapped species with similar ecology, or the presence of known prey species may help to infer the likelihood of occurrence for the target SCC.
FIGURE 10.3.—Top: Basic design and layout of a drift fence funnel trap array with central pitfall; dual-ended funnel trap (D) placement along drift fence shown in C only. Bottom: A deployed and active drift fence funnel trap array.
10.2.3.6 Opportunistic sampling

Certain herpetofauna are very elusive and difficult to observe. Consequently, all possible opportunities to observe SCC should be taken during a survey in order to augment the standard sampling procedures described above. These include the following:

- During driving between the different sampling sites, the road and road verge should constantly be scanned for active and killed (road mortalities) reptiles. Driving speed should be slower than normal to increase the likelihood of a successful observation. Once a reptile has been observed, the vehicle should be rapidly (but safely) brought to a halt and the observed reptile captured and/or photographed. Note that the presence and intensity of road kills must be documented as part of the current impacts.

- If an aquatic specialist team is participating in the same project, they should be requested to opportunistically collect (temporarily) any adult amphibians or tadpoles encountered during the fish and invertebrate sampling procedures (electro-shocking, netting etc.).

- All other biodiversity and social specialists participating in the same project should be requested to opportunistically take photographs of reptiles and amphibians observed within the PAOI. These images can then be copied for proper identification and added to the list of random incidental observations. Ideally, a geographic coordinate of the observation should be obtained.

- Interviews with landowners, local farmers, staff etc. are very useful in providing historical context and evidence useful in the description of the herpetofauna community. With the proliferation of cellular phones capable

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**FIGURE 10.4.**—iButton temperature logger placed inside a ventilated polystyrene cup to record temperature and humidity every 30 minutes.

**FIGURE 10.5.**—Example of graphical display of weather data recorded during a herpetofauna fieldwork survey. Note the different climatic conditions due to the different habitat types.
of taking photographs, it is often possible to acquire verifiable and identifiable images of species within the PAOI. This information should be collated separately and discussed in the specialist report.

Unsupervised local collection assistance – in the past, it was customary for biodiversity specialists to request specimen collection assistance from local inhabitants in rural areas. Typically, these people would be paid upon presentation of specimens to the specialist(s) that were collected. This is an unacceptable practice as it:
- is unethical and often results in the unnecessary death of specimens;
- is not accompanied by appropriate collection permits;
- puts people at unnecessary high health risk from envenomation by snakes; and
- may create undue conflict within local communities in respect of payment of particular individuals etc.

In cases where local assistance is required due to unique local knowledge (often from hunters), the community liaison officer (CLO) should approach the village chief to negotiate the terms and conditions of such assistance. Assistance can then be provided in a supervised manner, where a responsible person (such as a CLO or the specialist) is present to observe that appropriate protocols, ethical considerations and legal regulations are followed.

10.2.3.7 Safety considerations

There are a number of safety considerations to take into account during herpetofauna field surveys. The specialist should inform the proponent beforehand in order to ensure appropriate health and safety protocols are followed were necessary.

- Catching and handling venomous snakes – it is advisable to avoid the capture and handling of venomous species during surveys if photographic evidence can be obtained otherwise. However, this is not always avoidable since traps will occasionally capture a venomous species which will require removal from the trap. Herpetofauna specialists must therefore:
  - be competent in handling venomous species;\(^ 66\);
  - be aware of appropriate first aid treatment in the case of snakebite; and
  - take suitable preventative measures, such as using appropriate gloves, protective eyewear and handling equipment.

- Crocodiles – in areas where crocodiles occur, there is a serious risk of negative encounters with this species during nocturnal surveys of amphibians. Herpetologists should take every precaution to avoid such encounters by:
  - scanning the body of water to be surveyed for crocodile eye shine (using a torch) prior to inception of

the amphibian survey, as well as regularly during the amphibian survey;
- avoiding the necessity to enter the body of water deeper than ankle high and then only in clear water not visibly obstructed by vegetation; and
- resorting to alternative methods (photography, spoor, acoustic recording etc.) in cases where crocodiles cannot safely be avoided during nocturnal surveys.

- Trapped snakes – apart from potential envenomation of the specialist by trapped snake species described above, there is a risk that curious local inhabitants in rural areas, which have not been properly informed about the trapping procedure, may inspect the traps. While it is unlikely that such people will handle the trap, especially if it contains a snake, there is a risk that trapped spitting cobras \((Naja mossambica, Naja nigricincta woodi)\) or rinkhals \((Hemachatus haemachatus)\) may spray venom into the eyes of the person. This is possible because funnel traps are constructed from metal gauze. Care should therefore be taken to inform local inhabitants of this potential danger prior to the initiation of trapping activities as simple signage indicating danger is an insufficient deterrent due to illiteracy, especially for children.

- Nocturnal surveys – these are associated with several safety concerns that should be appropriately addressed prior to inception of the survey. These may include:
  - arrangement for security escorts for areas with a high associated probability of crime (e.g. adjacent to informal settlements);
  - potential attack by farmers seeking to protect their livestock from livestock thieves (farmers in the PAOI and adjacent areas should be informed of the nocturnal surveys prior to the inception and with provision of vehicle make and registration details, as well as the telephone number of the specialist); and
  - appropriate communication devices (two-way radios or satellite phones) in areas without cell phone reception in case of an emergency.

10.2.3.8 Disease transmission

Chytridiomycosis, an infectious disease caused by the fungal pathogen \(Batrachochytrium dendrobatidis\), is one of the most important global drivers of amphibian declines and extinction. Herpetologists that capture and handle amphibians can easily transfer this pathogen if appropriate considerations are not given to the disinfection of equipment and the person handling the animals too. A protocol using the veterinary disinfectant F10SC, which is effective against \(B. dendrobatidis\) during short contact times, has been developed by De Jong et al. (2018) and should be followed for the disinfection of equipment used during fieldwork to prevent translocations of this pathogen.

\(^{66}\)It is strongly recommended that a venomous snake handling course should be attended.
10.2.3.9 Data collection

- Planned sample sites/meanders – each sample site/meander must be named with a unique identifier and the following data should be recorded for the survey:
  - date and time;
  - geographic coordinate (WGS 84);
  - general weather conditions;
  - identity of observed SCC;
  - total number of individuals of a particular SCC (for large numbers of congregatory species an upper maximum can be defined e.g. > 10);
  - photographic evidence or sound recording of a particular SCC (where possible);
  - at least two representative habitat photographs;
  - a brief description of the habitat type;
  - suitability of the habitat type for expected SCC in terms of:
    - refugia; and
    - foraging;
  - any current impacts observed at the particular site; and
  - any additional information deemed relevant or necessary.

Because it can be extremely time-consuming to record such data in the field, the use of weather-proof cellular phones with applications capable of automatically recording several of the above data types (e.g. date and time, GPS coordinates) and taking high-quality photographs is recommended. Several database type applications exist where all of this data can be collated simultaneously. An example of how to present collected information per sample site is presented in Table 10.4.

- Ad hoc samples – such samples include those obtained opportunistically as described above and by any means other than directed sampling efforts (e.g. observing a

<table>
<thead>
<tr>
<th>Sample Site</th>
<th>Habitat Description</th>
<th>Photo 1</th>
<th>Photo 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trap 1</td>
<td>Heavily sedged area adjacent to stream which has been artificially dammed due to road crossing, creating marshy area.</td>
<td><img src="image1.png" alt="Photo 1" /></td>
<td><img src="image2.png" alt="Photo 2" /></td>
</tr>
<tr>
<td>AS01</td>
<td>Edge of <em>Eucalyptus</em> plantation at high altitude. Much debris (wood) from adjacent harvested plot. Many alien invasive flora and extensive grassy cover under trees.</td>
<td><img src="image3.png" alt="Photo 1" /></td>
<td><img src="image4.png" alt="Photo 2" /></td>
</tr>
<tr>
<td>AS02</td>
<td>Ephemeral drainage in dense forest/bushveld mosaic. Undisturbed.</td>
<td><img src="image5.png" alt="Photo 1" /></td>
<td><img src="image6.png" alt="Photo 2" /></td>
</tr>
<tr>
<td>AS03</td>
<td>Large granite dome at high altitude. Excellent refugia. <em>Lantana</em> and jacaranda invasive species present degrading habitat.</td>
<td><img src="image7.png" alt="Photo 1" /></td>
<td><img src="image8.png" alt="Photo 2" /></td>
</tr>
</tbody>
</table>

*Sample site locations and dates have been falsified.*
lizard crossing the road while driving). As much of the above-mentioned associated data must be recorded for ad hoc samples as possible. Cellular phone applications are particularly useful in this regard. However, during night drives, for example, it is not always possible to accurately evaluate the surrounding habitat type (since it is dark) and therefore, where necessary/important, it may be required to revisit the observation location and add habitat data in a post hoc manner.

- Diagnostic photographs – it is essential for herpetofauna specialists to take a series of diagnostic photographs for each known or suspected SCC encountered in the field, where possible. This is because herpetofauna can be very difficult to positively identify in the field and it is often not possible to obtain collecting permits in time so that sample specimens may be collected for later identity verification.
  - Due to limited time in the field, diagnostic photographs should be taken for at least one specimen of each known or suspected SCC observed. However, due to variation and overlap in morphological characters between species, and within species between sexes, it is advised that diagnostic photographs are taken for several individuals of a known or suspected SCC, particularly when the confidence in the identification is low (Figure 10.6).
  - Diagnostic photographs of tadpoles should be taken in two ways (Figure 10.7):
    - Live tadpoles should be placed in a small glass/Per-Oex aquarium so that a lateral-view photograph may be taken to show the profile of the tailfin.
    - Because some tadpoles are very difficult to identify from photographs as described above, the mouthparts (comprising jaw sheath, labial tooth rows and jaw papillae) should also be photographed, as the arrangement of these is usually diagnostic. Where collecting permits are in place, any deceased specimens should be preserved and donated to an appropriate museum or analogous institute.

10.2.4 Reporting requirements

The following herpetofauna-specific reporting requirements are required in addition to the general reporting requirements described in 9.3 Data interpretation, presentation and reporting.

10.2.4.1 SCC observations

A summary table of all SCC observed during the fieldwork per trap and sample site must be prepared and should contain the number of individuals (density) observed per SCC per trap and sample site.

10.2.4.2 Presence of alien and invasive species

It is important to report on both native and non-native herpetofauna species encountered during a herpetofauna survey, and to provide specific management recommendations in this regard (which may include continued monitoring). Alien specimens encountered in the field should preferably be euthanised immediately.

Three indigenous amphibian species are considered to be invasive, in the Western Cape (see Measey et al., 2017 and Vogt et al., 2017) namely:

- guttural toad (*Sclerophrys gutturalis*);
- painted reed frog (*Hyperolius marmoratus*); and
- African clawed frog (*Xenopus laevis*), in a few instances where this species has invaded *Xenopus gilli* wetlands.

It is essential that observations of the above three species outside of their natural geographic distributions are highlighted in the report. Relevant conservation authorities and I&APs should also be notified immediately.

10.2.4.3 Detection likelihood of SCC

Because herpetofauna surveys are susceptible to the influence of unpredictable adverse weather conditions, it may be necessary to recommend that additional follow-up studies are conducted to verify the presence of an SCC. Should this not be possible within the timeframe of the environmental authorisation process, then the precautionary principle must be applied and it must be assumed that the SCC is present until such time that appropriate fieldwork can be conducted to confirm its absence.\(^{68}\)

10.2.5 Buffers for SCC

Implementation of buffers for herpetofauna SCC is typically problematic because the life history of the majority of SCC and their habitat requirements are poorly understood. In the past, standard practice has been to apply buffers to sensitive herpetofauna habitats (e.g. wetlands or rocky outcrops) according to guides developed for other groups of species or for general conservation of a particular sensitive habitat type (e.g. Macfarlane and Bredin, 2017). However, these are typically insufficient because many herpetofauna species, especially semi-aquatic species such as the majority of amphibians, require different habitat types for different aspects of their life history (Semlitsh and Bodie 2003; Ficetola *et al.*, 2009). For example, most amphibians require aquatic habitats for breeding purposes but rely on terrestrial habitats for foraging and refugia purposes (including aestivation). Buffer recommendations for certain species or groups of species are provided in Table 10.5. These buffers\(^{69}\) are to

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\(^{68}\)Note that surveys required to prove the absence of a highly cryptic SCC may require continuous survey effort for extended periods of time, up to multiple years (see 9.3.7 Expected SCC with very low detection probabilities).

\(^{69}\)These buffers were mostly derived from a document produced by Ground *et al.* for the eThekwini Municipality (informed by Tarrant, 2013).
be applied for activities that may cause any disturbance resulting in loss or major degradation of habitat, as well as direct impact on the SCC. This includes chemical contamination, siltation/sedimentation from erosion caused by ploughing, grazing, clearing for development, etc. For most of the herpetofauna (specialists should motivate if not) but for sungazers (*Smaug giganteus*) in particular, buffer application is also required for construction, operation and upgrading of roads that will increase vehicle traffic substantially.

10.2.6 Data dissemination

- Observations of SCC and any alien species.
- Specimens representing geographic range extensions.
- It is required, per section 2.2.2 of the Terrestrial Animal Species Protocol, that at least one observation per SCC, per project, be disseminated to an appropriate database source (ReptileMAP, FrogMAP, iNaturalist or GBIF70).
- Any collected voucher specimens (appropriate permitting required) to be submitted to recognised museums.

70 Global Biodiversity Information Facility (www.gbif.org/).
### TABLE 10.5.—Buffer applications for herpetofauna SCC.

<table>
<thead>
<tr>
<th>Species or species group</th>
<th>Attribute</th>
<th>Minimum buffer (m)</th>
<th>Recommend buffer (m)</th>
<th>Discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic and semi-aquatic species. Includes all amphibians listed in Table 10.3 and the following reptiles: Crocodylus niloticus Pelusios castanoides Pelusios rhodesianus</td>
<td>Aquatic habitats (wetlands, ponds, rivers, streams, seeps etc.) utilised by these species for breeding and foraging purposes. This must include catchment areas of these aquatic habitats.</td>
<td>100</td>
<td>400</td>
<td>Buffers to be applied from the wetland edge (as per wetland delineations). Buffers to be applied must ensure connectivity between buffers of other aquatic habitats. If this can be achieved through the application of the minimum buffer distance, then it may be applied. However, should this not be the case, the buffer size should be increased until this can be demonstrated. If no such connectivity is possible at all, then the recommended buffer must be applied. Minimum buffer recommendations for wetlands provided in Macfarlane and Bredin (2017) are not applicable for these SCC.</td>
</tr>
<tr>
<td>Herpetofauna reliant on forest habitats</td>
<td></td>
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</tr>
<tr>
<td><strong>Amphibians:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Afrixalus knysnae</td>
<td></td>
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<tr>
<td>Anhydrophryne ngongoniensis</td>
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<td></td>
<td></td>
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<tr>
<td>Natalobatrachus bonebergi</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anhydrophryne rattrayi</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Reptiles:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bradypodion caeruleogula</td>
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<td></td>
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<tr>
<td>Bradypodion caffer</td>
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<td></td>
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<tr>
<td>Bradypodion thamnobates</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Dendroaspis angusticeps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scelotes inornatus</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Smaug giganteus</strong></td>
<td>Colonies, indicated by the presence of recently excavated burrows.</td>
<td>250</td>
<td>400</td>
<td>Buffer to be applied around the periphery of sungazer colonies. Buffer must specifically exclude eroded runoffs from areas cleared of vegetation (e.g. crop farming) that can bury and destroy sungazer burrows. Applied buffer must ensure no exposure to pesticides and other chemicals used to treat adjacent agricultural crops or wind-blown ash (from power stations) or mining tailings. Therefore, the prevalent wind direction must be taken into account. Sungazers are known to migrate distances of up to 1 km and may regularly move between 30–80 m during mating seasons (S. Parusnath pers. comm.), making them particularly susceptible to being killed by road traffic.</td>
</tr>
</tbody>
</table>


### Table 10.5.—Buffer applications for herpetofauna SCC (continued).

<table>
<thead>
<tr>
<th>Species or species group</th>
<th>Attribute</th>
<th>Minimum buffer (m)</th>
<th>Recommended buffer (m)</th>
<th>Discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herpetofauna specifically reliant on grassland: <strong>Amphibians:</strong> Vandijkophrynus amatolicus <strong>Reptiles:</strong> Tetradactylus fitzsimonsi Scelotes bourquini</td>
<td>Presence as determined through recent (&lt; 10 y) observation.</td>
<td>300</td>
<td>500</td>
<td>Habitat requirements, utilisation, densities and dispersal abilities of these species are rather poorly understood. In addition, because of their reliance on grassland habitats, they are likely to be negatively impacted by regular fires. Consequently, large minimum buffers surrounding known observation locations of these species with demonstrable connectivity to other undisturbed grassland habitats is required.</td>
</tr>
<tr>
<td>Reptiles reliant on rocky habitats: Hemicordylus nebulosus Chersobius boulengeri Bitis albanica</td>
<td>Presence as determined through recent (&lt; 10 y) observation.</td>
<td>300</td>
<td>500</td>
<td>These species are reliant on different types of rocky habitats predominantly for refuge purposes (avoidance of predators etc.). Foraging habitats for these species are usually not exclusively confined within the rocky habitats, and therefore large buffers are required to ensure appropriate foraging requirements are met. In addition, these rocky habitats tend to occur patchily in the landscape, and therefore large buffers must be applied in order to ensure habitat connectivity. If connectivity to other suitable rocky habitats (with 300 m buffer) is not possible, then the recommended buffer must be applied.</td>
</tr>
<tr>
<td>Reptiles occurring over a wide variety of habitats and a wide geographic area: Chersobius signatus Kinixys lobatsiana Kinixys natalensis Bitis armata</td>
<td>Presence as determined through recent (&lt; 10 y) observation.</td>
<td>30</td>
<td>100</td>
<td>Intact habitat patches where these species are known to occur should be buffered from disturbance taking into account connectivity to other similar habitat, or at least habitats that these species will utilise for migration and dispersal purposes.</td>
</tr>
<tr>
<td>Psammobates geometricus</td>
<td>Presence as determined through recent (&lt; 10 y) observation.</td>
<td>300</td>
<td>500</td>
<td>Remaining habitat for this species is so limited that any habitat suitable for this species must be preserved with a large buffer. Buffer should be managed to enhance and increase available habitat for utilisation by this species.</td>
</tr>
</tbody>
</table>
with herpetofauna collections, such as the Port Elizabeth Museum, National Museum (Bloemfontein) and the Dit-song National Museum of Natural History (Pretoria).

10.3 Avifauna

10.3.1 Species included in the screening tool

The screening tool currently includes 59 bird SCC (Table 10.6). An up-to-date list of SCC included in the screening tool, along with necessary metadata is provided on BirdLife South Africa’s website (https://www.birdlife.org.za/what-we-do/science-and-innovation/site-screening-tool/). All possible methods for the detection of expected SCC should be applied by the specialist for ‘high’ and ‘very high’ sensitivities defined by the screening tool. Although medium sensitivity, as evaluated by the screening tool, does not indicate the actual known presence of SCC within the proposed development footprint/PAOI, but rather predicted modelled habitat for that species, specialists should conduct verification surveys through comprehensive fieldwork if the SSV indicates the presence of suitable habitat.

10.3.2 Avifauna-specific guidelines for certain developments

Certain development projects may require long-term monitoring of specific SCC that have been identified as impact receptors in the PAOI. Generic avifauna survey methods may not be sufficient for monitoring particular species and a species-specific survey methodology will need to be developed by the specialist taking into account the following:

- confirmed localities where the target species has been recorded;
- habitat preferences of target species;
- behaviour of target species – cryptic species will not be easily monitored with transects or even point counts unless some playback is used, while large terrestrial species

<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>IUCN status</th>
<th>LDP?</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Afrotis afra</em></td>
<td>Southern Black Korhaan</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td><em>Anthus brachyurus</em></td>
<td>Short-tailed Pipit</td>
<td>VU</td>
<td>X (out of breeding season [Oct.–Feb.])</td>
</tr>
<tr>
<td><em>Anthus chloris</em></td>
<td>Yellow-breasted Pipit</td>
<td>VU</td>
<td>X (out of breeding season [Oct.–Mar.])</td>
</tr>
<tr>
<td><em>Aquila rapax</em></td>
<td>Tawny Eagle</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td><em>Aquila verreauxii</em></td>
<td>Verreaux’s Eagle</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td><em>Balearica regulorum</em></td>
<td>Grey Crowned Crane</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td><em>Bradypterus sylvaticus</em></td>
<td>Knysna Warbler</td>
<td>VU</td>
<td>X (out of breeding season [Sep.–Nov.])</td>
</tr>
<tr>
<td><em>Bucorvus leadbeateri</em></td>
<td>Southern Ground-Hornbill</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td><em>Calendulauda burra</em></td>
<td>Red Lark</td>
<td>VU</td>
<td>X</td>
</tr>
<tr>
<td><em>Caprimulgus natalensis</em></td>
<td>Swamp Nightjar</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td><em>Ciconia nigra</em></td>
<td>Black Stork</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td><em>Cinnyris neergaardi</em></td>
<td>Neergaard’s Sunbird</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td><em>Circaetus fasciolatus</em></td>
<td>Southern Banded Snake Eagle</td>
<td>CR</td>
<td></td>
</tr>
<tr>
<td><em>Circus maurus</em></td>
<td>Black Harrier</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td><em>Circus ranivorus</em></td>
<td>African Marsh Harrier</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td><em>Columba delegorguei</em></td>
<td>Eastern Bronze-naped Pigeon</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td><em>Cursorius rufus</em></td>
<td>Burchell’s Courser</td>
<td>VU</td>
<td>X</td>
</tr>
<tr>
<td><em>Ephippiorhynchus senegalensis</em></td>
<td>Saddle-Billed Stork</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td><em>Eupodotis senegalensis</em></td>
<td>White-bellied Korhaan</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td><em>Falco biarmicus</em></td>
<td>Lanner Falcon</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td><em>Falco fasciinucha</em></td>
<td>Taita Falcon</td>
<td>CR</td>
<td></td>
</tr>
</tbody>
</table>

?Low detection probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
<table>
<thead>
<tr>
<th>Species</th>
<th>Common name</th>
<th>IUCN status</th>
<th>LDP71</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geokichla guttata</td>
<td>Spotted Ground Thrush</td>
<td>EN</td>
<td>X</td>
</tr>
<tr>
<td>Geronticus calvus</td>
<td>Southern Bald Ibis</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Gorsachius leucogaster</td>
<td>White-backed Night Heron</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Bugeranus carunculatus</td>
<td>Wattled Crane</td>
<td>CR</td>
<td></td>
</tr>
<tr>
<td>Gypaetus barbatus</td>
<td>Bearded Vulture</td>
<td>CR</td>
<td></td>
</tr>
<tr>
<td>Gyps africanus</td>
<td>White-backed Vulture</td>
<td>CR</td>
<td></td>
</tr>
<tr>
<td>Gyps coprotheres</td>
<td>Cape Vulture</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Halcyon senegaloides</td>
<td>Mangrove Kingfisher</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Heteromira ruddi</td>
<td>Rudd’s Lark</td>
<td>EN</td>
<td>X     (out of breeding season [Oct.–Apr.])</td>
</tr>
<tr>
<td>Hirundo atrocaerulea</td>
<td>Blue Swallow</td>
<td>CR</td>
<td></td>
</tr>
<tr>
<td>Lioptilus nigricapillus</td>
<td>Bush Blackcap</td>
<td>VU</td>
<td>X     (out of breeding season [Oct.–Apr.])</td>
</tr>
<tr>
<td>Macheiramphus alcinus</td>
<td>Bat Hawk</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Microparra capensis</td>
<td>Lesser Jacana</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Mycteria ibis</td>
<td>Yellow-billed Stork</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Necrosyrtes monachus</td>
<td>Hooded Vulture</td>
<td>CR</td>
<td></td>
</tr>
<tr>
<td>Neotis denhami</td>
<td>Denham’s Bustard</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Neotis ludwigii</td>
<td>Ludwig's Bustard</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Nettapus auritus</td>
<td>African Pygmy Goose</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Pelecanus onocrotalus</td>
<td>Great White Pelican</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Pelecanus rubescens</td>
<td>Pink-backed Pelican</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Podica senegalensis</td>
<td>African Finfoot</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Poicephalus robustus</td>
<td>Cape Parrot</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Polemaetus bellicosus</td>
<td>Martial Eagle</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Sagittarius serpentarius</td>
<td>Secretarybird</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Sarothrura affinis</td>
<td>Striped Flufftail</td>
<td>VU</td>
<td>X     (out of breeding season [Sep.–Mar.])</td>
</tr>
<tr>
<td>Sarothrura ayresi</td>
<td>White-winged Flufftail</td>
<td>CR</td>
<td>X</td>
</tr>
<tr>
<td>Scotopelia peli</td>
<td>Pel’s Fishing Owl</td>
<td>EN</td>
<td>X</td>
</tr>
<tr>
<td>Smithornis capensis</td>
<td>African Broadbill</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Spizocorys fringillaris</td>
<td>Botha’s Lark</td>
<td>EN</td>
<td>X     (out of breeding season [Oct.–Jan.])</td>
</tr>
<tr>
<td>Stactolaema olivacea</td>
<td>Green Barbet</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Stephanoaetus coronatus</td>
<td>Crowned Eagle</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Stercorarius antarcticus</td>
<td>Subantarctic Skua</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Terathopius ecaudatus</td>
<td>Bateleur</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Torgos tracheliotus</td>
<td>Lappet-faced Vulture</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Trigonoceps occipitalis</td>
<td>White-headed Vulture</td>
<td>CR</td>
<td></td>
</tr>
<tr>
<td>Turnix hottentottus</td>
<td>Hottentot Buttonquail</td>
<td>EN</td>
<td>X</td>
</tr>
<tr>
<td>Turnix nanus</td>
<td>Black-rumped Buttonquail</td>
<td>EN</td>
<td>X</td>
</tr>
<tr>
<td>Tyto capensis</td>
<td>African Grass Owl</td>
<td>VU</td>
<td></td>
</tr>
</tbody>
</table>

71 Low detection probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
that forage over vast tracts of grassland may need to be monitored using the road count method;
• seasonality – this is particularly important for migrant species or even resident species that undergo local seasonal movements such as altitudinal migrants; and
• nature of the risk (e.g. fatalities, displacement or reduced breeding success).

Existing guidance should be consulted where available and applicable to a particular development (e.g. BirdLife South Africa’s Best Practice guidelines for assessing and monitoring the impact of solar energy facilities on birds; Jenkins et al., 2015).

10.3.3 Desktop Study – Expected SCC

The screening tool report will ultimately provide a complete list of all confirmed occurring and potentially occurring bird SCC within the proposed development footprint/PAOI. Where necessary, this list should firstly be updated and confirmed against all very recently published literature sources, information from provincial management authorities, and online resources that are constantly updated with new observations, specifically:
• Southern African Bird Atlas Project 2 (SABAP2, 2020)72;
• Co-ordinated Wetland Counts73;
• Co-ordinated Avifaunal Roadcounts74;
• Birds in Reserves Project75; and
• iNaturalist76.

The above procedure will ensure that any very recent and new observations of SCC within the proposed development footprint/PAOI not already captured by the screening tool can be taken into account during the impact analysis.

Secondly, it is important to provide a list of any additional potentially occurring bird SCC within the defined bird-specific PAOI that are not already indicated by the screening tool report to occur within the proposed development footprint/PAOI. The impact analysis must consider the potential impacts from the proposed development on these additional SCC in the PAOI. See 9.3.6 Researching and presenting data for expected SCC for further guidance in this regard.

10.3.4 Field survey considerations

10.3.4.1 General

Sampling during fieldwork surveys must always take the following into consideration:
• Location of sample sites – a representative number of sample sites should be placed subjectively across all major habitat types within the PAOI in order to maximise the detection of SCC and assess the habitat quality for potentially occurring SCC. Sample sites must be placed far enough apart (at least 250 m) to avoid unnecessary duplication of records.
• Disturbance at breeding/roosting sites – it is vitally important that the specialist upholds the strictest ethical behaviour at nesting or roosting sites of birds, especially for SCC. Overzealous attempts to photograph birds at the nest could result in lower nesting success rate, predation of eggs or chicks due to parental absence or even nest abandonment. If a nest is located, the specialist must make an attempt to identify the species, obtain a record photograph and locality coordinates, and then withdraw sampling efforts from the general area (50–100 m should be sufficient).

10.3.4.2 Fieldwork timing and seasonality

In order to optimise species detection and adequately assess habitat suitability for SCC, avifaunal surveys should wherever possible be scheduled to coincide with periods of high bird activity and visibility. The most important of these periods is the onset of the breeding season when most birds are displaying and thus most vocal and visible. This is particularly important for detecting cryptic species that are difficult to locate at other times of the year, or species that are difficult to identify when not vocal (e.g. some larks and pipits), or species that are difficult to identify in non-breeding plumage (e.g. bishops and widowbirds). While breeding season for many species in the summer rainfall region of South Africa commences in spring and early summer (September to November), the main breeding season for many species in the winter rainfall region is March to September. Another important survey period is late summer/autumn (February to April), when birds are still in breeding plumage and migrants are congregating in large numbers for the northward migration. Many raptors are considered SCC and a large percentage of larger raptors (such as Martial and Tawny Eagles) breed in the drier months and may be more visible during these periods.

If project timing only allows for a single survey outside of the optimal periods described above, then this needs to be sufficiently justified, e.g. sites that are sufficiently degraded to make it unlikely that SCC are present, and the specialist needs to demonstrate sufficient experience in order to be able to adequately assess habitat suitability for SCC.

Fieldwork timing should be guided by the optimal survey times for key SCC potentially occurring in the PAOI. Where these times do not coincide with breeding seasons of most other birds, then targeted surveys for SCC should be

71 http://sabap2.birdmap.africa/
72 http://cwac.birdmap.africa/
73 http://car.birdmap.africa/
74 http://birp.adu.org.za/
75 https://www.inaturalist.org
conducted in addition to at least one survey during optimal times for most other species.

10.3.4.3 Sampling method overview

The primary focus of the specialist survey should be the detection of SCC and assessment of potential occurrence of SCC. This also includes significant gatherings of birds, such as at roosts, breeding colonies or waterbodies.

It is recommended that well-established, repeatable survey methods are applied to collect avifaunal data. Given the time constraints present with most EIA projects, methods that maximise data collection and probability of detecting SCC in a short period of time are preferable. In most instances a combination of survey methods will be required, with transects or point counts supplemented with specific survey methods that target specific SCC. Table 10.7 provides an indication of which survey methods might be applicable for different groups of birds and these survey methods are briefly described below.

10.3.4.4 Transects and point counts

Surveys can be undertaken along predefined transects or at specific points, or a combination of both. These are not the only available methods but have been shown to be particularly efficient in tropical conditions over relatively short time periods (O’Dea et al., 2004; Cavarzere et al., 2012).

Walked, linear transects are a useful survey method to detect small SCC in open habitats. Specialists should record SCC within a fixed distance from the transect (e.g. Leddy et al., 1999) and then estimate their density (birds per km²) or an index of kilometic abundance. The probability of detection is not taken into account with this approach and comparisons across habitats will therefore be problematic. All the major habitat types present, and that may contain SCC, should be sampled. Circular transects should be avoided to minimise the likelihood of duplication. The start and end times of the transect should be recorded, as well as the track (using a GPS). Abundance of each SCC should be recorded and presented for each transect.

Following Buckland et al. (1993), at each point sample the number of bird SCC seen or heard within a 50 m radius is recorded, as well as their respective abundance values. The 50 m radius is used as a guideline only and may be deviated from. For example, in open areas such as grassland a 100 m radius will be more suitable. However, radius value should remain the same for a particular survey of a PAOI to allow for comparisons between habitat types. Each point count lasts 10 minutes (Sutherland et al., 2004) but the period will depend on the structure of the habitat and the general bird richness of the area (areas with a high general richness will take longer to sample). To maximise the independence of observations, points must be positioned at least 250 m apart (Hertzog et al., 2016). At least ten points per habitat type is recommended. The location (geographic coordinates) of all points must be recorded. Fieldwork should be focussed on the first three to four and last two hours of the day to maximise species detection. Data should be recorded and presented in an appendix to the specialist report as the abundance of each SCC from each point count (e.g. Table 10.8).

<table>
<thead>
<tr>
<th>Avifauna groups</th>
<th>Transects or point counts</th>
<th>Vantage point counts</th>
<th>Acoustic surveys</th>
<th>Road counts</th>
<th>Raptor surveys</th>
<th>Nocturnal surveys</th>
<th>Camera traps</th>
<th>Waterbird surveys</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passerines and other small birds</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raptors</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large birds (e.g. bustards, korhaans and cranes)</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soaring birds</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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<td>Cryptic species</td>
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<td></td>
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<td>x</td>
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<tr>
<td>Nocturnal species</td>
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<td></td>
<td></td>
<td></td>
<td>x</td>
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<tr>
<td>Waterbirds</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

TABLE 10.8.—Example of presentation of point count raw data.

<table>
<thead>
<tr>
<th>Species</th>
<th>Point count No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>wb01</td>
</tr>
<tr>
<td>SCC 1</td>
<td>1</td>
</tr>
<tr>
<td>SCC 2</td>
<td>1</td>
</tr>
<tr>
<td>SCC 3</td>
<td></td>
</tr>
<tr>
<td>SCC 4</td>
<td>2</td>
</tr>
</tbody>
</table>
10.3.4.5 Vantage point counts

This method involves sitting at a suitable vantage point overlooking habitat likely to be used by target species and recording all observations for a set time period. The method is particularly useful for surveying foraging raptors, especially between 09:00 and 11:00 when raptors use thermals to soar up to a suitable height for foraging and are then easily observed and counted. The method can also be used for surveying large migrating birds such as storks and raptors, which often follow prominent landmarks such as high ridges where they utilise the uplift provided by these topographical features.

10.3.4.6 Road counts

Many large terrestrial birds (such as bustards, korhaans and cranes) have extensive areas over which they forage and are difficult to detect without covering areas beyond the boundary of a typical PAOI. If suitable habitat for these species exists within the PAOI and surrounding properties, the methodology employed by CAR counts can be used (Young et al., 2003). This involves observers driving slowly along roads in the PAOI and searching for the target species. This technique can be combined with the vantage point count method. As many roads as possible within and adjacent to the PAOI should be surveyed.

10.3.4.7 Raptor surveys

Dedicated raptor surveys could be important for certain projects, for example transmission lines and energy infrastructure. Existing raptor survey techniques can be consulted, e.g. Malan (2009), but can also include aerial surveys of eagles and vultures using light aircraft and helicopters, use of telescopes to survey cliffs for nests, evening counts of cranes) have extensive areas over which they forage and are difficult to detect without covering areas beyond the boundary of a typical PAOI. If suitable habitat for these species exists within the PAOI and surrounding properties, the methodology employed by CAR counts can be used (Young et al., 2003). This involves observers driving slowly along roads in the PAOI and searching for the target species. This technique can be combined with the vantage point count method. As many roads as possible within and adjacent to the PAOI should be surveyed.

10.3.4.8 Nocturnal bird surveys

Nocturnal birds such as owls and nightjars are rarely encountered during diurnal surveys, unless flushed from daytime roosts. Surveys of these species need to be undertaken at night in order for them to be adequately sampled. However, unless specific nocturnal SCC are potentially present, these surveys should not be considered mandatory for all projects. The method involves driving slowly on roads within the PAOI once it is totally dark and scanning for any birds perched in the road or on roadside perches such as fence posts, using high powered spotlights. Ideally, the survey should be done by two observers, one driving and watching for birds in the road and the other scanning the adjacent habitat with a spotlight or torch. Regular stops should be made to listen for calling nocturnal birds; these stops can also be used to play vocalisations of target species in order to elicit responses from birds that may not be calling. Where possible, all habitats present within the PAOI should be sampled in this manner. While it is possible to do these surveys on foot, it is not as effective as vehicle-based surveys, which cover far more ground than foot surveys in the limited time available.

10.3.4.9 Acoustic surveys

- Active recording (point recording) – this is a useful method to supplement the data obtained from other survey technique/s. Two to three stationary dawn chorus recordings lasting 15 minutes each can be performed each morning, starting with the first vocalisations of diurnal bird species. The recommended minimum distance between recording stations should be at least 250 m (Hertzog et al., 2016) and different stations should be sampled each morning. The coordinates of each recording station must be recorded. Recordings should be made using a directional microphone, which should be pointed in the direction of the greatest vocal activity. The microphone must then be rotated by 90° every minute until two full rotations are completed after eight minutes. The microphone direction can then be changed at will for the remaining seven minutes in response to current bird activity.
- Passive recording – this is another useful way to detect cryptic species, most of which have characteristic calls and can easily be sampled without being seen if birds are vocal, such as at the onset of the breeding season. The method is similar to point recording, but the sound recording equipment is not manually rotated but merely positioned at the sample point and records all sounds passively for a pre-defined period of time (usually at least 30 minutes). If several passive recording devices are being used simultaneously then these should be at least 250 m apart. The benefit of using this method it that point count surveys can take place concurrently, albeit not within 250 m of the recording device.
- Call play-backs – if the specialist believes that a habitat is likely to have certain cryptic species but these are not visible nor vocal, then one possible method is to play the calls of these species and elicit a response from the birds which enables positive identification, such as the bird calling back or even coming into view. While this method can be effective, it can also be disruptive to the SCC, especially in the breeding season, and these techniques should be used sparingly and only until identification is confirmed. This method should preferably not be used unless all other methods have been attempted and confirmation of the presence of a particular SCC is essential.

10.3.4.10 Camera traps

Motion-detecting camera traps can be used to confirm the presence of certain cryptic species, for example the first confirmed breeding record for White-winged Flufftail (Sarothrura ayresi) in the Southern Hemisphere was recently recorded by BirdLife South Africa near Dullstroom, Mpumalanga. Large birds such as bustards and raptors may also be...
observed in this manner (Table 10.7), either through intentional camera trapping or from the mammal survey camera traps. Details on how to use motion-detecting cameras can be found in Wearn and Glover-Kapfer (2017).

10.3.4.11 Waterbird counts

It is important for the specialist to assess waterbird populations in wetlands found within the PAOI, whether the waterbirds are considered SCC or not. South Africa is a Party to the Ramsar Convention on Wetlands of International Importance, Convention on the Conservation of Migratory Species of Wild Animals (CMS) and Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) and, as such, has committed to conserving wetlands as habitat for waterbirds. Total counts are suggested, with the use of a spotting scope and tripod to count birds. Additional information is available in Taylor et al. (1999).

10.3.4.12 Ad hoc sampling

This refers to the recording of incidental observations when travelling between sample sites within the PAOI. The method is only supplementary to other methods described above but can often be the only observation of an SCC during a rapid field survey.

10.3.4.13 Data collection

The following information should be collected during fieldwork:
- All observations of SCC – including verifiable photographs/sound recordings of each, wherever possible; however, the specialist should not attempt to photograph these species at nests or disturb them with excessive use of song playback.
- Coordinates of all sample sites must be recorded.
- General weather conditions.
- Raw data according to sample method used (e.g. point counts).
- Photographs of all avian habitats within the PAOI must be taken.
- Notes of current and potential threats to avifauna (particularly SCC) and avifaunal habitats should be made for inclusion in the report.
- Notes of habitat suitability for SCC should be made for inclusion in the report and be used for updating the list of potentially occurring SCC, with specific reference to:
  - breeding (nest sites, particularly of raptors, must be actively searched for during the avifaunal study and the coordinates recorded);
  - congregations; and
  - foraging.

10.3.5 Reporting requirements

The following bird-specific reporting requirements are required in addition to the general reporting requirements described in 9.3 Data interpretation, presentation and reporting.

In some cases, sensitive areas (e.g. breeding sites of Critically Endangered species) might be at risk if the location is revealed to the public (e.g. through poaching or disturbance). The specialist should therefore use their discretion before revealing these details (for example, by masking or buffering the precise location).

10.3.5.1 SCC observations

- The list of potentially occurring SCC that was produced in the desktop phase should be updated to reflect more accurate assessments of occurrence and likelihood of occurrence based on fieldwork observations of habitat suitability.
- Each SCC, as well as species occurring in nationally or globally significant congregations (such as certain waterbirds, Barn Swallows, or Lesser Kestrels), that have been confirmed to occur in the PAOI during fieldwork must be discussed. This should include a summary of the conservation status, distribution and current threats of each species in order to provide context for the threats and impacts within the PAOI.
- Information regarding where SCC individuals were located in the PAOI, associated habitats and approximate densities should be provided.
- Potentially occurring SCC that were not located during fieldwork should be discussed appropriately.

10.3.5.2 Presence of alien and invasive species

The presence of alien and invasive species (as listed in NEMBA’s Alien and Invasive Species Lists77) observed within the PAOI must be listed, including approximate densities of each species and their apparent impact on the biodiversity within the PAOI.

10.3.5.3 Detection likelihood of SCC

Additional taxon-specific specialist studies – if a potentially occurring SCC could not be located due to survey timing, such as species that are only present in winter when most surveys take place in summer, then additional surveys at an optimal time for locating these SCC should be recommended. Alternatively, the precautionary principle must be applied, and it must be assumed that the SCC is present until such time that appropriate fieldwork can be conducted to confirm its absence.

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77 Published in Government Notice No. 864 in Government Gazette 40166 of 29 July 2016. Note that on 1 March 2021, these lists will be repealed and replaced by the Alien and Invasive Species Lists published in Government Notice No. 1003 in Government Gazette 43726 of 18 September 2020.
10.3.6 Buffers for SCC

Buffers between a proposed activity and a species’ attribute or impact receptor (e.g. breeding site, roost, foraging area or other key habitat) may be necessary to avoid or minimise impacts of a development. A number of factors influence appropriate buffer distances, including the nature, timing and intensity of the activity, as well as the characteristics of a species affected and receiving environment. Buffer distances must therefore be determined on a case-by-case basis and reasoned opinion provided that draws on scientific literature, expert opinion, and an evaluation of the activity, site and species affected. Table 10.9 summarises the factors that should be considered when determining an appropriate buffer. Note that the sizes of recommended buffers provided in Table 10.9 are intended to give an indication of the likely range of expected values, the final recommended buffer size may differ significantly from these values.

10.3.7 Data dissemination

- Threatened species databases of provincial conservation authorities (where relevant) – e.g. MTPA has a threatened species database which is used for queries from EIA consultants, as well as updates to the Mpumalanga Biodiversity Sector Plan.
- It is recommended to share observation data on bird SCC by registering for relevant causes (e.g. BirdLife South Africa, Southern Ground Hornbill, Cape Parrot etc.) and logging data using the BirdLasser App.78
- iNaturalist.

78 https://www.birdlasser.com/about/conservation/causes
### TABLE 10.9.—Factors determining appropriate buffers for bird SCC (developed by BirdLife South Africa).

<table>
<thead>
<tr>
<th>Species group</th>
<th>Attributes/impact receptor</th>
<th>Type of impact</th>
<th>Factors to consider when determining buffer size</th>
<th>Likely buffer size</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCC at risk of collision/electrocution/burning from linear and/or energy infrastructure (e.g. vultures, raptors, cranes, bustards).</td>
<td>• Nesting/breeding sites. • Roosts, colonies, and other congregatory areas. • Foraging areas. • Flight paths. • Wetlands, cliffs and slopes.</td>
<td>Fatalities or injury as a result of collision/electrocution/burning. For example: • Renewable energy (wind turbines, concentrated solar power tower facilities). • Roads and railway lines. • Utility and service power lines. • Suspended wire strands or cables. • Fences.</td>
<td>Infrastructure characteristics: • Type and design of infrastructure. • Height. • Layout (e.g. relative to attributes). Species characteristics: • Ability to perceive risk. • Avoidance potential. • Site fidelity. • Size of home range/dispersal distance. • Flight height. Site characteristics: • Topography. • Location of attributes within landscape. • Exposure (e.g. number of individuals or passage rates).</td>
<td>• Typically, larger than disturbance buffers. • Buffers for energy infrastructure are strongly influenced by home range, thus species with large home ranges (e.g. vultures and eagles) require buffers several kilometres wide. • Wetlands, cliffs and slopes buffers can range 100–1000 m or more. • Smaller buffers may be appropriate for roads and railways. Consult BirdLife South Africa and EWT for up-to-date guidance on wind and powerline buffers.</td>
</tr>
<tr>
<td>SCC sensitive to disturbance (e.g. breeding raptors and large birds such as bustards, cranes and waterbirds).</td>
<td>• Nesting/breeding sites. • Roosts, colonies, and other congregatory areas. • Foraging areas.</td>
<td>Noise/visual disturbance that could cause abandonment, avoidance, reduced densities, fitness and/or breeding success. For example: High intensity • Mining and quarrying. • Drilling, loud noise, vibration, seismic blasting. • Commercial and industrial development. • Removal of vegetation or soil. • Forestry plantations. Low intensity • Annual and perennial crops. • Forestry plantations. • Aquaculture. • Renewable energy. • Housing and urban areas. • Tourism and recreational activities.</td>
<td>Nature of disturbance: • E.g. blasting, seismic surveys, visual (habitat alterations), vehicle traffic, pedestrians and pets. • Degree of disturbance is influenced by frequency, level and duration of disturbance (high intensity requires larger buffers). • High intensity = frequent, loud (i.e. more than 10 dB above ambient levels), and/or long term (years) and requires larger buffers than lower levels of disturbance. • Low = quiet (i.e. below or near ambient levels), infrequent, short duration (hours), small area. • Timing/season of disturbance. (Seasonal buffers may be proposed to minimise impacts during breeding season.) Species characteristics: • Species natural history and tolerance of human activities. • Alert distances (i.e. the distance at which a bird exposed to risk exhibits alert behaviour) and flight/flush initiation distance (distance at which a bird initiates escape behaviour). Existing data can be supplemented with experimental data and expert opinion. Site characteristics: • Type of attribute(s) (e.g. nesting vs non-nesting) and habitat quality. Current level of disturbance (e.g. urban, rural, wilderness). Individuals in urban environments may be more...</td>
<td>...</td>
</tr>
</tbody>
</table>
### TABLE 10.9.—Factors determining appropriate buffers for bird SCC (developed by BirdLife South Africa) (continued).

<table>
<thead>
<tr>
<th>Species group</th>
<th>Attributes/impact receptor</th>
<th>Type of impact</th>
<th>Factors to consider when determining buffer size</th>
<th>Likely buffer size</th>
</tr>
</thead>
</table>
| SCC dependent on unique and/or sensitive habitats for part of their lifecycle (e.g. grassland, wetland and forest specialists). | Unique habitat feature (e.g. wetland, forest). | Activities that could lead to edge effects/habitat degradation. For example:  
- Annual and perennial crops.  
- Forestry plantations.  
- Aquaculture.  
- Energy production and mining.  
- Abstraction and alteration of surface water and other ecosystem modification.  
- Mining and quarrying.  
- Residential and commercial development. | Buffers must be sufficient to ensure the integrity of the habitat and that ecological connectivity is maintained. | Consult relevant habitat specialists, ecosystem/provincial guidelines and biodiversity sector plans. |
10.4 Mammals

10.4.1 Species included in the screening tool

The screening tool currently includes a list of 37 mammal SCC, which are arranged according to a particular group based on body size and general habits (Table 10.10). All possible methods for the detection of expected SCC should be applied by the specialist for 'high' and 'very high' sensitivities defined by the screening tool. Although medium sensitivity, as evaluated by the screening tool, does not indicate the actual known presence of SCC within the proposed development footprint/PAOI, it requires verification through comprehensive fieldwork if the SSV indicates the presence of suitable habitat.

10.4.2 Mammal-specific guidelines for certain developments

For wind-energy projects, the existing guidelines for bat surveys should be followed by the specialist when assessing such projects, which require carefully designed scoping, pre-construction and operational monitoring surveys. Ideally, trained bat specialists⁷⁹ should perform such surveys due to the technical nature thereof. The specialist should follow the guidelines and monitoring protocols provided by the South African Bat Assessment Association (SABAA⁸⁰). There are currently four guideline documents available:

2. South African Good Practice Guidelines for Operational Monitoring for Bats at Wind Energy Facilities: 2nd Edition (Aronson et al., 2020);
3. South African Bat Fatality Threshold Guidelines: 2nd Edition (MacEwan et al., 2018); and

10.4.3 Relevance of mammal SCC

Because several mammal SCC are introduced to areas outside of their historical distribution or are farmed/ranched in South Africa (e.g. buffalo, white rhinoceros, giraffe), it is important to discuss the relevance of these populations to the conservation of the species. Guidance for determining the relevance of populations of these mammal SCC is provided in Table 10.11. The specialist is required to provide justification for their decision to include/exclude an SCC in the specialist report.

10.4.4 Desktop study – Expected SCC

The screening tool report provides a complete list of all confirmed occurring and potentially occurring mammal SCC within the proposed development footprint/PAOI. Where necessary, this list should firstly be updated and confirmed against all very recently published literature sources, information from provincial management authorities, and online resources that are constantly updated with new observations, specifically:

- Virtual Museum of African Mammals (MammalMAP, 2020)⁸²;
- iNaturalist⁸³; and

The above procedure will ensure that any very recent and new observations of SCC within the proposed development footprint/PAOI not already captured by the screening tool can be taken into account during the impact analysis. Caution should be exercised regarding the level of confidence in identification of small mammals from online sources based solely on photographs, as certain small mammals are very

---

<table>
<thead>
<tr>
<th>Group</th>
<th>Species</th>
<th>Common name</th>
<th>LDP⁸¹</th>
<th>IUCN status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic carnivores</td>
<td>Hydrictis maculicollis</td>
<td>Spotted-necked otter</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Arboreal herbivores</td>
<td>Dendrohyrax arboreus</td>
<td>Tree hyrax</td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Arboreal primates</td>
<td>Cercopithecus albogularis labiatus</td>
<td>Samango monkey</td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Arboreal primates</td>
<td>Cercopithecus albogularis schwarzi</td>
<td>Schwarz’s white-collared monkey</td>
<td>EN</td>
<td></td>
</tr>
</tbody>
</table>

---

⁷⁹ For a list of recognised accredited specialists, see http://www.sabaa.org.za/pages/2_batspecialists.html
⁸⁰ http://www.sabaa.org.za/
⁸¹ Low detection probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities
⁸² http://vmus.adu.org.za
⁸³ https://www.inaturalist.org
### TABLE 10.10.—Mammal SCC included in the screening tool (continued).

<table>
<thead>
<tr>
<th>Group</th>
<th>Species</th>
<th>Common name</th>
<th>LDP&lt;sup&gt;1&lt;/sup&gt;</th>
<th>IUCN status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burrowing mammals</td>
<td>Smutsia temminckii</td>
<td>Temminck’s ground pangolin</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Large carnivores</td>
<td>Acinonyx jubatus</td>
<td>Cheetah</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Large carnivores</td>
<td>Lycaon pictus</td>
<td>African wild dog</td>
<td></td>
<td>EN</td>
</tr>
<tr>
<td>Large carnivores</td>
<td>Panthera leo</td>
<td>Lion</td>
<td></td>
<td>LC</td>
</tr>
<tr>
<td>Large herbivores</td>
<td>Equus zebra hartmannae</td>
<td>Hartmann’s mountain zebra</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Large herbivores</td>
<td>Hippopotamus amphibius</td>
<td>Hippopotamus</td>
<td></td>
<td>LC</td>
</tr>
<tr>
<td>Large herbivores</td>
<td>Loxodonta africana</td>
<td>African elephant</td>
<td></td>
<td>LC</td>
</tr>
<tr>
<td>Small carnivores</td>
<td>Felis nigripes</td>
<td>Black-footed cat</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Small flying mammals</td>
<td>Cloeotis percival</td>
<td>Short-eared trident bat</td>
<td></td>
<td>EN</td>
</tr>
<tr>
<td>Small flying mammals</td>
<td>Laephotis namibensis</td>
<td>Namibian long-eared bat</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Small flying mammals</td>
<td>Laephotis wintoni</td>
<td>De Winton’s long-eared bat</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Small flying mammals</td>
<td>Rhinolophus cohenae</td>
<td>Cohen’s horseshoe bat</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Small flying mammals</td>
<td>Rhinolophus swinnyi</td>
<td>Swinny’s horseshoe bat</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Small flying mammals</td>
<td>Tadarida ventralis</td>
<td>Giant free-tailed bat</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Small herbivores</td>
<td>Bunolagus monticularis</td>
<td>Riverine rabbit</td>
<td></td>
<td>CR</td>
</tr>
<tr>
<td>Small mammals</td>
<td>Crocidura maquassiensis</td>
<td>Maquassie musk shrew</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Small mammals</td>
<td>Dasymys capensis</td>
<td>Cape marsh rat</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Small mammals</td>
<td>Dasymys robertii</td>
<td>Robert’s marsh rat</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Small mammals</td>
<td>Myosorex cafer</td>
<td>Dark-footed forest shrew</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Small mammals</td>
<td>Myosorex sclateri</td>
<td>Sclater’s forest shrew</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Small mammals</td>
<td>Myosorex longicaudatus</td>
<td>Long-tailed forest shrew</td>
<td>X</td>
<td>EN</td>
</tr>
<tr>
<td>Small mammals</td>
<td>Myosorex sclateri</td>
<td>Sclater’s forest shrew</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Small mammals</td>
<td>Mystromys albicaudatus</td>
<td>White-tailed rat</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Small–medium-sized herbivores</td>
<td>Nesotragus moschatus zuluensis</td>
<td>Suni</td>
<td></td>
<td>EN</td>
</tr>
<tr>
<td>Small–medium-sized herbivores</td>
<td>Ourebia ourebi ourebi</td>
<td>Oribi</td>
<td></td>
<td>EN</td>
</tr>
<tr>
<td>Small–medium-sized herbivores</td>
<td>Philantomba monticola</td>
<td>Blue duiker</td>
<td></td>
<td>VU</td>
</tr>
<tr>
<td>Small–medium-sized herbivores</td>
<td>Redunca fulvorufula fulvorufula</td>
<td>Southern mountain reedbuck</td>
<td></td>
<td>EN</td>
</tr>
<tr>
<td>Fossorial small mammals</td>
<td>Amblysomus marleyi</td>
<td>Marley’s golden mole</td>
<td>X</td>
<td>EN</td>
</tr>
<tr>
<td>Fossorial small mammals</td>
<td>Amblysomus robustus</td>
<td>Robust golden mole</td>
<td>X</td>
<td>VU</td>
</tr>
<tr>
<td>Fossorial small mammals</td>
<td>Chlorotalpa duthieae</td>
<td>Duthie’s golden mole</td>
<td>X</td>
<td>VU</td>
</tr>
<tr>
<td>Fossorial small mammals</td>
<td>Chrysospalax villosus</td>
<td>Rough-haired golden mole</td>
<td>X</td>
<td>VU</td>
</tr>
<tr>
<td>Fossorial small mammals</td>
<td>Chrysospalax trevelyani</td>
<td>Giant golden mole</td>
<td>X</td>
<td>EN</td>
</tr>
<tr>
<td>Fossorial small mammals</td>
<td>Cryptochloris wintoni</td>
<td>De Winton’s golden mole</td>
<td>X</td>
<td>CR</td>
</tr>
<tr>
<td>Fossorial small mammals</td>
<td>Cryptochloris zyli</td>
<td>Van Zyl’s golden mole</td>
<td>X</td>
<td>EN</td>
</tr>
<tr>
<td>Fossorial small mammals</td>
<td>Eremitalpa granti granti</td>
<td>Grant’s golden mole</td>
<td>X</td>
<td>VU</td>
</tr>
<tr>
<td>Fossorial small mammals</td>
<td>Neamblysomus gunning</td>
<td>Gunning’s golden mole</td>
<td>X</td>
<td>EN</td>
</tr>
<tr>
<td>Fossorial small mammals</td>
<td>Neamblysomus julianae</td>
<td>Juliana’s golden mole</td>
<td>X</td>
<td>EN</td>
</tr>
</tbody>
</table>

<sup>1</sup>Low detection probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities
difficult to identify without a comprehensive investigation of a collected specimen.

Secondly, it is important to provide a list of any additional potentially occurring mammal SCC within the defined mammal-specific PAOI that are not already indicated by the screening tool report as likely to occur within the proposed development footprint/PAOI. The impact analysis must also consider the potential impacts from the proposed development on these additional SCC in the PAOI. See 9.3.6 Researching and presenting data for expected SCC for further guidance in this regard.

### 10.4.5 Field survey considerations

Due to the varied habits and body sizes of mammal SCC, and the fact that a single survey method can be applied to several mammal groups, recommended field survey methods have been provided in Table 10.12 along with their applicability to particular mammal groups. Each of the survey methods are described in greater detail below. However, the specialists are required to review current literature in addition to the information presented below, in order to apply any newly developed or recommended methods, where applicable.

#### 10.4.5.1 Fieldwork timing and seasonality

Most mammal SCC are active throughout the year and therefore have few seasonal constraints. However, many golden mole species (see Table 10.10) can only be reliably detected during the warmer and/or wetter seasons. This is not only due to seasonal ecology of the species, but because displacement of soil during their subterranean activities, resulting in visible ‘runs’, remains observable for extended periods in moist soil. In dry soil these ‘runs’ collapse and are not easily detectable (refer to 9.3.7 Expected SCC with very low detection probabilities). For bat SCC, consideration must be given to the possibility of seasonal migration (e.g. cave-roosting species), and periods of torpor in the colder, drier months.

<table>
<thead>
<tr>
<th>Species or species groups</th>
<th>Description</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large carnivores</td>
<td>Introduced, outside area of historical distribution, ranched or farmed, not functioning as part of PAOI ecosystem. May persist in artificially inflated numbers due to feeding supplementation and/or intensive practices and will not exhibit usual home range/ecological behaviour. Species that have been introduced into areas outside of historical distribution and have fully integrated into the natural PAOI ecosystem are considered ‘feral’ or ‘alien’.</td>
<td>Highly unlikely to be relevant. Specialist advised to exclude presence of species as part of the impact analysis and SEI evaluation. If species are to remain within the PAOI post development, rare or high-value species should form part of the security management plan.</td>
</tr>
<tr>
<td>Large carnivores</td>
<td>Re-introduced, within area of historical distribution, ranched or farmed, possibly semi-free roaming but not fully functioning as part of PAOI ecosystem. May persist in artificially inflated numbers in modified habitat (i.e. intensive fencing) due to supplementation and/or intensive practices and will exhibit altered home range/ecological behaviour.</td>
<td>Potentially relevant but unlikely. Specialist advised to exclude presence of species as part of the impact analysis and SEI evaluation, unless it can be motivated otherwise. Species-specific national management plans will apply. Rare or high-value species should form part of the security management plan.</td>
</tr>
<tr>
<td>Large, medium and small SCC carnivores, mountain zebra, hippopotamus and elephant</td>
<td>Re-introduced, within area of historical distribution, supplemented/ranched/maintained although introduced population is functioning as part of PAOI ecosystem, persisting under the auspices of species-specific management plan. Species may occur in artificially inflated numbers due to supplementation and may exhibit some altered home range/ecological behaviour although not markedly so.</td>
<td>Most likely relevant but not always. Specialist advised to include presence of species as part of the impact analysis and SEI evaluation but will require some justification. Species should be considered within the framework of the EMP. Rare or high-value species may form part of the security management plan.</td>
</tr>
<tr>
<td>Large, medium and small SCC carnivores, mountain reedbuck, oribi, mountain zebra, hippopotamus and elephant</td>
<td>Naturally occurring SCC functioning as part of PAOI ecosystem.</td>
<td>Highly relevant. Specialist advised to include presence of species as part of the impact analysis and SEI evaluation. Species should be considered within the framework of the EMP. Rare or high-value species may form part of the security management plan.</td>
</tr>
</tbody>
</table>
Several mammal species/groups regularly vocalise in a species-specific manner, which can be used to detect their presence (e.g. a roaring lion). In particular, acoustic surveying for SCC that vocalise in a predictable manner (either spatially or temporally) greatly improves the probability of detection during rapid field surveys. This is specifically relevant for bat SCC that produce regular, species-specific echolocation sounds that can be easily detected, recorded and identified without the need for direct observation or capture. Consequently, acoustic surveys should not be used exclusively to evaluate the presence or absence of certain bat SCC, unless a call library has been developed for a particular area, which was based on verified identifications from voucher specimens.

The presence of insectivorous bats can be identified by their guano in day roosts, insect remains at night roosts, smudges on buildings or rock crevices and smell. Fruit bat presence can be determined through daytime visual assessments, the presence of spit-outs below fruiting trees and night-time audible calls by male bats.

### TABLE 10.12.—Recommended survey methods for mammal SCC.

<table>
<thead>
<tr>
<th>Survey method</th>
<th>Mammal groups</th>
<th>Additional considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acoustic surveys</td>
<td>Small flying mammals</td>
<td>Passive (remote deployed devices) or active survey options.</td>
</tr>
<tr>
<td></td>
<td>Arboreal primates</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Large carnivores</td>
<td></td>
</tr>
<tr>
<td>Mist netting or harp traps</td>
<td>Small flying mammals</td>
<td>Licence required to acquire mist nets. Laborious to set up and accompanied by many ethical and safety considerations. Recommended only if conducted by trained professionals.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Camera trapping</td>
<td>Aquatic carnivores</td>
<td>Traps can be baited (to attract target groups) or unbaited.</td>
</tr>
<tr>
<td></td>
<td>Arboreal herbivores</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Arboreal primates</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Burrowing mammals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Large carnivores</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Large herbivores</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small carnivores</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small herbivores</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small flying mammals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small– to medium-sized herbivores</td>
<td></td>
</tr>
<tr>
<td>Spoor and other signs</td>
<td>Aquatic carnivores</td>
<td>Includes footprints, scats, quills, hair, burrows, runs (moles), scrapings and rubbing posts.</td>
</tr>
<tr>
<td></td>
<td>Arboreal primates</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Burrowing mammals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Large carnivores</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Large herbivores</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small carnivores</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small herbivores</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small flying mammals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Small– to medium-sized herbivores</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fossorial small mammals</td>
<td></td>
</tr>
<tr>
<td>Direct visual observation</td>
<td>All</td>
<td>Dead or alive, diurnal or nocturnal.</td>
</tr>
<tr>
<td>Community and landowner</td>
<td>All</td>
<td>Evidence (photographs, skins etc.) should be acquired to corroborate records.</td>
</tr>
<tr>
<td>interactions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scat content identification</td>
<td>Potentially all except small flying mammals</td>
<td>Hair and jaw bones in scat can be used to identify prey items.</td>
</tr>
<tr>
<td>Small mammal trapping (baited)</td>
<td>Small mammals</td>
<td>Ants and other invertebrates attracted to bait in turn attract insectivores (shrews).</td>
</tr>
<tr>
<td>Pitfall and funnel trapping</td>
<td>Small mammals</td>
<td>Mostly shrews are trapped, but at low densities. Not recommended due to intensive labour required for setup and low trap success. Usually only a supplementary method during herpetofauna/invertebrate trapping.</td>
</tr>
</tbody>
</table>

85 It is, however, important to note that not all bat SCC in South Africa are identifiable via their calls. *Laephotes* species are likely to be confused with *Vespertilionidae* species and there is not a known call for *Laephotes wintoni* (Monadjem et al., 2010). Furthermore, recent studies have shown variations in the calls of certain *Rhinolophus* species making them difficult to identify on the basis of their calls alone (see Fawcett et al., 2015; Mutumi et al., 2016; Jacobs et al., 2017; and Maluleke et al., 2017). Consequently, acoustic surveys should not be used exclusively to evaluate the presence or absence of certain bat SCC, unless a call library has been developed for a particular area, which was based on verified identifications from voucher specimens.

86 The presence of insectivorous bats can be identified by their guano in day roosts, insect remains at night roosts, smudges on buildings or rock crevices and smell. Fruit bat presence can be determined through daytime visual assessments, the presence of spit-outs below fruiting trees and night-time audible calls by male bats.
• Active acoustic surveys – throughout the day, hand-held devices capable of recording sounds can be used to record vocalising mammal SCC in an ad hoc manner. This is particularly useful for vocalising primates. During nocturnal searches, usually involving driving slowly in a vehicle while spotlighting (see below), activated bat detectors\(^7\) can detect and record echolocating bats flying nearby. In all cases, audio recordings of an SCC should be accompanied by associated data such as the date, time and location.

• Passive acoustic surveys – automated sound recorders allow the recording of environmental audio at pre-programmed times and durations without the necessity for an observer to be present. Certain sophisticated devices are capable of recording only when a pre-set sound threshold is reached, e.g. when an animal calls nearby. Devices should be deployed in areas where SCC are expected to vocalise (e.g. cave entrances for bats or sleeping trees for primates).

10.4.5.3 Mist nets and harp traps

The use of mist nets and harp traps is an important method for the collection of bat specimens and these devices are regularly used for the monitoring of bats as reservoirs for zoonotic viruses, which requires the capture of individuals for acquisition of blood samples. Basic guidance on the operation of this equipment is provided in Monadjem et al. (2010). Trapping is laborious, time-consuming and has significant ethical and safety considerations but is often the only reliable method in certain situations for the detection of bat SCC. Trapped individuals can be identified with the aid of Monadjem et al. (2010) or the African Chiroptera Report (https://africanbats.org/publications/african-chiroptera-report/), which includes all known keys to African bat species. Trapping should be carried out if the presence of bat SCC is likely and if alternative sampling methods are unlikely to detect the target SCC. Trapping should only be carried out by a specialist that has:

• requisite inoculations;
• received required training (courses are available in South Africa);
• appropriate permits and ethical clearance in place; and
• demonstrated prior, relevant experience in mist-netting and/or harp trapping procedures\(^8\).

For species that cannot be identified reliably without comprehensive examination of a specimen, at least one exemplar per species must be euthanized and collected in accordance with best practice. Such specimen samples and any mortalities due to trapping must be preserved and deposited at a museum or other public facility.

Appropriate health and safety considerations are required for the trapping and handling of bats, which can be found at http://www.africanbats.org/publications/resources/.

10.4.5.4 Camera trapping

The use of camera trapping (Figure 10.8) has long been considered as a valuable ecological census tool in the field of mammalogy (Rowcliffe and Carbone, 2008; Tobler et al., 2008; McCallum, 2012). Numerous studies have been conducted exploring best practice, minimum number of trap nights\(^9\) and target species/habitats (Hanekom and Randall, 2015; Power et al., 2019; Power and Olivier, 2019), and it is recommended that the specialist consults these references prior to conducting camera trap surveys. An initial reconnaissance of the PAOI should be conducted prior to camera-trap deployment to select optimal camera-trap locations based on the following guidelines:

• Mammal walkways/areas of frequent use – the camera should be placed in an area subject to frequent use by mammals such as drainage lines, burrowing systems, termitaria, isolated burrows, natural carcasses, rubbish dumps etc.

• Naturally occurring attractant – the camera could be deployed adjacent to local mammal attractants such as water holes.

• Height – the camera should be placed out of reach of carnivores and the camera should be handled, programmed and deployed before handling or application of baits (see below) to prevent contamination and increased likelihood of interference by predators. In addition, the placement height should be aimed at the shoulder heights of the most important target SCC.

• Camera traps should have a trigger speed of less than 0.5 seconds and should ideally be set to record video footage in order to extract representative identification photographs from the recording, which provides the greatest chance of obtaining accurate identification of a species\(^9\). Still images are satisfactory if there is a need to conserve battery life and memory on storage devices.

• Baiting the camera traps reduces the survey duration for both herbivores and carnivores due to the presence of an attractant. The recommended bait to use is fish or fish remains\(^9\), as it can be easily acquired locally and provides a strong smell which is attractive for a wide range of species. Tinned fish (‘sardines or pilchards’) may also be used.

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\(^7\) Devices capable of recording ultrasonic echolocation sounds.

\(^8\) Qualified bat specialists can be contacted via http://www.sabaa.org.za/pages/2_batspecialists.html

\(^9\) ‘Trap nights’ are calculated as the number of nights that a camera is deployed and actively recording data, summed across each of the deployed camera units, e.g. five cameras, each deployed and active for seven nights, will result in a survey of 35 trap nights.

\(^9\) Video footage is superior to still images as more angles of recorded species are captured, allowing for enhanced likelihood of positive identification. Still images can be cropped out of video recordings for the purposes of reporting.

\(^9\) Precautions must be taken not to use baits that may easily spread diseases.
It must be accepted that camera traps may not be applicable for some areas, despite being zoologically optimal for the survey. These extenuating circumstances may apply to areas such as military installations, areas of national interest and areas that exhibit a high risk of camera loss through damage or theft. Adequate motivation must be provided by the specialist if cameras were not deployed despite adequate/optimal survey conditions.

10.4.5.5 Spoor and other signs

Spoor tracking is considered to be the world’s oldest science, enabling detailed sampling of mammalian species without the need for trapping or direct observation (see Gutteridge and Liebenberg, 2013). Mammal scats (defecations) are identifiable using a number of field guides such as Stuart and Stuart (2000). All spoor and other signs, including footprints, scats, den sites, burrows, hairs, scrapings and diggings can be recorded and documented as evidence. Spoor observation is one of the most effective survey methods for detecting carnivore species (Thorn et al., 2010).

Observations of spoor and other signs to detect SCC should take place continuously within the PAOI during general fieldwork, but specifically focused at carefully chosen locations (e.g. roads or waterholes) with highly trackable substrates. Baited stations can also be prepared where the ground is swept clean and examined for spoor daily. The optimal time of day for spoor tracking is usually at first light.
It is important to exercise caution when interpreting data obtained through interviews that cannot be reliably confirmed through appropriate evidence (photos, skins etc.).

To maximise the chance of recording nocturnal mammals that were foraging during the previous night before substrate disturbances (such as wind and cars) decrease the ability of the observer to accurately identify the spoor. Furthermore, at this time the sun’s angle allows for optimal spoor detectability for the observer. All spoor of SCC must be photographed with an object for scale in the picture in order to aid with identification (Figure 10.9) and provide evidence. The location of spoor from SCC should be recorded with a GPS (or geo-tagged photo). Importantly, for cases where spoor quality is poor (e.g. loose sand) or where multiple species with very similar spoor cannot easily be distinguished, the specialist should indicate the degree of certainty of identification.

10.4.5.6 Landowner and local community interactions

In the South African context, the study of mammalogy is inextricably linked to the local landowners, local communities and their traditional hunters. This is due to the strong link between humans and the utilisation of the natural environment and the bush meat trade (as well as subsistence protein acquisition) that is axiomatic to the region. Local hunters and landowners often have an excellent knowledge of the home ranges, seasonality, habits and primary habitats of many mammal species and this information should be gathered from interviews and used to provide focus on the following issues concerning the mammalian SCC within the PAOI:

- The extent of the current impacts on the mammalian SCC within the PAOI (including poaching, human/wildlife conflict and utilisation).
- The attitudes of the landowners and local communities towards the mammalian SCC, including their awareness of conservation status or legislative protection of certain SCC.
- Additional useful information on the mammal SCC populations, including estimated population size, preferred habitats and seasonality.
- Using local assistants to conduct random surveying of communities, villagers/workers to assess frequency and extent of consumption of bush meat from SCC.
- Local markets (if any) observed as far as possible (especially on market days) in order to create a species list of consumed/traded mammal SCC. SCC acquired in the PAOI that appear in the markets should be recorded and their approximate locations of acquisition confirmed (if possible, via interview) in order to provide a context for the PAOI. At no point must any specialist solicit bush meat or pay communities to hunt a particular species.
- Public information acquisition campaigns, using questionnaires and posters placed at strategic locations.

10.4.5.7 Direct visual observation

Direct visual observation methods are varied but are all linked by the fact that mammal SCC are seen by the specialist and positively identified (where possible) to species level.

- Sightings – all mammal SCC observed within the PAOI during the sampling period are to be recorded. Records must include geographic coordinates, brief descriptions of surrounding habitat and any pertinent behaviour (e.g. mating).
- Diurnal and nocturnal drives – given that most studies make use of a vehicle, this technique is an essential tool for mammalian sampling, due to the large distances that can be rapidly covered and the fact that some SCC can be more closely approached from a vehicle than on foot. For night drives, high-powered spotlights (preferably with red spectrum filtered lenses to limit disturbance) should be used from the vehicle to illuminate nocturnal species.

It is important to exercise caution when interpreting data obtained through interviews that cannot be reliably confirmed through appropriate evidence (photos, skins etc.).
Binoculars (and cameras where possible) should be used to assist in the identification of distant individuals.

• Diurnal and nocturnal transects/meanders on foot – due to very poor access within certain areas of some PAOs (impassable terrain or construction areas), walking may be the primary mode of movement during field sampling. A GPS device should be used to record the exact path followed for the transect/meander and start and end times should be noted. Nocturnal transects/meanders should be conducted using red-filtered, high-powered spotlights which cause minimal disturbance while still detecting the eye shine of nocturnal mammals.

• Road Mortalities – all mammal SCC observed dead on the roads should be examined using gloves and the geographic location date/time, as well as a representative photograph, should be taken. Dead mammal SCC should only be recorded either on the PAOI or within major road arteries in the area of the PAOI (i.e. main roads immediately adjacent to the PAOI), the latter of which should be interpreted as evidence for a high likelihood of occurrence within the PAOI but not a confirmed observation within the PAOI.

10.4.5.8 Scat content identification

Hair and bones extracted from carnivore, omnivore or scavenging mammal scats (e.g. Figure 10.10) can be used to identify prey species using microscopy techniques described by Grobler and Wilson (1972), Keogh (1979), Perrin and Campbell (1980), Putman (1984). These techniques may require laboratory access, with the use of slides and dissecting microscopes for the examination of hair cross sections and hair scale patterns, as well as examination of other scat contents. This technique is considered to be optional but may be very important if an SCC is a small mammal and can be detectable by such means (if small mammal trapping is not successful or applicable).

However, undigested jawbones in predator scats provide an excellent supplementary method for detecting small mammal SCC. Small mammal skulls and jawbones are extracted from scats or regurgitations (e.g. from owl pellets) and the teeth are used for identification provided by reference guides such as De Graaff (1981) and Monadjem et al. (2015) or verified against extensive reference collections in the various natural history collections in South Africa.

10.4.5.9 Small mammal trapping

Trapping of small mammal SCC is usually carried out using Sherman traps. Perforated Sherman traps are preferable to reduce mortalities from overheating of trapped specimens (Figure 10.11). Depending on the preferred habitat of the target species, which must always be considered during trapping surveys, transect line and/or grid array are acceptable configurations for small mammal trapping using either Sherman® live traps, PVC small mammal traps, or Tomahawk live traps. For nocturnal SCC, traps should be set and baited in the evening (to prevent complete consumption by ants) and must be checked daily in the early morning before the ambient temperature rises to lethal levels, in order to limit trap deaths (of which zero deaths are the target). Traps must then be closed and reset in the evening. For diurnal SCC, traps are set in the morning and closed at night, but must be checked regularly during the day and greater care in placement must be considered to

93 Some species with high metabolisms (e.g. shrews) may require more frequent trap checking to prevent mortalities.

94 See Do et al. (2013) for additional methods to reduce trap mortality.
prevent direct exposure to sunlight leading to overheating. If both nocturnal and diurnal SCC are expected, then traps can remain active over a 24 h cycle with frequent checking and rebaiting as required. Bait used is often a combination of peanut butter, sardines, vegetable oil and oats (see Willan, 1986; Kok et al., 2013). Ethical considerations for trapped animals must be taken into account, e.g. ensuring that traps won’t flood during rainfall, the provision of insulation (e.g. cotton wool balls) etc. A minimum of five consecutive nights is recommended to allow for trap-shy animals to be captured. Trapping should be carried out if the presence of small mammal SCC is likely and if alternative sampling methods are unlikely to detect the target SCC. Trapping should only be carried out by a specialist that has:

- requisite inoculations;
- appropriate permits and ethical clearance in place; and
- demonstrated prior, relevant experience in small mammal trapping procedures.

For species that cannot be identified reliably without comprehensive examination of a specimen, at least one exemplar per species must be euthanised and collected in accordance with best practice. Such specimen samples and any small mammal mortalities due to trapping must be preserved and deposited at a museum or other public facility.

10.4.5.10 Pitfall and funnel trapping

Herpetological and entomological equipment such as pitfall and funnel traps are often excellent sources of supplementary data (Figure 10.12), and close communication should be maintained with other specialists participating

FIGURE 10.11.—Example of a deployed Sherman trap used for capturing small mammals (note perforations to reduce trap mortality by allowing air movement).

FIGURE 10.12.—Small mammals captured in a herpetofauna pitfall trap (left) and a funnel trap (right) – useful by-catch for a mammalogist.
on the same project to obtain such data. However, as mentioned in Table 10.12, pitfall and funnel trapping are not recommended as primary methods for the surveying of small mammal SCC due to their labour-intensive nature and low probability of success.

### 10.4.6 Reporting requirements

The following mammal-specific reporting requirements are required in addition to the general reporting requirements described in [9.3 Data interpretation, presentation and reporting](#).

#### 10.4.6.1 SCC observations

A summary table of all SCC observed during the fieldwork per survey method must be prepared and should contain the number of individuals observed per SCC per survey method and habitat types.

#### 10.4.6.2 Presence of alien and invasive species

It is important to report on alien and invasive species encountered during a mammal survey, and to provide specific management recommendations in this regard. Alien specimens (e.g. *Rattus rattus*) encountered in the field should preferably be euthanised safely and immediately, if possible.

#### 10.4.6.3 Detection likelihood of SCC

In cases where a particular SCC was not observed during a survey but the habitat conditions are conducive to a high likelihood of occurrence, it may be necessary to recommend that additional follow-up studies are conducted in order to acquire positive verification of presence. Should this not be possible within the timeframe of the environmental authorisation process, then the precautionary principle must be applied and it must be assumed that the SCC is present until such time that appropriate fieldwork can be conducted to confirm its absence.

### 10.4.7 Buffers for SCC

Buffer determination for mammals requires careful consideration of a particular species, its behaviour and habitat requirements in relation to the anticipated impacts from the proposed development. There are no published standardised recommendations on appropriate buffer sizes and management of buffers for each of the mammal SCC in relation to a range of different impacts. Specialists are required to assess necessary buffers for mammal SCC on a project-by-project basis, taking into account any recommendations provided in species-specific relevant BMPs (see [9.3.4 Biodiversity management plans for specific species](#)).

Any buffer recommendations from provincial authorities must be complied with. For example, for non-renewable energy projects, the GDARD Minimum Requirements for Biodiversity Assessments (2014) require all bat habitats (such as caves) to be buffered by at least 500 m. The primary focus of such a buffer relates to the refugia habitat requirements of bats, connectivity to known habitats, and feeding requirements for bat SCC. Most bat SCC require substantial enclosed roosting refugia such as dolomite caves (or subterranean equivalents), mine adits, suitable road/rail underpasses and large natural crevices, although some species use narrow crevices and fissures on vertical rock faces (e.g. *Laephotis namibensis* and *Laephotis wintoni*; see Jacobs et al., 2005). For wind energy developments, buffers are provided for bats in MacEwan et al. (2020).

### 10.4.8 Data dissemination

- Observations of SCC and any alien species.
- Specimens representing geographic range extensions.
- At least one observation per species, per project, per QDGC should be disseminated to an appropriate database source (MammalMAP, iNaturalist or GBIF®).
- Voucher specimens (appropriate permitting required) to be submitted to recognised museums e.g. Ditsong National Museum of Natural History (Pretoria).

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GBIF® Global Biodiversity Information Facility (www.gbif.org/).
10.5 Terrestrial invertebrates

10.5.1 Species included in the screening tool

The screening tool currently includes 333 terrestrial invertebrate SCC, which includes taxa that are classified as threatened (CR, EN, VU), Near Threatened under the IUCN criteria, or are nationally listed as Rare (restricted range, low density or habitat specialist) or Extremely Rare. Included in the screening tool are 21 beetle species, 131 butterfly species, 47 grasshopper, bladdergrass hopper and katydid species, 12 millipede species and 122 spider species (see Table 10.13 and Table 12.4).

In addition, and specifically for invertebrates, a ‘forest layer’ has been developed and included in the screening tool that takes into account potentially sensitive forest patches. The reasoning behind this is that there are many invertebrate taxa that are confined to forests that are short-range endemics. This is especially true for ground-dwelling taxa that have limited mobility, and that have limited mechanisms to control water loss. The majority of these taxa have not yet been assessed against the IUCN Red List criteria but given the high levels of endemism and limited distribution ranges such species should be taken into account during the EA process. The forest layer is thus included in the screening tool and triggers the requirement of surveys by invertebrate specialists for specific taxonomic groups where expertise is available to support identifications. These groups include millipedes (Myriapoda, Diplopoda), velvet worms (Onychophora), terrestrial molluscs (Mollusca, Gastropoda), and harvestmen (Arachnida, Opilionida).

It should also be noted that conservation assessments of most groups of terrestrial invertebrate species are at a very early stage and the vast majority of species both nationally and globally have not yet been assessed. As a result, substantial expansion of the list of species included in the screening tool can be expected over time as additional taxa are assessed and additional SCC are identified on national and global IUCN Red Lists.

Table 10.13 provides a summary of the terrestrial invertebrates included in the screening tool, showing numbers of genera and species per family. A complete list of included species is presented in Table 12.4 and provides information (where available) on microhabitat requirements, seasonal activity patterns, mutualistic associations and food sources, all of which may aid in planning of surveys and determining habitat suitability and likelihood of occurrence.

Methods for the detection of expected invertebrate SCC should be applied by the specialist for ‘high’ and ‘very high’ sensitivities defined by the screening tool. Medium sensitivity, as an outcome by the screening tool, does not necessarily indicate the actual known presence of an invertebrate SCC within the proposed development footprint/PAOI, and those included are derived from a statistical method known as species distribution modelling. These areas require verification through detailed fieldwork since it indicates the potential occurrence of suitable habitat for SCC.

10.5.2 Desktop study – Expected SCC

The screening tool report provides a list of all confirmed occurring and potentially occurring terrestrial invertebrate SCC within the proposed development footprint/PAOI. However, as noted above, some terrestrial invertebrate SCC listed by the IUCN Red List have not yet been incorporated into the screening tool and will thus not currently be included in its output. These species, which are listed in Table 12.4, include members of groups such as Onychophora (velvet worms) and Gastropoda (slugs and snails) for which suitable habitat is coincident with the Forest layer of the screening tool. For this reason, and also to take into account more recent information that may have become available since the latest update of the screening tool, prior to commencement of surveys the screening tool report list should be supplemented and updated by checking against all very recently published literature sources, information from provincial management authorities, and online resources that are constantly updated with new observations, specifically:

- Atlas of African Lepidoptera (LepiMAP, 2020);
- Atlas of Dung Beetles in southern Africa (DungBeetleMap, 2020);
- Atlas of African Spiders (SpiderMap, 2020); and
- iNaturalist.

The above procedure will ensure that any very recent and new observations of SCC within the proposed development footprint/PAOI not already captured by the screening tool can be taken into account during the impact analysis.
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Furthermore, it is important to include in the specialist report a list of any additional potentially occurring invertebrate SCC within the defined invertebrate-specific PAOI that are not already indicated by the screening tool report to occur within the proposed development footprint/PAOI. The impact analysis must consider the potential impacts from the proposed development on these additional SCC in the PAOI. See Section 9.3.6 Researching and presenting data for expected SCC for further guidance in this regard.

The specialist is also reminded that many of the available online resources should be used as a starting point only since they are by no means complete and only have relevance to some of the target invertebrate taxa listed by the screening tool. It is possible that the data on several of the invertebrate taxa could be incomplete and gaps may occur in remote or inaccessible areas where a particular species was not sampled and may well occur. However, the use of these online facilities is encouraged as they not only include the latest verified publicly contributed data (when available), but in some instances also provide a complete record of the museum material in South Africa.

Some provinces have incorporated invertebrate species as part of their conservation targets. Some of these species include restricted-range or endemic invertebrate taxa as listed by the screening tool, which must be included in the desktop survey if the PAOI coincides with such a province (see Appendix 6 – Target invertebrate species based on provincial biodiversity plans).

It is the responsibility of the specialist to obtain a list of priority species with the potential to be present within the PAOI from the conservation authorities and compare these to the screening tool list. Appropriate sampling methods should then be selected to search for these taxa.

KwaZulu-Natal (KZN) has specified a large number of invertebrate taxa, including some listed by the screening tool, which must be searched for during assessments (refer to Ezemvelo KZN Wildlife conservation targets as published in the KZN Biodiversity Spatial Planning Terms and Processes [EKZN Wildlife, 2016]). Specialists conducting surveys in KZN should request a list of priority species relevant to their PAOI from data@kznwildlife.com.

Gauteng specified three threatened butterfly species (Aloeides dentatis, Lepidochrysops praeterita and Chrysoritis aureus), which must be searched for during environmental assessments, in GDARD’s C-Plan version 3.3 (GDARD, 2011). The GDARD minimum requirements for biodiversity assessments provide detailed rules on survey methods.

<table>
<thead>
<tr>
<th>Phylum</th>
<th>Class</th>
<th>Order</th>
<th>Family</th>
<th># Genera</th>
<th># Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthropoda</td>
<td>Insecta</td>
<td>Coleoptera</td>
<td>Lucanidae</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Arthropoda</td>
<td>Insecta</td>
<td>Coleoptera</td>
<td>Scarabaeidae</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Arthropoda</td>
<td>Insecta</td>
<td>Lepidoptera</td>
<td>Hesperiidae</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Arthropoda</td>
<td>Insecta</td>
<td>Lepidoptera</td>
<td>Lyceaeidae</td>
<td>17</td>
<td>103</td>
</tr>
<tr>
<td>Arthropoda</td>
<td>Insecta</td>
<td>Lepidoptera</td>
<td>Nymphalidae</td>
<td>10</td>
<td>21</td>
</tr>
<tr>
<td>Arthropoda</td>
<td>Insecta</td>
<td>Lepidoptera</td>
<td>Papilionidae</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Arthropoda</td>
<td>Insecta</td>
<td>Orthoptera</td>
<td>Acridae</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Arthropoda</td>
<td>Insecta</td>
<td>Orthoptera</td>
<td>Lentulidae</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Arthropoda</td>
<td>Insecta</td>
<td>Orthoptera</td>
<td>Pneumoridae</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Arthropoda</td>
<td>Insecta</td>
<td>Orthoptera</td>
<td>Tettigoniida</td>
<td>16</td>
<td>35</td>
</tr>
<tr>
<td>Arthropoda</td>
<td>Diplodopa</td>
<td>Spirostreptida</td>
<td>Spirostreptida</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Mollusca</td>
<td>Gastropoda</td>
<td>Stylommatophora</td>
<td>Chiropidae</td>
<td>Endemics to forest patches.</td>
<td></td>
</tr>
<tr>
<td>Mollusca</td>
<td>Gastropoda</td>
<td>Stylommatophora</td>
<td>Chloromyophoridae</td>
<td>Endemics to forest patches.</td>
<td></td>
</tr>
<tr>
<td>Mollusca</td>
<td>Gastropoda</td>
<td>Stylommatophora</td>
<td>Uroyclidae</td>
<td>Endemics to forest patches.</td>
<td></td>
</tr>
<tr>
<td>Mollusca</td>
<td>Gastropoda</td>
<td>Stylommatophora</td>
<td>Rhytidae</td>
<td>Endemics to forest patches.</td>
<td></td>
</tr>
<tr>
<td>Mollusca</td>
<td>Gastropoda</td>
<td>Stylommatophora</td>
<td>Streptaxidae</td>
<td>Endemics to forest patches.</td>
<td></td>
</tr>
<tr>
<td>Onychophora</td>
<td>Udeonychophora</td>
<td>Euonychophora</td>
<td>Peripatopsida</td>
<td>Endemics to forest patches.</td>
<td></td>
</tr>
</tbody>
</table>

Total 127 333
and sensitivity map rules for two of the aforementioned species (GDARD, 2014), and in addition provide minimum and recommended search and trapping effort for mygalomorph (trapdoor and baboon spider) species (Appendix 2 in GDARD, 2014), although at the time these taxa were no longer considered priority species in the province. Given the inclusion in the current screening tool of 19 mygalomorph spider species, seven of which occur in Gauteng, these guidelines should be considered as an indication of recommended sampling effort for such species, not only in Gauteng, but in other provinces as well.

10.5.3 Field survey considerations

A number of survey techniques and methods are proposed to verify the occurrence of terrestrial invertebrate species as listed by the screening tool report (or indicated as potentially occurring in the PAOI by the desktop study). Recommended methods are briefly described in sections 10.5.3.4.1 to 10.5.3.4.12 and their applicability to the various SCC taxa (grouped by family) is indicated in Table 10.14. It is important that the specialist conducts a preliminary delineation of the habitat types in the PAOI which have the potential to sustain the target species. Vegetation and soil maps from other specialist surveys, if available, often provide the best foundation for this. Alternatively, satellite imagery may be used to roughly identify and delineate habitat types. These habitat units should be used as ‘sampling units’ during the survey.

It is important that after the final expected SCC list has been compiled, characteristics of each species must be researched to enable appropriate sampling methodology to be selected, and for field surveys of appropriate duration and with the correct seasonal timing, spatial and temporal scheduling to be planned. Diurnal variation in detectability of SCC, such as some butterflies, can severely constrain the number of effective survey hours and render survey of more than one or two habitat units per day impractical. Familiarisation of the target species’ microhabitat requirements or food sources (e.g. host plant species or, when relevant, ant associations of butterflies) will aid in detecting the species during field surveys and during an assessment of the potential occurrence of suitable habitat. Information on characteristics of SCC is provided in Table 12.4 and Table 12.5 based on a preliminary review of the literature and online data sources. However, it is recommended that the specialist carry out detailed research on each predicted SCC, including inspection of the collection information in the original species descriptions, to obtain the information needed to guide the survey process.

10.5.3.1 Seasonally appropriate surveys

Surveys for a terrestrial invertebrate species must take place during a seasonal period where the probability of detecting an identifiable life history stage of the species is highest, based on the biology of that species. Even species that are long-lived, with adults present year-round (for example many millipedes and baboon spiders), may become dormant and difficult to locate during periods such as dry winter months. In some species (e.g. some butterflies and the chafer beetle *Ichnestoma stobbiai*), the identifiable adult stage may be present for only a few days per year, under very specific conditions. For such species it is recommended that the specialist conducts at least two independent surveys to mitigate for apparently appropriate climatic conditions failing to trigger activity. For example, *Ichnestoma stobbiai* emergence is generally triggered by the first rainfall event of about 20 mm or more during September to November, followed by warm, sunny conditions; ‘false alarms’ may occur (and fruitless surveys carried out) if the first rains are too early or are followed by conditions that are too cold; the main emergence may only be triggered by a later rainfall event, when a second survey will detect this SCC. Where multiple SCC have been indicated by the screening tool as potentially occurring on a site, it will often be necessary to carry out more than one survey at different times of the year to accommodate variation in seasonal activity between species.

Where possible, an indication of seasonal activity has been indicated in Appendix 5 for each SCC, but for many species, especially species known from only one or a few collections, this information is not available at present. The specialist will thus need to determine appropriate seasonal timing of surveys based on known activity patterns of related species, or if this is not available, timing should be based on a reasoned evaluation of climate and general activity of invertebrate species in the area. In summer-rainfall regions the majority of invertebrate species are most active in the warm and moist summer months, but in winter-rainfall regions (e.g. Western Cape and west coast of the Northern Cape) activity patterns are more complex and less predictable. When in doubt the specialist should consult taxon specialists relevant to the species indicated by the screening tool report. The timing and duration of the survey(s) must be explained in the context of the target species and justified in the report. Take note that the precautionary principle must be applied for any surveys conducted outside of the optimal seasonal timing (see 9.3.2 Application of the precautionary principle and ‘absence data’), as well as for SCC that are very difficult to detect (see 9.3.7 Expected SCC with very low detection probabilities).

10.5.3.2 Temporally appropriate surveys

The PAOI should be surveyed at the time(s) of the day when the target species are most active and most detectable. For many (but not all) butterflies it is best to start the survey during the hotter times of the day (e.g. 10:00 to 14:00) when cloud cover is minimal and when conditions are calm (i.e. in the absence of strong winds) (Armstrong et al., 2013). In contrast, katydid and bladder grasshoppers are nocturnal...
TABLE 10.14.—Recommended survey methods to detect terrestrial invertebrate SCC.

<table>
<thead>
<tr>
<th>Class/Order</th>
<th>Family</th>
<th>Microhabitat/behavioural characteristics/feeding habits</th>
<th>Active search</th>
<th>Targeted netting</th>
<th>Sweep-netting</th>
<th>Point and strip transects</th>
<th>Beating</th>
<th>D-vac sampling</th>
<th>Pitfall trapping - passive</th>
<th>Pitfall trapping - baited</th>
<th>Auditory searches</th>
<th>Light trapping</th>
<th>Leaf litter sifting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Araneae</td>
<td>Amaurobiidae</td>
<td>Ground web dweller</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>(looking for silk webs)</td>
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<tr>
<td>Araneae</td>
<td>Anapidae</td>
<td>Ground orb web spinners, sometimes nocturnal</td>
<td>X</td>
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<td>(looking for silk webs)</td>
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<tr>
<td>Araneae</td>
<td>Araneidae</td>
<td>Web dwellers, often active at night</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Archaeidae</td>
<td>Vegetation layer, free-living, predators of other spiders</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Atypidae</td>
<td>Purse web spiders/trapdoor type spiders</td>
<td>X</td>
<td></td>
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<td></td>
<td></td>
<td>X</td>
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<td></td>
<td></td>
<td>(soil scraping)</td>
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</tr>
<tr>
<td>Araneae</td>
<td>Caponiidae</td>
<td>Often under rocks</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Cheiracanthiidae</td>
<td>Usually on plants</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Araneae</td>
<td>Corinnidae</td>
<td>Often actively wandering or under/on/in tufts of grass</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Cyatholipidae</td>
<td>Tree sheet spiders</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(search for webs on plants)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Drymusidae</td>
<td>Often inside cave-like structures</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Araneae</td>
<td>Entypesidae</td>
<td>Trapdoor spider</td>
<td>X</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>(rock/log turning)</td>
<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Galleniellidae</td>
<td>Often actively wandering or under/on/in tufts of grass</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Araneae</td>
<td>Hersiliidae</td>
<td>Build retreats under stones on rocks, very fast-moving</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>(turning over rocks)</td>
<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Idiopidae</td>
<td>Trapdoor-covered burrows in soil</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>(visual/soil scraping)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Araneae</td>
<td>Linyniellidae</td>
<td>Associated with the vegetation, often really small in size</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Araneae</td>
<td>Lycosidae</td>
<td>Active ground wandering spiders</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Araneae</td>
<td>Microstigmatidae</td>
<td>Ground wandering mygalomorphs that don’t make a silk web</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

* Not currently included in screening tool but included in IUCN Red List SCC and must be included in surveys of forests.
<table>
<thead>
<tr>
<th>Class/Order</th>
<th>Family</th>
<th>Microhabitat/behavioural characteristics/feeding habits</th>
<th>Active search</th>
<th>Targeted netting</th>
<th>Sweep-netting</th>
<th>Point and strip transects</th>
<th>Beating</th>
<th>D-vac sampling</th>
<th>Pitfall trapping - passive</th>
<th>Pitfall trapping - baited</th>
<th>Auditory searches</th>
<th>Light trapping</th>
<th>Leaf litter sifting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Araneae</td>
<td>Migidae</td>
<td>Ground dwellers with silk burrows on the ground or trees</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Araneae</td>
<td>Penestomidae</td>
<td>Live in dense silk-lined retreats, often under rocks or logs</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Pholcidae</td>
<td>Daddy-long legs, often inside cave-like structures e.g. inside a termite mound or real caves</td>
<td>X</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Phyxelididae</td>
<td>Mesh webbuilding spider often found on/under rocks and logs</td>
<td>X</td>
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<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Pycnotheriidae</td>
<td>Trapdoor spider (soil scraping)</td>
<td>X</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Salticidae</td>
<td>Various habitats, usually on plants</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Scytodiidae</td>
<td>Ground wandering, under logs, stones, leaf litter, under bark</td>
<td>X</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Selenopidae</td>
<td>Ground dwelling and often under rocks and flat surfaces that provide protection</td>
<td>X</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Sicariidae</td>
<td>Wandering spiders or can be found in caves</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Sparassidae</td>
<td>Ground and plant wanderers</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Stasimopidae</td>
<td>Trapdoor spiders/ground dwellers (visual/soil scraping)</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Araneae</td>
<td>Telemidae</td>
<td>Cave dwelling spiders</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Tetragnathidae</td>
<td>Plant dwellers</td>
<td>X</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Araneae</td>
<td>Theraphosidae</td>
<td>Burrows in soil or under rocks/logs, males wander when searching for mates</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Araneae</td>
<td>Thomisidae</td>
<td>Often on plants</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Araneae</td>
<td>Trachelidae</td>
<td>Often actively wandering or under/on/in tufts of grass</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Araneae</td>
<td>Zodariidae</td>
<td>Ground dwellers and ground wandering</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Araneae</td>
<td>Zoropsidae</td>
<td>Ground wandering</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Coleoptera</td>
<td>Lucanidae</td>
<td>Active October–March, mainly late afternoon/early evening</td>
<td>X</td>
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<td></td>
<td></td>
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<td></td>
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* Not currently included in screening tool but included in IUCN Red List SCC and must be included in surveys of forests.
<table>
<thead>
<tr>
<th>Class/Order</th>
<th>Family</th>
<th>Microhabitat/behavioural characteristics/feeding habits</th>
<th>Active search</th>
<th>Targeted netting</th>
<th>Sweep-netting</th>
<th>Point and strip transects</th>
<th>Beating</th>
<th>D-vac sampling</th>
<th>Pitfall trapping - passive</th>
<th>Pitfall trapping - baited</th>
<th>Auditory searches</th>
<th>Light trapping</th>
<th>Leaf litter sifting</th>
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<tr>
<td>Coleoptera</td>
<td>Scarabaeidae</td>
<td>Usually summer-active</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<td>X</td>
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<td>Lepidoptera</td>
<td>Hesperiidae</td>
<td>Flying species; see Table 12.4 for species-specific characteristics and activity</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
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<td>Lycaenidae</td>
<td>Flying species; see Table 12.4 for species-specific characteristics and activity</td>
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<td>X</td>
<td>X</td>
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</tr>
<tr>
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<td>Flying species; see Table 12.4 for species-specific characteristics and activity</td>
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<td>X</td>
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</tr>
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<td>Flying species; see Table 12.4 for species-specific characteristics and activity</td>
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<td></td>
<td></td>
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<td>X</td>
<td>X</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Gastropoda</td>
<td>Charopidae*</td>
<td>Leaf litter ground dwelling or arboreal and soil layer, under rocks/logs</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td>X</td>
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</tr>
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<td></td>
<td></td>
<td></td>
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<td>X</td>
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<td>Rhytididae*</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
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<td>X</td>
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<td>Streptaxidae*</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
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<td>X</td>
</tr>
<tr>
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<td>Leaf litter and soil layer, under rocks/logs</td>
<td></td>
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<td></td>
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<td>X</td>
</tr>
<tr>
<td>Euonychopora</td>
<td>Peripatopsidae*</td>
<td>Leaf litter or under rocks/logs, usually in forest, but some cave species, predators</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>(rock &amp; log turning)</td>
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<td></td>
<td></td>
<td></td>
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<td>X</td>
</tr>
<tr>
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<td>Acrididae</td>
<td>Usually on vegetation, diurnally active</td>
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<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>Orthoptera</td>
<td>Pneumoridae</td>
<td>Usually on vegetation, nocturnally active</td>
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<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</tr>
<tr>
<td>Orthoptera</td>
<td>Tettigoniidae</td>
<td>Usually on vegetation, nocturnally active</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Spirostreptida</td>
<td>Spirostreptidae</td>
<td>Adults present year-round but usually active in warm, wet conditions only</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

* Not currently included in screening tool but included in IUCN Red List SCC and must be included in surveys of forests.
and should be surveyed at night using auditory cues to aid in detection; some spiders such as *Palytes* spp. are also nocturnal and should be searched for at night, although their nests containing egg sacs may be found during the day and the females guarding them located and identified.

**10.5.3.3 Sampling intensity, quantification and replication**

Evaluation of likelihood of detection of invertebrate SCC, which are often small, cryptic and difficult to locate, must be supported by quantification of sampling effort. While general recommendations for minimum sampling effort are provided below (and discussed in **9.3.9 Description of sampling effort**), effort required may vary between target SCC and it is advisable to consult the literature and/or taxon specialists for guidance on the particular target SCC set if there is any uncertainty.

Population size estimation, as required by section 2.2.3 of the Terrestrial Animal Species Protocol, is usually not possible within the limited EIA timeframe for the cryptic, elusive and rare species that constitute the majority of terrestrial invertebrate SCC; the approach suggested in section **9.3.10 Population size estimates for selected expected SCC** provides an appropriate alternative to the intensive and lengthy field surveys that would be required.

**10.5.3.4 Survey methods for invertebrates**

The diversity of invertebrates and their habits and the variety of habitat requirements has resulted in the development of a profusion of methods by which to sample them; some methods are fairly generally applicable, while others are specifically designed to efficiently sample particular taxa. The selection of methods to be employed in a given survey will depend strongly on the list of target taxa provided by the screening tool and subsequent research as described in section **9.3.6 Researching and presenting data for expected SCC**. Appropriate methodology should be determined and preparations made (adequate sample bottles, preservatives, pre-printed labels etc.) prior to commencement of the survey. The techniques described are limited to those considered most appropriate to the SCC currently included in the screening tool, and do not represent a comprehensive list of all invertebrate survey methods, nor are the descriptions exhaustive – the specialists should familiarise themselves with any required methods with which they are not fully familiar prior to commencing survey work. Future addition or exclusion of taxa from the screening tool may require the addition or removal of survey methods (e.g. UV light searches for scorpions), which will be addressed in updated versions of this guideline.

For most invertebrates, confirmation of identifications requires the collection, preservation and deposition in a recognised collection of voucher specimens for each potential SCC encountered. It is essential that these specimens are properly labelled and preserved; most institutional collections will not accept specimens with incomplete data.

**10.5.3.4.1 Active searching**

Active searching covers a wide range of activities aimed at increasing the probability of encountering a particular target species; the specialist should research the habitats and microhabitat requirements of target SCC in order to guide the process. Active search may include:

- Visual inspection of appropriate microhabitats such as soil surface (searching for burrows, as well as SCC themselves), vegetation, bark of trees, mammal burrows, caves etc.
- Turning rocks and logs.
- Scraping the soil surface, using a spade, hoe or trowel to remove the top layer to expose burrows, or brushing the surface with a stiff-bristled brush to expose burrow entrances. This method is especially relevant to some mygalomorph spiders and GDARD (2014) provides an indication of minimum search effort required.
- Digging to expose organisms feeding on plant roots.

Specimens may be collected by hand, with forceps, or by capture directly into a vial or collecting bottle. Active search effort should be quantified (see section 9.3.9) in terms of the amount of time spent searching a particular habitat area, or in units such as numbers of rocks/logs turned, or numbers of soil scrapes carried out.

**10.5.3.4.2 Targeted netting**

Commonly known as hand-netting, this method is widely used to sample insects. A standard hand net may be used to capture SCC such as adult butterflies and grasshoppers for identification. It is possible to release captured individuals afterwards, but it is generally not possible to identify grasshopper SCC and certain cryptic butterfly species in hand. In this case, it is recommended that sufficient voucher specimens are collected to ensure that identifications are correct. If SCC specimens are released, photographic documentation should first be obtained. To determine the presence and absence of a particular butterfly species, a minimum of two sampling occasions of four hours each in full sunshine is recommended.

**10.5.3.4.3 Strip and point transects**

Strip and point transects are quantitative methods whereby the specialist walks along a predetermined route or line, recording the number of a particular SCC seen (strip transects) or by counting individuals at predetermined points along a transect (point transects). These methods are best used to count flying individuals where the objective is to estimate absolute abundances and are most applicable to butterflies, which can be identified on the wing by a suitably qualified
and experienced specialist. It is important to survey transects in each habitat unit for a predetermined time period to allow for comparisons (Armstrong et al., 2013). Such surveys can provide the information required to estimate population size if sufficient sampling intensity is applied. It is recommended that a minimum of 10–15 counts between 09:00 and 14:00 in full sunshine are carried out along a strip or point transect; a minimum of two sampling occasions is required with a minimum of 20 such counts per habitat.

10.5.3.4.4 Sweep-netting

Sweep-netting is used to collect a variety of invertebrates from vegetation and is mainly employed in low to medium height vegetation. The method is easy to utilise and may be used to collect spider, grasshopper and katydid SCC. A sturdy net is required and standard hand nets as used for butterflies should not be used as they cannot be driven into the vegetation without damage; see Figure 10.13 and https://www.nhm.ac.uk/our-science/data/chalcidoids/coll-methods.html for an excellent and durable design by John Noyes (Natural History Museum, London).

Sweep-netting entails sampling of the graminoid and shrub layer up to a height of 1.5 m above the ground along a transect using a standard sweep net with a diameter of approximately 400 mm. The direction of the sweeps is alternated from left to right (and vice versa) while moving through the vegetation. One ‘sweep’ is defined as a combined stroke and return stroke and the net should be pushed as deep into the vegetation and as close to the ground as possible, as many species are found close to the base of the vegetation layer, in addition to being swept through vegetation up to a height of 1.5 m. An insecticide (commercial aerosol) may be sprayed into the net to immobilise the arthropods before transferring the sample to collection jars filled with preservative (95–100% ethanol). Alternatively an extraction box system (see Figure 10.13) may be employed to separate the live specimens from vegetation debris and facilitate sorting, but the residue should be checked for injured specimens and those which may not be attracted to light and hence remain in the box. Sampling should be standardised (e.g. 50 or 100 sweeps per sample depending on vegetation density and invertebrate activity) and replicated to enable sampling effort to be quantified to aid in evaluation of the likelihood.
of false negatives when investigating the presence of SCC. A minimum of ten (preferably 20) replicates of 100 sweeps per sample in each habitat type is recommended.

10.5.3.4.5 Beating

Beating entails brushing and beating of the woody vegetation (shrubs and trees) with a stick up to a height of 3 m above the ground, to dislodge invertebrates into a hand net or onto a beating sheet or tray. An insecticide (commercial aerosol) may be sprayed onto the contents of the net, sheet or tray to kill the arthropods before transferring the sample to collection jars filled with preservative (95–100% ethanol). Alternatively, if significant vegetation fragments accumulate in the sample, an extraction box system (see Figure 10.13) may be employed to separate the live specimens from vegetation debris and facilitate sorting, but the residue should be checked for injured specimens and those which may not be attracted to light and hence remain in the box. Sampling should be standardised (e.g. 50 or 100 beats per sample) and replicated to enable sampling effort to be quantified to aid in evaluation of the likelihood of false negatives when investigating the presence of SCC. A minimum of ten (preferably 20) replicates of 100 beats per sample in each habitat type is recommended.

10.5.3.4.6 D-vac sampling

D-vac sampling uses a modified petrol-driven garden leaf blower in vacuum mode, as an alternative to sweep-netting or beating, to sample invertebrates from the vegetation layer. The inlet tube opening is run over and pushed into the vegetation to allow specimens to be sucked into the sample bag. An insecticide (commercial aerosol) may be sprayed onto the contents of the bag to kill the arthropods before transferring the sample to collection jars filled with preservative (95–100% ethanol). Alternatively an extraction box system (see Figure 10.13) may be employed to separate the live specimens from vegetation debris and facilitate sorting, but the residue should be checked for injured specimens and those which may not be attracted to light and hence remain in the box. Sampling should be standardised (usually five minutes per sample) and replicated (a minimum of ten, preferably 20, samples per habitat type) to enable sampling effort to be quantified to aid in evaluation of the likelihood of false negatives when investigating the presence of SCC.

10.5.3.4.7 Passive pitfall trapping

Passive pitfall trapping is used to capture epigaecic (ground-dwelling) invertebrates, including dung beetles (Scarabaeidae), millipedes (Spirostreptida) and many spiders (Araneae). It is especially effective in detecting mygalomorph spiders (trapdoor, sheetweb and baboon spiders) by capturing males wandering in search of mates. For the latter, timing is critical, and the survey should be timed to coincide with rainfall events during the main activity period of target SCC (see Engelbrecht, 2013). The number of traps will depend on the sampling effort (trap-days) required and duration of the survey (days left in situ). Trapping should be replicated in each habitat unit where target SCC may potentially occur. The specialist should be guided in determination of sampling effort by Engelbrecht (2013) and GDARD (2014). The minimum pitfall trapping duration required by GDARD (2014) is 4 × 48-hour trapping sessions spread over a four-week period, or continuous trapping for a four-week period. A trap is defined as one capturing unit, e.g. a plastic tub or bucket with a minimum diameter of 10 cm, with drift fences in place. Sampling effort per habitat area for pitfall trapping recommended by GDARD (2014) is as follows (deviations from the recommended sampling effort should be motivated by the specialist):

- for areas up to 7 ha in extent, ten traps for 4 × 48 hours, five traps for four weeks continuous;
- for areas 7–20 ha in extent, 15 traps for 4 × 48 hours, 7.5 traps for four weeks continuous;
- for areas 20–50 ha in extent, 20 traps for 4 × 48 hours, ten traps for four weeks continuous.
• for areas 50–150 ha in extent, 25 traps for 4 × 48 hours, 12.5 traps for four weeks continuous;
• for areas 150–400 ha in extent, 30 traps for 4 × 48 hours, 15 traps for four weeks continuous; and
• for areas 400–1 000 ha in extent, 35 traps for 4 × 48 hours, 17.5 traps for four weeks continuous.

Traps may be spaced (usually at least 10 m apart) in regular or random patterns, each trap with its own drift fences (1 m long, 50–100 mm high) attached (GDARD, 2014), or may be combined in trap arrays (Engelbrecht, 2013) with drift fences linking the traps. Each trap must be buried flush with the soil surface and protected from rain with a cover. The traps must be filled with a preservative consisting of 50% propane-1,2-diol (propylene glycol) and 50% ethanol (for short duration trapping) or 100% propylene glycol (for longer periods); specimens should be transferred to ethanol (80% or higher; at least 95% if DNA extraction is envisaged) as soon as the samples are removed from the traps. The relatively non-toxic propylene glycol should be used in preference to ethylene glycol, which is highly toxic to vertebrates which might ingest the contents of traps.

10.5.3.4.8 Baited pitfall trapping

Baited pitfall trapping is almost exclusively used to capture dung beetles. Pitfalls should be placed in transects with a minimum of five traps deployed within each habitat unit in the PAOI or focussed within those habitat(s) in which the target SCC is most likely to occur. Two litre traps (buckets) are usually adequate, although it is recommended to use five litre traps where high captures of non-target dung beetles (e.g. Pachylomera) are expected, especially in the Kalahari Basin and arid Sandveld areas, where a 2 litre trap is likely to become overfilled with dung beetles. The traps should be spaced along the transects at least 50 m (preferably 100 m) apart and in a linear configuration as suggested by Larsen and Forsyth (2005). In certain circumstances, e.g. where the habitat type is linear (e.g. along a riverine forest) or extremely small, a standard distance of 50–100 m between the traps is impossible. In such cases, it is recommended to deploy ten traps spaced 1 m apart along two parallel rows (five traps on each row) to maximise point (immediate) sampling of the prevailing habitat structure and soil conditions as opposed to the normal recommended 50–100 m distance between traps.

Each trap must be buried flush with the soil surface and protected from rain with a cover. Approximately 25 g of fresh dung is suspended above the trap; the type of dung should correspond to the preferred food of the target SCC. Ideally, it is recommended to capture beetles during a 48-hour period and to re-bait every 24 hours. During a 48-hour trapping session the traps can be filled with water (and a drop of mild detergent). However, if the traps will be left for an extended time period, then it is recommended that the traps are filled with 100% propane-1,2-diol (propylene glycol) to immobilise and, more importantly, preserve the trapped invertebrates until the traps are emptied. All specimens caught must be preserved in at least 95% ethanol.

10.5.3.4.9 Auditory searches

Nocturnal auditory searches are probably the most effective method for locating katydid (Tettigoniidae) and bladder
grasphopper (Pneumoridae) SCC; use of a red-light torch aids in approaching specimens closely enough to enable recording and capture. Prior to the survey the call characteristics of the target SCC should be determined; if possible an audio file should be obtained to act as a reference, but if this is not available a description of the call and a sonogram or oscillogram (which are more commonly available and are often included in species descriptions), may be used to provide an indication. It should be borne in mind that temporal characteristics of many species vary significantly with temperature and it is essential to measure ambient temperature and allow for changes in frequency and call pulse rate. At least four hours of survey, preferably split between two or more nights, under optimal conditions for the target SCC, should be carried out in each habitat unit.

For most currently listed terrestrial invertebrate SCC that use auditory mate recognition signals, call recordings may not yet be available. Specialists should therefore attempt to obtain recordings 1) to be submitted to taxonomic specialists to aid in confirmation of identifications; 2) for dissemination as confirmation of SCC presence; and 3) to assist in establishing a library of recordings for download by specialists to facilitate further surveys and conservation efforts in South Africa. Refer to 10.2.3.3 Acoustic surveys for advice on making recordings.

Special attention to safety is required during night surveys due the risk of trip and fall accidents and potential encounters with venomous snakes or scorpions (see 9.2.5 Health and safety considerations).

10.5.3.4.10 Light trapping

In its simplest form a light trap may be constructed by suspending a ultraviolet (UV) fluorescent tube in front of a white sheet and specimens attracted to it picked off the sheet by hand or using forceps, but more complex designs (of which many proprietary forms exist for purchase) which capture specimens into a collecting receptacle, with or without preservative, may also be constructed. Light traps may be used to attract nocturnal SCC such as katydids and bladder grasshoppers, but it should be borne in mind that many of the current katydid SCC in South Africa are wingless and may not be attracted over long distances, rendering the technique less effective. Light trapping is generally used as an adjunct to other survey methods and thus no minimum effort is indicated; a light trap can be set up before carrying out an auditory survey and checked at the end of the evening for specimens of interest.

10.5.3.4.11 Leaf litter and soil scraping – forest fauna

Leaf litter and soil scraping is a direct searching technique used to sample ground-dwelling invertebrates and is the core method to be used for invertebrates during surveys of forests when this is indicated as required by the Forest layer of the screening tool. The focal SCC in forests are mainly millipedes (Spirostreptida), molluscs (Gastropoda) and velvet worms (Onychophora), but specialists should not restrict their attention entirely to these taxa and should highlight any other invertebrates of special interest, including potentially undescribed species and any other SCC indicated by the screening tool.

Two approaches may be followed for forest invertebrate surveys, as described below:

- **Plots of 20 x 20 m**

  An area of 20 × 20 m is marked out, preferably with tape measures, but if this is not feasible then it can be paced out and the corners marked. The area should be at least 30 m from the edge of the forest and cover different habitats. A timed search totalling 60 minutes should be carried out within the 20 × 20 m area, with time spent covering the entire area, and focussing on searching the leaf litter and top, loose soil to a depth of 2–5 cm around the base of trees, using a hand trowel, and searching under loose rocks and fallen logs. Decaying logs can be opened to search inside the log. If more than one person is involved then the total time must equal 60 minutes, so if three people are searching then each person searches for 20 minutes, and each person should be allocated an appropriate portion of the area to cover during the search.

  A Davis Sifter (see https://www.antwiki.org/wiki/Collecting_Ants#Davis_Sifter) is an extremely valuable tool when searching for small organisms in soil or leaf litter and should be considered an essential item for forest fauna surveys. The sifter comprises two plastic trays of equal size, one of which has had its bottom removed and replaced by wire mesh with a ~ 3 mm aperture. Leaf litter is placed into the mesh-bottomed tray, which is positioned over the intact tray; shaking the trays results in the soil, finer litter particles and small organisms falling into the bottom tray. Stones and larger leaf litter particles (as well as large invertebrates) remain in the mesh-bottomed tray, which should be searched separately for larger target species. The absence of coarse particles in the bottom tray greatly facilitates the search for very small target specimens.

  The number of 20 × 20 m plots that are required will depend on the size and habitat diversity of the forest, but two plots would be a minimum number for a 1–5 ha forest, and larger forests should have a minimum of four plots sampled, spread out so that these are set in different parts of the forest.

- **Quadrats of 2 x 10 m**

  These are far more time consuming than plots to sample, but research has shown that they do yield a higher number of species within an area. A 2 × 10 m quadrat (Figure 10.16) is set up using tape measures, and the entire area is thoroughly searched, using hand trowels. For one
person working alone, searching the entire quadrat may take up to five hours. Ideally, the quadrat should include the area around a tree or run outwards from the base of a tree. Diverse microhabitats such as fallen logs and accumulations of litter should be included in the quadrat. At least one quadrat should be sampled in a small forest, and two in larger forests, ensuring that the two are appropriately distanced.

10.5.3.4.12 Litter sampling for micromolluscs

To specifically target micromolluscs (adults have shells of under 5 mm diameter), collect two 2 litre leaf litter samples from each forest from areas around the base of trees. Each sample can be made up of litter from multiple trees, which can be collected into 2 litre ice-cream tubs, and then placed in plastic shopping bags.

10.5.3.5 Additional considerations for forest invertebrate samples

10.5.3.5.1 Processing of molluscs, millipedes and velvet worms collected

The sampler should carry a number of plastic containers, preferably of different sizes, and all millipedes, molluscs (including slugs and shells from dead snails) and velvet worms found should be collected into these containers. It is preferable not to overfill a container with too many specimens, and to store small specimens in small containers (e.g. pill vials for small millipedes and snails) so that they do not get lost. Plastic bottles (250 ml) can be used for larger specimens. Once sampling is completed, the specimens can be sorted on site, and if there are a large number of obvious duplicates, then the number of individuals can be recorded, a representative number retained (5–10 individuals), and the remainder can be released. If there is any level of uncertainty about the identity, then it is advisable to keep the specimens.

Note that for millipedes, male specimens are required to identify the specimen to species level. Males can be identified by the presence of gonopods which are modified legs on the seventh segment. The gonopods can be seen as small bulbous structures on the underside of the body on the seventh segment. In the keeled millipedes the gonopods are more obvious and are either curved or long, straight, peg-like structures. Males and females cannot be distinguished in the same way in pill millipedes.

Once in a laboratory-type setting, the specimens need to be removed from the containers and prepared in the following way:

- Live snails should be placed in a large container filled with water to the top of the container and closed with a lid. This will drown the molluscs with the foot extended. The following day the specimens can be placed in 80% ethanol. Make sure that the container is large enough and that there is sufficient ethanol.
- Snail shells can be placed in containers without ethanol, but make sure that the shells are actually empty. Often if millipedes have been placed in the same container as snails they will crawl into the shell. Some groups of terrestrial snails have a hard plate which covers the opening of the shell and if this is in place the snail is still living.
- Millipedes and slugs – these should be placed in plastic containers and left in the freezer for at least 48 hours. This can be done without preliminary sorting, straight from the field, if the sample is relatively clean and there are no snails in the container. After 48 hours the specimens can be placed in containers with 70–80% ethanol, again making sure that there is sufficient ethanol and that the containers are not overfilled with specimens. Try to put small polydesmids (keeled millipedes) separately from the large black millipedes to prevent small specimens getting lost or damaged. If there are only slugs in the samples these can be placed directly into ethanol and do not need to be frozen first.
- Velvet worms should be preserved in ethanol; at least one should be preserved in 95% or 100% ethanol (for

FIGURE 10.16.—Quadrat sampling. If more than one person is performing the sampling it can help to divide the 2 × 10 m area into 2 × 2 m blocks and to allocate blocks to individuals to cover systematically.
DNA preservation), but if sufficient specimens are available one or two may be preserved in 80% ethanol for morphological examination.

Leaf litter samples need to be dried thoroughly, either by spreading the litter out on trays for about 7–10 days, or by oven drying it at about 50 °C overnight. Once dry, the litter must be sieved through a 5 mm sieve. The material caught in the sieve can be checked with the naked eye for larger molluscs, and the material that passes through needs to be checked under a stereomicroscope for micromolluscs. These should be dead and dried already, and so they should not need preservation. They can be removed from the debris using soft forceps and stored in glass pill vials.

10.5.3.5.2 Labels

Ensure that every container/vial has a full label that includes the locality, with co-ordinates, the date of collection and the collector’s name. If only a site code is used on a label, inevitably there is confusion or loss of data at some point. Thick paper or soft card and a sharp pencil are best for labels. Specimens that will be incorporated into museum collections will get official labels from the museum staff. If other details are collected on data sheets this information would be valuable, especially where there are specimens that have been recorded but not collected, or habitat details. Copies of data sheets can be provided when the specimens are sent for identification.

Note that field labels should be of plasticised paper or other strong material because millipedes will often eat through paper labels, and ordinary paper can become wet and muddy and pencil markings illegible. Pre-printed and individually laminated collection code labels linked to data in a field notebook may be used to avoid damage to labels, but full label data should be added to the containers of preserved specimens prior to submission for identification.

10.5.3.5.3 Experts to identify material

Molluscs:
1. Dr Mary Cole, East London Museum (marybursey@elmuseum.za.org);
2. Dr Igor Muratov, KZN Museum, Pietermaritzburg (imuratov@nmsa.org.za);
3. Dr Dai Herbert, retired and residing in Wales, but still active and may be able to identify many species from photographs of shells, or photographs of slugs (phanianella@gmail.com).

Photographs of apertural, apical and basal view of shells need to be emailed.

Millipedes:
1. Prof Michelle Hamer, SANBI (M.Hamer@sanbi.org.za).

Spiders:
1. Robin Lyle, Agricultural Research Council (lyleR@arc.agric.za);
2. Stefan Foord, University of Limpopo (stefan@foord.co);
3. Ansie Dippenaar, retired from Agricultural Research Council, but still active (dippenaarA@arc.agric.za or dippenaaransie@gmail.com);
4. Charles Haddad, University of the Free State (HaddadCR@ufs.ac.za);
5. Ian Engelbrecht, SANBI (ianicus.za@gmail.com or I.Engelbrecht@sanbi.org.za).

Harvestmen:
1. Leon Lotz, retired, but still active (Leonlotz57@gmail.com).

Dungbeetles (Scarabidae):
1. Christiaan Deschodt (cdeschodt@zoology.up.ac.za);
2. Adrian Davis (adavis@zoology.up.ac.za).

Requirements: Good quality close up photos of the species along with habitats photographs should allow identification of most species. There may be a few species where specimens will be required for microscopic examinations so collect specimens in case this is required.

Bladder grasshoppers (Lendulidae):
1. Vanessa Couldridge, University of the Western Cape (vcouldridge@uwc.ac.za).

Grasshoppers (Lentulidae and Acrididae):
1. Precious Tshililo, National Museum, Bloemfontein, specimens to be sent to the National museum, Bloemfontein (precious@nasmus.co.za);
2. Adrian Armstrong, Ezemvelo KZN Wildlife (only for species that occur in KZN and only adult wingless grasshoppers (Lentulidae and certain wingless species of the Pamphagidae), requires lateral, dorsal and ventral photographs of the whole grasshopper, anterior photograph of the head, and lateral, dorsal and ventral photographs of the external genitalia (end of the abdomen), all photographs with a scale or scale bar (Adrian.Armstrong@kznwildlife.com).

10.5.3.6 Data collection

- Verifiable evidence of the target SCC should be collected as proof that the species occur(s) in the PAOI. This could include geo-referenced photographs of species that are easy to identify in the field. For cryptic species, or
species that are similar in appearance to close relatives, it is necessary to collect a series of specimens (vouchers) and present digital images of prominent morphological structures taken by means of high-resolution photographic equipment (e.g. digital cameras connected to a dissection microscope or by means of macro photo-stacking).

- When the identity of a potential SCC is uncertain, the specialist must collect a series of specimens which must be identified by an appropriate expert or taxonomist. All collected material must be appropriately labelled as voucher material and must be deposited in a recognised and publicly accessible collection (e.g. museums, National Collection of Insects), ideally one which has an online database that can be freely accessed. The labels should include the place and geographic coordinates where the specimen was collected, altitude, the date when collected and the name of the collector. An additional label may be added with information on the habitat where the specimen was collected.

- Where possible the specialist must collect environmental data from each sampling site. This information will assist in providing additional information on the ecological requirements of a particular species. Typical environmental parameters will include:
  - floristic structure (dominant height of each strata – grass, shrub, tree height), approximate density of woody layer and dominant floristic composition;
  - aspect and slope;
  - cloud cover;
  - soil texture (e.g. fine grained vs. coarse grained soils); and
  - notes of host/food plant/prey species when ovipositing or feeding was observed (a sample of the plant can be taken to a herbarium for identification).

- A hand-held environmental monitoring instrument will assist in providing measurements such as:
  - wind speed;
  - relative humidity;
  - ambient temperature;
  - noise (measured in dB); and
  - light intensity (measured in lux).

### 10.5.4 Reporting requirements

The following reporting requirements are required in addition to the general reporting requirements described in 9.3 Data interpretation, presentation and reporting.

#### 10.5.4.1 Additional requirements for the description of sampling methods

In addition to the general guidance on the description of sampling methods (see 9.3 Data interpretation, presentation and reporting), it is recommended that the specialist provide a tabular summary of methods and sample size used in each habitat type. Table 10.15 provides an example of how sampling methods can be presented. It is imperative that the specialist provides a map showing the localities of sampling sites in the PAOI.

#### 10.5.4.2 SCC observations

A summary table of all SCC observed during the fieldwork per sample site/transect must be prepared and should contain the number of individuals observed per SCC per sample site/transect.

#### 10.5.4.3 Presence of alien and invasive species

The specialist should familiarise themselves with all known and potential terrestrial invertebrate invasive species in South Africa, as they are in the best position to detect such species, which may affect many other aspects of the ecosystems in the PAOI. The specialist should provide a list of terrestrial alien and invasive invertebrate species that were confirmed in the PAOI and may pose a threat to a particular SCC or its habitat. List 8 of Notice 3 in the National Alien and Invasive Species Lists provides a list of invasive terrestrial invertebrate species. The specialist should also refer to the website www.invasives.org.za for updates and news on alien and invasive species.

<p>| TABLE 10.15.—Example of sampling methods summary used and the observed sample sizes for each habitat type. |
|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|</p>
<table>
<thead>
<tr>
<th>Broad-scale Habitat</th>
<th>Strip transects during week 1</th>
<th>Strip transects during week 2</th>
<th>Individuals @ week 1</th>
<th>Individuals @ week 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Anthropogenic modified habitat/ croplands</td>
<td>20</td>
<td>20</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2. Broad-leaved mountain woodland</td>
<td>20</td>
<td>20</td>
<td>35</td>
<td>9</td>
</tr>
<tr>
<td>3. Microphyllous woodland</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>4. Riverine forest</td>
<td>20</td>
<td>20</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>80</strong></td>
<td><strong>80</strong></td>
<td><strong>55</strong></td>
<td><strong>13</strong></td>
</tr>
</tbody>
</table>

103 Published in Government Notice No. 864 in Government Gazette 40166 of 29 July 2016. Note that on 1 March 2021, these lists will be repealed and replaced by the Alien and Invasive Species Lists published in Government Notice No. 1003 in Government Gazette 43726 of 18 September 2020.
Where an invasive alien species is detected with a high probability to pose a threat to a particular SCC, the specialist must provide a separate description of the species in the report. The specialist must provide an indication of the threat the species presents, its occurrence (where it was found) in the PAOI and where possible the relative abundance of the species. Depending on the species, the specialist must report the occurrence to the local conservation authorities in order to take the necessary actions to contain the spread of the species. A typical example will be the presence of the harlequin or Asian lady beetle (*Harmonia axyridis*). It is regarded as one of the worst invasive and harmful insect species and a voracious generalist predator of other insect species, including butterflies. The Argentine ant (*Linepithema humile*) is also an invasive species of great significance that can cause major ecological disruption by displacing indigenous ant species that are important in mutualistic relationships with butterflies, as well as in seed dispersal and protection of seeds from fire.

**10.5.4.4 Additional recommendations**

Additional surveys may be recommended when the specialist has confirmed the presence of an SCC (as listed by the screening tool), an alien invasive species of importance, or an undescribed invertebrate species, or when the project layout or design has changed significantly enough. In most instances, additional studies are recommended to update and/or define the extent of occurrence of an SCC and to obtain an estimate of the population size of a particular species on the PAOI.

**10.5.5 Buffers for SCC**

The specialist must provide an adequate buffer area to the SCC subpopulation when such a species was confirmed. However, the specialist may prefer a different buffer size from those provided below, provided he/she has a scientific justification for doing so, based on published literature. Therefore, the buffer widths as provided below should be interpreted as a guideline only as they were adopted from the sensitivity mapping rules for Red Listed plants by the GDARD requirements for biodiversity assessments (GDARD, 2014). The GDARD buffer widths were sourced from a number of documents (Pfab, 2002; Pfab and Victor, 2002; Pfab, 2005) which were based on published and scientific literature. The purpose of the recommended buffer areas is to provide *in situ* conservation for a particular plant species which will also provide a means of conserving a particular habitat, thereby promoting the conservation of ecosystems, communities and hence an invertebrate SCC population. Currently, buffer requirements have been determined and listed here (Table 10.16) only for butterflies, but the specialist can apply the rules described below to determine appropriate buffers for non-butterfly SCC.

A priority grouping is allocated to each butterfly SCC which will determine the buffer area that should be applied. The priority groupings are listed in Table 10.5. The following groupings exist:

- A1 taxa are endemic to a single province;
- A2 taxa are endemic to two provinces; and
- A3 taxa are endemic to three or more provinces.

The recommended buffer zone widths are set out below:

- In urban and highly developed areas, a minimum buffer zone of 200 m is required from the edge of an SCC population.
- In rural areas, a larger buffer zone width is required (see Table 10.5):
  - for A1 species, a buffer zone of at least 600 m from the edge of the SCC population is required;
  - for A2 species, a buffer zone of at least 500 m from the edge of the SCC population is required; and
  - for A3 species, a buffer zone of at least 400 m from the edge of the SCC population is required.

The GDARD minimum requirements must be followed for *Chrysoritis aureus* and *Lepidochrysops praeterita* when the PAOI is located in Gauteng. In urban and highly developed areas a buffer zone of 200 m is required from the edge of the butterfly population, and in rural areas a minimum buffer area of 400 m is required from the edge of the butterfly population.

**10.5.6 Data dissemination**

- Relevant data to disseminate will include confirmed localities of terrestrial invertebrate SCC and/or alien and invasive species. A shapefile of the confirmed SCC or alien and invasive species localities should be e-mailed to the relevant person at the local and/or national conservation department.
- Collected material of terrestrial invertebrate SCC must be deposited as voucher specimens in a national museum or other appropriate institutional collection (e.g. the Ditsong National Museum of Natural History, Pretoria; the Iziko South African Museum, Cape Town; the National Collection of Arachnida (non-Acari), ARC-PPRI, Pretoria; or the National Collection of Insects, ARC-PPRI, Pretoria). Where possible, all collected material should be donated to museums or sent to taxonomists if the species is part of a group that is currently in the process of taxonomic revision. Images of collected material should be uploaded to the respective online databases (see http://vmus.adu.org.za/) and/or iNaturalist (see https://www.inaturalist.org/).
### TABLE 10.16.—Priority groupings allocated for each butterfly SCC with implications for the application of buffers.

<table>
<thead>
<tr>
<th>Species</th>
<th>Province</th>
<th>Priority grouping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaena margaritacea</td>
<td>Limpopo</td>
<td>A1</td>
</tr>
<tr>
<td>Aloeides barbarae</td>
<td>Mpumalanga</td>
<td>A1</td>
</tr>
<tr>
<td>Aloeides carolynnae carolynnae</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Aloeides clarki</td>
<td>Eastern Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Aloeides dentatis dentatis</td>
<td>Gauteng</td>
<td>A1</td>
</tr>
<tr>
<td>Aloeides egerides</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Aloeides lutescens</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Aloeides nubilus</td>
<td>Mpumalanga</td>
<td>A1</td>
</tr>
<tr>
<td>Aloeides pallida junos</td>
<td>Western and Eastern Cape</td>
<td>A2</td>
</tr>
<tr>
<td>Aloeides rossouwi</td>
<td>Mpumalanga</td>
<td>A1</td>
</tr>
<tr>
<td>Aloeides stevensoni</td>
<td>Limpopo</td>
<td>A1</td>
</tr>
<tr>
<td>Aloeides thyra orientis</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Aloeides trimeni southeysae</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Anthene lindae</td>
<td>Northern Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Aslauga australis</td>
<td>Eastern Cape and KwaZulu-Natal</td>
<td>A2</td>
</tr>
<tr>
<td>Capys penningtoni</td>
<td>KwaZulu-Natal</td>
<td>A1</td>
</tr>
<tr>
<td>Chrysoritis adonis Adonis</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Chrysoritis aureus</td>
<td>Gauteng and Mpumalanga</td>
<td>A2 (refer to GDARD minimum requirements for Gauteng)</td>
</tr>
<tr>
<td>Chrysoritis brooksi tearei</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Chrysoritis dicksoni</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Chrysoritis lyncurium</td>
<td>Eastern Cape and KwaZulu-Natal</td>
<td>A2</td>
</tr>
<tr>
<td>Chrysoritis penningtoni</td>
<td>Eastern Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Chrysoritis phosphor borealis</td>
<td>Mpumalanga and Eastern Cape</td>
<td>A2</td>
</tr>
<tr>
<td>Chrysoritis rileyi</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Chrysoritis thysbe schloszaz</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Chrysoritis thysbe whitei</td>
<td>Eastern Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Chrysoritis trimeni</td>
<td>Northern Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Dingana clara</td>
<td>Limpopo</td>
<td>A1</td>
</tr>
<tr>
<td>Dingana dingana</td>
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<td>A1</td>
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<tr>
<td>Dingana fraterna</td>
<td>Mpumalanga</td>
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</tr>
<tr>
<td>Dingana jerinae</td>
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<td>Dira swanepeoli isolata</td>
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<td>A1</td>
</tr>
<tr>
<td>Durbania amakosa albescens</td>
<td>Eastern Cape and KwaZulu-Natal</td>
<td>A2</td>
</tr>
<tr>
<td>Durbania amakosa flavida</td>
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<td>A1</td>
</tr>
<tr>
<td>Erikssonia edgei</td>
<td>Limpopo</td>
<td>A1</td>
</tr>
<tr>
<td>Hopolycaena lochmophila</td>
<td>KwaZulu-Natal</td>
<td>A2</td>
</tr>
</tbody>
</table>
TABLE 10.16.—Priority groupings allocated for each butterfly SCC with implications for the application of buffers (continued).

<table>
<thead>
<tr>
<th>Species</th>
<th>Province</th>
<th>Priority grouping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iolaus lulua</td>
<td>KwaZulu-Natal</td>
<td>A2</td>
</tr>
<tr>
<td>Kedestes barberae bunta</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Kedestes lenis lenis</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Kedestes niveostriga schloszi</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Kedestes sarahae</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Lepidochrysops irvingi</td>
<td>Mpumalanga</td>
<td>A1</td>
</tr>
<tr>
<td>Lepidochrysops jefferyi</td>
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</tr>
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<td>Lepidochrysops kesi leucocula</td>
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<td>A1</td>
</tr>
<tr>
<td>Lepidochrysops littoralis</td>
<td>Western Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Lepidochrysops lotana</td>
<td>Limpopo</td>
<td>A1</td>
</tr>
<tr>
<td>Lepidochrysops pephredo</td>
<td>KwaZulu-Natal</td>
<td>A1</td>
</tr>
<tr>
<td>Lepidochrysops praeterita</td>
<td>Free State, Gauteng and North West</td>
<td>A3 (refer to GDARD minimum requirements for Gauteng)</td>
</tr>
<tr>
<td>Lepidochrysops swanepoeli</td>
<td>Mpumalanga</td>
<td>A1</td>
</tr>
<tr>
<td>Lepidochrysops victori</td>
<td>Eastern Cape</td>
<td>A1</td>
</tr>
<tr>
<td>Metisella syrinx</td>
<td>Eastern Cape and KwaZulu-Natal</td>
<td>A2</td>
</tr>
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<td>Orachrysops ariadne</td>
<td>KwaZulu-Natal</td>
<td>A1</td>
</tr>
<tr>
<td>Orachrysops mijburghi</td>
<td>Free State and Gauteng</td>
<td>A2</td>
</tr>
<tr>
<td>Orachrysops montanus</td>
<td>Free State</td>
<td>A1</td>
</tr>
<tr>
<td>Orachrysops niobe</td>
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<tr>
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<td>Limpopo</td>
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<tr>
<td>Orachrysops violescens</td>
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<td>A1</td>
</tr>
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<td>Pseudonympha paragaika</td>
<td>Free State</td>
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<tr>
<td>Pseudonympha swanepoeli</td>
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<td>Serradinga clarki amissivallis</td>
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<td>Telchinia induna salmontana</td>
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</tr>
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<tr>
<td>Trimenia malagrida malagrida</td>
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</tbody>
</table>
TABLE 10.16.—Priority groupings allocated for each butterfly SCC with implications for the application of buffers (continued).

<table>
<thead>
<tr>
<th>Species</th>
<th>Province</th>
<th>Priority grouping</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Trimenia malagrida maryae</em></td>
<td>Western Cape</td>
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</tr>
<tr>
<td><em>Trimenia malagrida paarlensis</em></td>
<td>Western Cape</td>
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</tr>
<tr>
<td><em>Trimenia wallengrenii gonnemoi</em></td>
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<td>A1</td>
</tr>
<tr>
<td><em>Trimenia wallengrenii wallengreni</em></td>
<td>Western Cape</td>
<td>A1</td>
</tr>
</tbody>
</table>
References


12.1 Appendix 1
Metadata for terrestrial animal and plant spatial layers served via the screening tool

12.1.1 Very high sensitivity

Taxa that qualify for inclusion in the ‘very high’ sensitivity layer are highly range-restricted species which have an extent of occurrence (EOO)/core habitat area of less than 10 km². The fine scale distributions of these species were manually mapped by taxon experts who made use of accurate occurrence points and known habitat preferences to delineate a ‘very high’ range. Note that the ‘very high’ sensitivity distributions of invertebrate species (excluding butterflies) were extracted from the IUCN assessments and are currently those developed by the species assessors. These distributions will be refined based on point occurrence data in future versions of the screening tool.

12.1.2 High sensitivity

The ‘high’ sensitivity layer of mammals, amphibians, reptiles, spiders, invertebrates and butterflies is made up of post-2002 occurrence points which have a reasonable high spatial accuracy. For the purpose of the screening tool species data need to be represented in two dimensions, therefore, point data need to be converted to polygon data. In order to do this point data were intersected with a habitat segment layer and selected segments were then retained to represent the corresponding points. This segment layer was derived from remotely sensed 90 m Landsat imagery (https://landsat.visibleearth.nasa.gov/). The imagery was used to create fine-scale habitat patches that delineate areas of uniform vegetation structure and type.

12.1.2.1 Notes of sources of data

- **Mammals:** The majority of the mammal data came from the Endangered Wildlife Trust’s Red List database (https://www.ewt.org.za/resources/resources-mammal-red-list/). These data were compiled as part of the 2016 Mammal Red List of South Africa Lesotho and Swaziland. Additional ad hoc records were sourced from national and provincial conservation authorities.

- **Reptiles:** Data on threatened reptile species have been compiled as part of the 2018 Reptile Red List assessments coordinated by SANBI. Additional ad hoc records were sourced from national and provincial conservation authorities, as well as recent records collected during herpetological field surveys.

- **Amphibians:** Data on threatened amphibian species have been compiled as part of the IUCN Red List assessments of southern African amphibians. The latest assessment was conducted in 2015 by the South African Frog
Re-assessment Group (http://speciesstatus.sanbi.org/partners/). The majority of data come from this database. Additional ad hoc records were sourced from national and provincial conservation authorities, as well as recent records collected during field surveys.

- **Butterflies**: Data for butterflies came from the database compiled for the 2017 Southern African Lepidoptera Conservation Assessment (SALCA) project which was undertaken by the Brenton Blue Trust and the Lepidopterists’ Society of Africa (https://www.lepsocafrica.org/?p=projects&s=salca).

- **Invertebrates**: All invertebrate distribution records were obtained from the Red List assessments of each of the species. These polygons are based on the expert interpreted distribution maps or point records with buffers and will be refined in future versions of the screening tool (https://www.iucnredlist.org/search?permalink=8e400429-e90b-46f6-bb72-4ebfd65e7c91).

- **Spiders**: Point records for all spiders included were obtained from the South African National Survey of Arachnida (2020) and the National Collection of Arachnida database. All points were reviewed using basic data cleaning techniques and reviewing of locality description (https://www.arc.agric.za/arc-ppri/Pages/Biosystematics/SANSA.aspx).

- **Plants**: A point occurrence dataset that is maintained by the Threatened Species Unit at SANBI was used to derive high sensitivity areas for plants. The dataset combines occurrence data from more than 40 unique data sources, including herbaria, national and provincial conservation agencies, and citizen science projects. Extreme care is taken to confirm the accuracy of records used to generate the maps, but the dataset may contain errors.

### 12.1.2.2 Birds

The ‘high’ sensitivity layer for threatened bird species was compiled differently to the methods described above for other animal taxa. Species distribution models (SDMs) and SABAP2 data (http://sabap2.birdmap.africa/) were combined to delineate the high sensitivity. SDMs are empirical methods that relate species occurrence data to environmental predictor variables based on statistically derived response curves that best reflect the ecological requirements of the species. These relationships are then used to predict the potential distribution of a species in geographic space. The SDMs and output layers were developed by BirdLife South Africa.

SDMs were created using an ensemble modelling approach, namely the Biomod2 package in the R platform. The package makes use of multiple SDM algorithms and produces a number of model outputs from which to compare model performance and fit. The SDM toolbox and R package block-CV was used to control for spatial autocorrelation within the occurrence data used in the SDMs, as well as control for how data was split amongst testing and training data.

Environmental covariate layers used in SDM differed amongst species and/or guilds. An ecological trait-based assessment of species and guilds was conducted in order to select, collate and/or create ecologically meaningful variables for SDMs. Broad groups of covariates used across all species included bioclimatic layers representing climate (e.g. annual rainfall, temperature range, etc.), topographical layers (e.g. slope, aspect etc.), land cover and metric/s of habitat quality (remote sensing based).

In addition to scrutinising metrics of model performance such as AUC and kappa coefficient (κ), an additional assessment of model validation was conducted. The assessment compared the modelled distribution of suitable habitat to independent sources (i.e. not used in the SDM) of known occurrence and distribution. If models did not conform to the known distribution, and/or failed to predict known areas of suitability with a reasonable accuracy, the model was rejected and further refined/rerun with varied covariates and/or occurrence data.

In addition, point locations were used to inform the SDM, as well as for verification of the model. These point data were obtained through the mobile app BirdLasser, point data collected through tracking projects, as well as academic and other studies. SABAP2 data for each species was downloaded from the SABAP2 website in geoJSON format and then converted into shapefile format.

Raster data were then converted to a polygon shapefile using the appropriate tool in ArcMap. Shapefiles were then projected to determine size of each polygon and smaller patches deleted (< 2–4 ha). The size of the patch to be deleted differs from species to species, for example smaller areas will be deleted for forest-based species than species with large ranges.

The Select by Location tool was then used to identify the areas in the SDM which intersected with recent occurrence confirmed by SABAP2 data. These intersected areas were retained to represent ‘high’ sensitivity. Areas of a species distribution which do not overlap with pentads in which a species has recently been recorded were excluded from this layer.

### 12.1.3 Medium sensitivity

SDMs (introduced above) and expert delineated distributions were both used to delineate areas of ‘medium’ sensitivity. The methods differed slightly between taxa and are detailed below.

#### 12.1.3.1 Mammals, reptiles, and amphibians

For these three groups SDMs were used to generate predictive maps of the geographic range of species. SDMs were developed for each species independently and they paired all valid species occurrence points (including those collected
prior to 2002) with remotely sensed and categorically defined environmental variables that represented climate, land cover, vegetation type, topography, soils, primary productivity, wetland coverage, and habitat fragmentation. A full list of environmental covariates used in the SDMs is found in Table 12.2. The environmental variables (and resulting predictions) were defined at a spatial resolution of 30 arc-seconds. For each species, a custom set of environmental variables was chosen during model development in order to make the SDMs as biologically realistic as possible. The initial candidate set of environmental variables were then checked for collinearity prior to model inclusion. Highly correlated variables were removed leaving a further reduced set of covariates for the SDMs.

Once environmental variables were chosen, they were combined with occurrence records to produce predictive probability surfaces using MaxEnt modelling algorithm. A model selection framework was adopted in order to balance predictive power and model complexity while also reducing over-fitting. A candidate set of 20 models was defined (using combinations of different feature classes and regularisation parameters) and the model with the highest AICc was selected as the final SDM representation. Model selection was run using functions from the ENMeval R package. The AUC statistic was used to quantify model predictive power and this metric was calculated using different combinations of model test and training data. The data splits were defined using functions from the blockCV R package.

Predictive probability surfaces were then converted to a vector layer indicating presence using a threshold that maximised the sum of sensitivity and specificity. This vector layer was then constrained to the known limits of the distribution of each species. These limits were set using the expert delineated ranges for amphibians and reptiles, while for mammals, a minimum convex polygon was drawn around the QDS records of the species which was then used as the distribution limits.

The quality and robustness of SDMs relies to a certain extent on the amount of available occurrence data. For species where these data were lacking, expert defined distributions were used to represent the ‘medium’ distribution instead.

### 12.1.3.2 Birds

In order to quantify the ‘medium’ layer for bird species, an identical modelling approach was adopted for quantifying ‘high’ sensitivity, with the exception that areas in which a species had not been recorded during SABAP2 (i.e. areas in which SDM predictions did not intersect with an occupied SABAP2 pentad) were designated as ‘medium’ sensitivity.

### 12.1.3.3 Butterflies

In order to quantify the ‘medium’ sensitivity of butterfly species, two approaches were followed. The first used SDMs to create predictive surfaces while the second approach used expert knowledge of habitat associations to delineate butterfly distributions.

SDMs were developed for 10 species for which enough occurrence data were available. These were *Aloeides thyra orientis*, *Anthene minima minima*, *Chrysoritis beaufortia stepheni*, *Chrysoritis dicksoni*, *Deloneura millari millari*, *Lepidochrysops irvingi*, *Lepidochrysops ketsi leucomacula*, *Lepidochrysops littoralis*, *Orachrysops ariadne*, and *Teriomima zuluana*. Bayesian Additive Regression Tree models were used to generate the SDMs. A set of candidate environmental variables (Table 12.2) was chosen for each species and then paired with the respective occurrence data. Once the model was run, the predictive probability surface was then converted to a presence or absence layer using a threshold generated by the model. The presence layer was then intersected with the vegetation in which the species is known to occur. This was done using the 2018 National Vegetation Map (http://bgis.sanbi.org/vegmap). Non-natural land cover was then removed from the presence using the Terrestrial Habitat Modification Change map (1990–2014) for South Africa.

### Table 12.1: Summary statistics by sensitivity layer for each taxon included in the screening tool.

<table>
<thead>
<tr>
<th>Taxa</th>
<th>Class</th>
<th>Very high sensitivity</th>
<th>High sensitivity</th>
<th>Medium sensitivity</th>
<th>Total species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphibians</td>
<td>Amphibia</td>
<td>4</td>
<td>12</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Birds</td>
<td>Aves</td>
<td>0</td>
<td>42</td>
<td>38</td>
<td>42</td>
</tr>
<tr>
<td>Butterflies</td>
<td>Insecta</td>
<td>44</td>
<td>113</td>
<td>84</td>
<td>130</td>
</tr>
<tr>
<td>Invertebrates</td>
<td>-</td>
<td>14</td>
<td>0</td>
<td>48</td>
<td>62</td>
</tr>
<tr>
<td>Mammals</td>
<td>Mammalia</td>
<td>1</td>
<td>32</td>
<td>23</td>
<td>40</td>
</tr>
<tr>
<td>Reptiles</td>
<td>Reptilia</td>
<td>2</td>
<td>17</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>Spiders</td>
<td>Arachnida</td>
<td>23</td>
<td>0</td>
<td>18</td>
<td>41</td>
</tr>
<tr>
<td>Plants</td>
<td></td>
<td>580</td>
<td>2067</td>
<td>4053</td>
<td>4633</td>
</tr>
</tbody>
</table>
For the remaining butterfly species, the following approach was applied. First, valid occurrence points from the SALCA database were plotted. A MCP was then drawn around the points to represent the EOO for each species. A buffer was added to the MCP. The buffer distance depended on the EOO as follows: 1 km buffer when EOO < 100 km², 5 km buffer when EOO was between 100–5000 km², and 7.5 km buffer when EOO > 5000 km². The EOO was then intersected with the vegetation in which the species is known to occur using the vegetation map. Non-natural land cover was then removed from the layer.

12.1.3.4 Spiders

Undated point occurrence records of spiders were intersected with the habitat segment to represent the ‘medium’ sensitivity (this method follows that of point intersections of other taxa in the ‘high’ sensitivity; see above).

12.1.3.5 Invertebrates

Polygons developed by species experts during IUCN assessments were used to represent the ‘medium’ sensitivity of invertebrate species.

12.1.3.6 Forest invertebrates

National forest vegetation cover was used as a surrogate for the ‘medium’ sensitivity distribution of threatened and range-restricted forest invertebrate species. The data were extracted from the 2018 National Vegetation Map (http://bgis.sanbi.org/vegmap) and included the following 12 forest types: Ironwood Dry Forest, Lowveld Riverine Forest, Mangrove Forest, Northern Afrotemperate Forest, Northern Coastal Forest, Northern Mistbelt Forest, Sand Forest, Scarp Forest, Southern Afrotemperate Forest, Southern Coastal Forest, Southern Mistbelt Forest, and Swamp Forest. Forest patches smaller than 0.5 ha were removed from the layer.

12.1.3.7 Plants

Plant distribution models used to define ‘medium’ sensitivity areas are expert-driven suitable habitat models, and are derived by combining areas of suitable vegetation types and altitudes within the known ranges of species. Distribution maps are based on best available data for plant species, many of which are poorly known, and therefore the ability to generate accurate maps is constrained.

<table>
<thead>
<tr>
<th>COVARIATE NAME</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOCLIM_01</td>
<td>Annual mean temperature</td>
</tr>
<tr>
<td>BIOCLIM_02</td>
<td>Mean diurnal range (mean of monthly [max. temp. – min. temp.])</td>
</tr>
<tr>
<td>BIOCLIM_03</td>
<td>Isothermality (BIO2/BIO7) (* 100)</td>
</tr>
<tr>
<td>BIOCLIM_04</td>
<td>Temperature seasonality (standard deviation *100)</td>
</tr>
<tr>
<td>BIOCLIM_05</td>
<td>Max. temperature of warmest month</td>
</tr>
<tr>
<td>BIOCLIM_06</td>
<td>Min. temperature of coldest month</td>
</tr>
<tr>
<td>BIOCLIM_07</td>
<td>Temperature annual range (bio5-bio6)</td>
</tr>
<tr>
<td>BIOCLIM_08</td>
<td>Mean temperature of wettest quarter</td>
</tr>
<tr>
<td>BIOCLIM_09</td>
<td>Mean temperature of driest quarter</td>
</tr>
<tr>
<td>BIOCLIM_10</td>
<td>Mean temperature of warmest quarter</td>
</tr>
<tr>
<td>BIOCLIM_11</td>
<td>Mean temperature of coldest quarter</td>
</tr>
<tr>
<td>BIOCLIM_12</td>
<td>Annual precipitation</td>
</tr>
<tr>
<td>BIOCLIM_13</td>
<td>Precipitation of wettest month</td>
</tr>
<tr>
<td>BIOCLIM_14</td>
<td>Precipitation of driest month</td>
</tr>
<tr>
<td>BIOCLIM_15</td>
<td>Precipitation seasonality (coefficient of variation)</td>
</tr>
<tr>
<td>BIOCLIM_16</td>
<td>Precipitation of wettest quarter</td>
</tr>
<tr>
<td>BIOCLIM_17</td>
<td>Precipitation of driest quarter</td>
</tr>
<tr>
<td>BIOCLIM_18</td>
<td>Precipitation of warmest quarter</td>
</tr>
<tr>
<td>BIOCLIM_19</td>
<td>Precipitation of coldest quarter</td>
</tr>
<tr>
<td>COVARIATE NAME</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ENVIREM_annualPET</td>
<td>Annual potential evapotranspiration: a measure of the ability of the atmosphere to remove water through evapotranspiration processes, given unlimited moisture</td>
</tr>
<tr>
<td>ENVIREM_aridityindex</td>
<td>Thornthwaite aridity index: Index of the degree of water deficit below water need</td>
</tr>
<tr>
<td>ENVIREM_climaticmoistureindex</td>
<td>A metric of relative wetness and aridity</td>
</tr>
<tr>
<td>ENVIREM_continentality</td>
<td>Average temp. of warmest month – average temp. of coldest month</td>
</tr>
<tr>
<td>ENVIREM_embergerQ</td>
<td>Emberger’s pluviothermic quotient: a metric that was designed to differentiate among Mediterranean type climates</td>
</tr>
<tr>
<td>ENVIREM_growingdegdays0</td>
<td>Sum of mean monthly temperature for months with mean temperature greater than 0 °C multiplied by number of days</td>
</tr>
<tr>
<td>ENVIREM_growingdegdays5</td>
<td>Sum of mean monthly temperature for months with mean temperature greater than 5 °C multiplied by number of days</td>
</tr>
<tr>
<td>ENVIREM_maxtempcoldest</td>
<td>Max. temp. of the coldest month</td>
</tr>
<tr>
<td>ENVIREM_mintempwarmest</td>
<td>Min. temp. of the warmest month</td>
</tr>
<tr>
<td>ENVIREM_monthcountbytemp</td>
<td>Count of the number of months with mean temp. greater than 10°C</td>
</tr>
<tr>
<td>ENVIREM_PETcoldestquarter</td>
<td>Mean monthly PET of coldest quarter</td>
</tr>
<tr>
<td>ENVIREM_PETdriestquarter</td>
<td>Mean monthly PET of driest quarter</td>
</tr>
<tr>
<td>ENVIREM_PETSestseasonality</td>
<td>Monthly variability in potential evapotranspiration</td>
</tr>
<tr>
<td>ENVIREM_PETwettestquarter</td>
<td>Mean monthly PET of wettest quarter</td>
</tr>
<tr>
<td>ENVIREM_thermicityindex</td>
<td>Compensated thermicity index: sum of mean annual temp., min. temp. of coldest month, max. temp. of the coldest month, × 10, with compensations for better comparability across the globe</td>
</tr>
<tr>
<td>LC_Built_up</td>
<td>Proportion of built up land cover in 30 arc-second cell</td>
</tr>
<tr>
<td>LC_Cropland</td>
<td>Proportion of cropland land cover in 30 arc-second cell</td>
</tr>
<tr>
<td>LC_Natural</td>
<td>Proportion of natural land cover in 30 arc-second cell</td>
</tr>
<tr>
<td>LC_Secondary_natural</td>
<td>Proportion of secondary natural land cover in 30 arc-second cell</td>
</tr>
<tr>
<td>NDVI_mean</td>
<td>Mean normalised difference vegetation index</td>
</tr>
<tr>
<td>BDRICM_Clipped</td>
<td>Depth to bedrock (R horizon) up to 200 cm</td>
</tr>
<tr>
<td>BLDRIE_Clipped</td>
<td>Bulk density (fine earth) in kg/cubic meter</td>
</tr>
<tr>
<td>CLYPPT_Clipped</td>
<td>Clay content (0–2 micrometer) mass fraction in %</td>
</tr>
<tr>
<td>CRFVOL_Clipped</td>
<td>Coarse fragments volumetric in %</td>
</tr>
<tr>
<td>ORCDRC_Clipped</td>
<td>Soil organic carbon content (fine earth fraction) in g per kg</td>
</tr>
<tr>
<td>PHIHOX_Clipped</td>
<td>Soil ph × 10 in H2O</td>
</tr>
<tr>
<td>SLTPT_Clipped</td>
<td>Silt content (2–50 micrometer) mass fraction in %</td>
</tr>
<tr>
<td>SNDPPT_Clipped</td>
<td>Sand content (50–2 000 micrometer) mass fraction in %</td>
</tr>
<tr>
<td>Aspect_East</td>
<td>Eastness of slope</td>
</tr>
<tr>
<td>Aspect_North</td>
<td>Northness of slope</td>
</tr>
</tbody>
</table>
### TABLE 12.2.—Environmental layers used in species distribution modelling (continued).

<table>
<thead>
<tr>
<th>COVARIATE NAME</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevation</td>
<td>Mean elevation</td>
</tr>
<tr>
<td>Slope</td>
<td>Mean slope</td>
</tr>
<tr>
<td>TPI</td>
<td>Topographic position index. Difference between elevation of focal cell and the mean of its eight surrounding cells. Positive and negative values correspond to ridges and valleys respectively, while zero value correspond to flat</td>
</tr>
<tr>
<td>TRI</td>
<td>Terrain ruggedness index. Quantifies total elevation change of $3 \times 3$ cell (flat areas have zero where mountainous areas with steep ridges have positive values)</td>
</tr>
<tr>
<td>TWI</td>
<td>Terrain wetness index. High values indicate areas with high potential runoff (such as water courses and rivers)</td>
</tr>
<tr>
<td>vm_Albany_Thicket</td>
<td>Proportion of Albany Thicket biome</td>
</tr>
<tr>
<td>vm_Azonal_Vegetation</td>
<td>Proportion of Azonal Vegetation biome</td>
</tr>
<tr>
<td>vm_Desert</td>
<td>Proportion of Desert biome</td>
</tr>
<tr>
<td>vm_Forests</td>
<td>Proportion of Forests biome</td>
</tr>
<tr>
<td>vm_Fynbos_montane</td>
<td>Proportion of Montane Fynbos biome</td>
</tr>
<tr>
<td>vm_Fynbos_plain</td>
<td>Proportion of Plains Fynbos biome</td>
</tr>
<tr>
<td>vm_Grassland</td>
<td>Proportion of Grassland biome</td>
</tr>
<tr>
<td>vm_Indian_Ocean_Coastal_Belt</td>
<td>Proportion of Indian Ocean Coastal Belt biome</td>
</tr>
<tr>
<td>vm_Nama.Karoo</td>
<td>Proportion of Nama Karoo biome</td>
</tr>
<tr>
<td>vm_Savanna</td>
<td>Proportion of Savanna biome</td>
</tr>
<tr>
<td>vm_Sub.Escarpment_Grassland</td>
<td>Proportion of Sub-Escarpment Grassland biome</td>
</tr>
<tr>
<td>vm_Sub.Escarpment_Savanna</td>
<td>Proportion of Sub-Escarpment Savanna biome</td>
</tr>
<tr>
<td>vm_Succulent_Karoo</td>
<td>Proportion of Succulent Karoo biome</td>
</tr>
<tr>
<td>frag_clumpy</td>
<td>CLUMPY is an ‘aggregation metric’. It equals the proportional deviation of the proportion of like adjacencies involving the corresponding class from that expected under a spatially random distribution. Equals -1 for maximally disaggregated, 0 for randomly distributed and 1 for maximally aggregated classes.</td>
</tr>
<tr>
<td>frag_cai_mn</td>
<td>CAI_MN is a ‘core area metric’. The mean core area index is the mean percentage of core area in relation to patch area. A cell is defined as core area if the cell has no neighbour with a different value than itself. CAI_MN = 0 when all patches have no core area and approaches CAI_MN = 100 with increasing percentage of core area within patches.</td>
</tr>
<tr>
<td>frag_shape_mn</td>
<td>SHAPE_MN is a ‘shape metric’. SHAPE describes the ratio between the actual perimeter of the patch and the hypothetical minimum perimeter of the patch. The minimum perimeter equals the perimeter if the patch would be maximally compact. Equals SHAPE_MN = 0 if all patches are squares. Increases, without limit, as the shapes of patches become more complex.</td>
</tr>
<tr>
<td>frag_pd</td>
<td>Number of patches per 100 hectares. Increases as the landscape gets more patchy. Reaches its maximum if every cell is a different patch.</td>
</tr>
<tr>
<td>frag_area_mn</td>
<td>Mean patch area. Approaches AREA_MN = 0 if all patches are small. Increases, without limit, as the patch areas increase.</td>
</tr>
<tr>
<td>wetlands_natural</td>
<td>Proportion of natural wetland cover</td>
</tr>
<tr>
<td>wetlands_all</td>
<td>Proportion of all wetland types cover</td>
</tr>
</tbody>
</table>
12.2 **Appendix 2**  
Example of a Terrestrial Animal/Plant Species Compliance Statement

The information described in the text of points 12.2.1 to 12.2.7 below represents the minimum requirements for a compliance statement, per section 5.3 of the Protocols on Terrestrial Animal/Plant Species. In addition, it is strongly recommended that the types of data presented in Table 12.3 and Figure 12.1 be included in such compliance statements as a matter of best practice.

12.2.1 Specialist details

- Luke Verburgt (phone: 0837841997; email: luke@enviro-insight.co.za).
- SACNASP registration for Zoological Science (member # 400506/11).
- Experience: 16 years of consulting, primary expertise in herpetofauna.
- Curriculum vitae attached.

12.2.2 Statement of independence

I, Luke Verburgt, as the appointed terrestrial animal specialist, hereby declare/affirm the correctness of the information provided in this compliance statement, and that I:

- meet the general requirements to be independent and have no business, financial, personal or other interest in the proposed development and that no circumstances have occurred that may have compromised my objectivity; and
- am aware that a false declaration is an offence in terms of regulation 48 of the EIA Regulations (2014).

Signature: [Signature]
Date: 20 February 2020

20 February 2020

12.2.3 Site inspection details

- Date: 12 February 2020.
- Duration: 6 hours.
- Season: Summer.
- Season Relevance: due to the highly transformed nature of the PAOI, seasonality of the survey was not considered to be an important factor for the detection of animal SCC.

12.2.4 Methodology

12.2.4.1 Desktop Study

- Historical satellite imagery was obtained (courtesy Google Corporation) to investigate historical land use for the study area.
- No modelling was required.

12.2.4.2 Field Survey

- The specialist investigated the study area on foot during a single day.
- A total of seven sample sites were investigated across the study area (45 ha).
- At each sample site the habitat was characterised, photographs were taken and the likelihood of any SCC being present was assessed.
- All fauna observed during the site survey were photographed using Canon EOS 6D with 100–400 mm zoom lens.

12.2.5 Results

12.2.5.1 Assumptions and limitations

- It is assumed that all third-party information used (e.g. GIS data and satellite imagery) is correct at the time of generating this report.
- The survey was restricted to a single season (summer), but it is not considered necessary to perform an additional winter survey.
- One portion of the study area could not be accessed due to a locked gate, but it is not considered necessary since satellite imagery and photographs taken in that direction indicate identical habitat to the rest of the study area.

12.2.5.2 Sampling

- A total of eight sample sites (convex hull = 37.4 ha) were investigated across the study area (44 ha) resulting in a sampling density of one sample site per 4.7 ha (Figure 12.1).
- Habitat characteristics and likelihood of SCC being found at each sample site is provided in Table 12.3.
12.2.6 Proposed impact management actions

- Due to the location of a small artificial wetland in close proximity to the south-eastern boundary of the proposed development area (S1), it is recommended that a solid wall be erected to prevent migrating amphibians and potential predators (e.g. snakes) from entering the proposed development and being unnecessarily subject to the proposed activities within.
- Compliance with industry best practice standards related to potential hydrocarbon pollution and storm water management will be required to ensure that rainwater runoff is appropriately managed and does not result in erosion or the pooling of potentially toxic water acting as an attractant for fauna.

12.2.7 Conclusion

- This compliance statement is applicable to the study area as described in the BA/EIA documentation and shown in Figure 12.1;
- due to its transformed habitat, the study area is of a low sensitivity for terrestrial animal species;
- the proposed development will not have any impact on terrestrial animal SCC; and
- there are no conditions to which this compliance statement is subjected.
FIGURE 12.1.—Location of sample sites and specialist GPS track in relation to the study area.
12.3 Appendix 3
Additional examples for defining PAOI

The purpose of these additional examples is to demonstrate at least two scenarios where the PAOI is larger and extends beyond the boundary of the development footprint. People that have not received appropriate training in ecological principles typically have difficulty with understanding and interpreting such scenarios from a biodiversity-only perspective and therefore, analogous examples, where people are involved or affected are provided too, to illustrate the point more clearly for a wider audience.

12.3.1 Coal-fired power plant ash dump

A coal-fired power generation plant requires additional space to store coal ash and selects a 190-ha area adjacent to the current facility. The developer indicates in the design plan that appropriate preventative measures will be put in place to prevent leachate and stormwater runoff. Given the known negative impacts of coal ash on the surrounding environment and on human health (see Carlson and Adriano, 1993; Xu and Li, 2009; Munawer, 2018 and references within) and the tendency for coal ash to be transported by wind (known as ‘fly-ash’, see Figure 12.2), a study was commissioned to model the anticipated deposition of fly-ash due to the prevailing wind conditions (Figure 12.3). From this information, the PAOI was defined by the herpetologist for amphibians as follows:

- Direct (primary) influence – limited to the project footprint.
- Indirect (secondary) influence – no major secondary influence expected from contaminated water because leachate and stormwater runoff are managed and contained within the footprint. However, fly-ash deposition up to 140 m from the edge of the dump is expected to occur at intensities high enough to be toxic to amphibians from ingestion of prey covered in ash or absorption of toxic chemicals directly through the skin. Note that this assertion is fictitious for the purposes of this example. However, the toxicity of various components of fly-ash is attracting on-going research, see https://srelherp.uga.edu/projects/coal.htm for examples.
FIGURE 12.3.—Site infrastructure layout showing the proposed new ash dump (purple) and the projected ash plume due to wind action. Blue arrows indicate direction of stream flow.

influence can be expected to persevere for up to 1 000 m downstream of the projected plume, after which dilution is expected to be sufficient to limit the toxicity of the deposited ash.

- Indirect (tertiary) influence – the indirectly affected stream is a tributary to a major river with known sensitive amphibian species of conservation concern. Continuous deposition of toxic chemicals from fly-ash in this stream have the potential to bio-accumulate in aquatic amphibians. Because the toxicity of these chemicals is not known for the sensitive amphibian receptors (research results are pending), the precautionary principle is applied assuming that these downstream populations, at least for 500 m after the confluence, would be negatively affected by the fly-ash deposition.

The above description of the PAOI in relation to amphibian receptors is mapped in Figure 12.4.

Analogous anthropocentric considerations to the above scenario include:

- health aspects of villagers or farm workers within the ash plume such as:
  - prevalence of respiratory ailments due to inhaled ash;
  - birth deformities or other abnormalities due to involuntary ingestion of toxic constituents of ash;
  - contamination of drinking water sources;
- poor crop yields of agricultural fields within the ash plume leading to reduced income for local farmers due to ash covering planted crops reducing their ability to photosynthesize; and
- death, deformities or weakening of livestock feeding on vegetation covered with coal ash.

Note that this ‘wind-borne’ impact example is transferable to other scenarios involving slimes dams (mine dumps), coal stockpiles or tailings storage facilities from any mine with potentially hazardous chemicals (e.g. uranium mine with radio-active tailings).

References


12.3.2 Blasting noise from mining activity

A mining developer requires EA for a mining project and submits the infrastructure design within the mining right boundary including a list of the proposed mining activities. Since several of the activities are expected to produce loud noises, a noise assessment study is commissioned which models noise levels from the various activities (Figure 12.5). The noise and vibration from blasting (using dynamite) of the mine pits is of particular concern as very loud intermittent noises are known to negatively affect fauna, particularly birds, where it can disrupt feeding or breeding behaviour (Ortega, 2012; Duarte et al., 2015).

From this information, the PAOI was defined by the ornithologist for birds as follows:
- Direct (primary) influence – the entire project footprint given the density and relatively close proximity of all the proposed infrastructure.
- Indirect (secondary) influence – area of influence around the mining pits where the noise levels are expected to be too high for sensitive bird species (predominantly raptors) to behave naturally. This area includes a cliff with nesting vultures, a species of conservation concern.
- Indirect (tertiary) influence – none.

The above description of the PAOI in relation to bird receptors is mapped in Figure 12.6.

Analogous anthropocentric considerations include:
- disturbance of daily activities, particularly sleeping, by noise from blasting leading to fatigue and stress-related problems in people living within a certain radius of the mine pits; and
- structural damage to buildings within a certain radius of the mine pits from ground vibration.

References


FIGURE 12.5.—Site footprint and infrastructure layout showing the blasting noise modelling performed in relation to a nearby cliff.

FIGURE 12.6.—Mapping of the defined project areas of influence.
## 12.4 Appendix 4

### Biodiversity management plans for species

The following list represents all of the BMPs for species that were either in implementation or in the process of development for South Africa, as of 2019.

<table>
<thead>
<tr>
<th>No.</th>
<th>Scientific and common name</th>
<th>Conservation status</th>
<th>Lead or implementing agent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Implementation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td><em>Encephalartos latifrons</em></td>
<td>TOPS – Critically Endangered</td>
<td>Eastern Cape Provincial Department of Economic Development and Environmental Affairs and SANBI</td>
</tr>
<tr>
<td></td>
<td>Albany cycad</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><em>Diceros bicornis</em></td>
<td>TOPS – Endangered</td>
<td>Rhino Management Group (RMG)</td>
</tr>
<tr>
<td></td>
<td>Black rhino</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><em>Pelargonium sidoides</em></td>
<td>Red List – Least Concern</td>
<td>Free State Provincial Department of Economic Development, Tourism and Environmental Affairs and Eastern Cape Provincial Department of Economic Development and Environmental Affairs</td>
</tr>
<tr>
<td></td>
<td>Umkalooba</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><em>Spheniscus demersus</em></td>
<td>IUCN – Endangered</td>
<td>DEA: Oceans and Coasts Branch</td>
</tr>
<tr>
<td></td>
<td>African penguin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td><em>Panthera leo</em></td>
<td>TOPS – Vulnerable</td>
<td>National African Lion Task Team (NALTT) coordinated by DEA</td>
</tr>
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<td></td>
<td>African lion</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bearded Vulture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td><em>Hyperolius pickersgilli</em></td>
<td>TOPS – Critically Endangered</td>
<td>EKZN Wildlife</td>
</tr>
<tr>
<td></td>
<td>Pickersgill reed frog</td>
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<td></td>
</tr>
<tr>
<td>8</td>
<td><em>Ceratotherium simum</em></td>
<td>TOPS – Protected</td>
<td>Rhino Management Group (RMG)</td>
</tr>
<tr>
<td></td>
<td>White rhino</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td><em>Encephalartos</em> priority species</td>
<td>(11) Critically Endangered plus (4) Endangered</td>
<td>National Cycad Task Team (NCTT) coordinated by DEA</td>
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<tr>
<td></td>
<td>15 cycads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td><em>Equus zebra zebra</em></td>
<td>TOPS – Endangered</td>
<td>CapeNature</td>
</tr>
<tr>
<td></td>
<td>Cape mountain zebra</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Public participation</strong></td>
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<td></td>
</tr>
<tr>
<td>11</td>
<td><em>Labeo seeberi</em></td>
<td>TOPS – Endangered</td>
<td>CapeNature and Northern Cape Provincial Department of Environmental Affairs and Nature Conservation</td>
</tr>
<tr>
<td></td>
<td>Clanwilliam sandfish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td><em>Damaliscus pygargus</em></td>
<td>TOPS – Vulnerable</td>
<td>(SANParks) and CapeNature</td>
</tr>
<tr>
<td></td>
<td>pygargus</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bontebok</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Development</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td><em>Acinonyx jubatus</em></td>
<td>TOPS – Vulnerable and Endangered</td>
<td>Endangered WildLife Trust (EWT)</td>
</tr>
<tr>
<td></td>
<td>and Lycaon pictus</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cheetah and wild dog</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td><em>Anthropoides paradiseus/Balearica regularum/Bugeranus carunculatus</em></td>
<td>TOPS – Critically Endangered and Endangered</td>
<td>EWT</td>
</tr>
<tr>
<td></td>
<td>Blue/Grey Crowned/Wattled Cranes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td><em>Sclerophrys pantherinus</em></td>
<td>IUCN – Endangered</td>
<td>SANBI/CapeNature</td>
</tr>
<tr>
<td></td>
<td>Western leopard toad</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No.</td>
<td>Scientific and common name</td>
<td>Conservation status</td>
<td>Lead or implementing agent</td>
</tr>
<tr>
<td>-----</td>
<td>---------------------------</td>
<td>---------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>16</td>
<td><em>Labeobarbus kimberleyensis</em> Orange-Vaal largemouth yellow fish</td>
<td>IUCN – Near Threatened, TOPS – Protected</td>
<td>EWT and Orange Vaal River Yellow-Fish Conservation and Management Association</td>
</tr>
<tr>
<td>17</td>
<td><em>Gyps coprotheres</em> Cape Vulture</td>
<td>IUCN – Endangered</td>
<td>EWT and Vulture Programme (Vulpro)</td>
</tr>
<tr>
<td>18</td>
<td><em>Tyto capensis</em> African Grass Owl</td>
<td>IUCN regional assessment – Vulnerable</td>
<td>Gauteng Provincial Department of Agriculture and Rural Development (GDARD) and African Grass-Owl Task Force of EWT</td>
</tr>
<tr>
<td>19</td>
<td><em>Smaug giganteus</em> Giant girdled lizard</td>
<td>IUCN – Vulnerable</td>
<td>EWT</td>
</tr>
<tr>
<td>20</td>
<td><em>Psammobates geometricus</em> Geometric tortoise</td>
<td>IUCN – Critically Endangered</td>
<td>CapeNature</td>
</tr>
<tr>
<td>21</td>
<td><em>Pseudobarbus burchelli tradou</em> Barrydale redfin</td>
<td>IUCN – Critically Endangered</td>
<td>CapeNature</td>
</tr>
<tr>
<td>22</td>
<td><em>Aloe ferox</em></td>
<td>Least Concern</td>
<td>DEA and SANBI</td>
</tr>
<tr>
<td>23</td>
<td>Two <em>Cyclopia</em> species (<em>Cyclopia intermedia</em> and <em>Cyclopia subternata</em>)</td>
<td>Least Concern both species</td>
<td>DEA and SANBI</td>
</tr>
<tr>
<td>24</td>
<td><em>Bucorvus leadbeateri</em> Southern Ground Hornbill</td>
<td>IUCN – Vulnerable</td>
<td>SANBI (NZG) and the Mabula Ground Hornbill Project.</td>
</tr>
</tbody>
</table>
12.5 **Appendix 5**

Terrestrial invertebrate species of conservation concern

Table 12.4 presents a full list of terrestrial invertebrate SCC currently included in the screening tool, while Table 12.5 lists those SCC not currently included in the screening tool as their occurrence coincides with the Forest layer. Where available, information is provided on microhabitat requirements, seasonal occurrence and food sources. However, for many, species-specific information is currently not readily available and only very broad genus or family-level characteristics, if any, could be provided. Similarly, common names provided are in many instances generic or even family-level common names, where no species-level common names could be found. When the formal South African national and IUCN Red List assessments have been published and/or further information becomes available it will be incorporated into future versions of this guideline. Specialists should attempt to obtain more detailed information on the particular SCC indicated by the screening tool prior to planning survey work. Conservation status of butterflies is shown according to the 2015 Red List and spiders according to the current (2020) South African national assessment, while that of other invertebrates is according to the IUCN Red List (2020).

The information presented in Table 12.4 and Table 12.5 was used to guide recommendations regarding survey methods for SCC in Table 10.14; the latter will also be updated when new information is added to Table 12.4 and Table 12.5.
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP(^{105})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylum: Arthropoda, Class: Arachnida, Order: Araneae</td>
<td>Amaurobiidae Chumma inquieta</td>
<td>Spiny-backed spider</td>
<td>December–April</td>
<td>Leaf litter, dune shrubland</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Amaurobiidae Chumma striata</td>
<td>Spiny-backed spider</td>
<td>September–January</td>
<td>Leaf litter, temperate forest</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anapidae Crozetulus scutatus</td>
<td>Cave orb-web spider</td>
<td>No data</td>
<td>Cave-dwelling species</td>
<td>Critically Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Araneidae Caerostris tinamaze</td>
<td>Bark spider</td>
<td>Often nocturnal</td>
<td>Hide on tree bark, construct orbweb between trees</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Araneidae Cladomelea akemani</td>
<td>African bolas spider</td>
<td>Nocturnal</td>
<td>Low vegetation; constructs reduced bolas web which it swings to capture prey</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Araneidae Cladomelea debeeni</td>
<td>African bolas spider</td>
<td>Nocturnal</td>
<td>Low vegetation; constructs reduced bolas web which it swings to capture prey</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Araneidae Afrarchaea cornutus</td>
<td>Long-necked spider</td>
<td>No data</td>
<td>Vegetation layer, predators of other spiders</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Araneidae Afrarchaea entabeniensis</td>
<td>Long-necked spider</td>
<td>No data</td>
<td>Vegetation layer, predators of other spiders</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Araneidae Afrarchaea fernkloofensis</td>
<td>Long-necked spider</td>
<td>No data</td>
<td>Vegetation layer, predators of other spiders</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Araneidae Afrarchaea neethlingi</td>
<td>Long-necked spider</td>
<td>No data</td>
<td>Vegetation layer, predators of other spiders</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Araneidae Afrarchaea angomensis</td>
<td>Long-necked spider</td>
<td>No data</td>
<td>Vegetation layer, predators of other spiders</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Araneidae Afrarchaea woodae</td>
<td>Long-necked spider</td>
<td>No data</td>
<td>Vegetation layer, predators of other spiders</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Atypidae Calommata transvaalica</td>
<td>Purseweb spider</td>
<td>No data</td>
<td>Permanent burrows; purse-like web covering in open ground</td>
<td>VU</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Caponiidae Diploglena dippenaareae</td>
<td>Orange lungless spider</td>
<td>No data</td>
<td>Free living ground spiders; under stones or leaf litter</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Caponiidae Diploglena proxila</td>
<td>Orange lungless spider</td>
<td>No data</td>
<td>Free living ground spiders; under stones or leaf litter</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{105}\) Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
TABLE 12.4.—Terrestrial invertebrate SCC included in the screening tool, including adult activity periods, microhabitat and/or food preferences as applicable (continued).

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP105</th>
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</thead>
<tbody>
<tr>
<td>Phylum: Arthropoda, Class: Arachnida, Order: Araneae (continued)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheiracanthidae</td>
<td>Cheramiona hogsbackensis</td>
<td>Nocturnal</td>
<td>Base of grass tussocks and in leaf litter in forests</td>
<td>Critically Rare</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corinnidae</td>
<td>Hortipes atalante</td>
<td>Dark sac spider</td>
<td>October</td>
<td>Leaf litter under bushes on riverbank, free living</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corinnidae</td>
<td>Hortipes coccinatus</td>
<td>Dark sac spider</td>
<td>August–September</td>
<td>Leaf litter in forested area; free living</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corinnidae</td>
<td>Hortipes contubernalis</td>
<td>Dark sac spider</td>
<td>November–December</td>
<td>Leaf litter in montane forest; free living. feeds on Collembola</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corinnidae</td>
<td>Hortipes merwei</td>
<td>Dark sac spider</td>
<td>August–May</td>
<td>Leaf litter layer in forested areas and grassland; shady wooded forest, under grass tufts</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corinnidae</td>
<td>Hortipes wimmertensi</td>
<td>Dark sac spider</td>
<td>November</td>
<td>Leaf litter in forested gorge</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyatholipidae</td>
<td>Cyatholipus tortilis</td>
<td>Tree sheetweb spider</td>
<td>No data</td>
<td>Arboreal webs found in vegetation between tree trunks</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyatholipidae</td>
<td>Ilisoa conjugalis</td>
<td>Tree sheetweb spider</td>
<td>No data</td>
<td>Arboreal webs found in vegetation between tree trunks</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyatholipidae</td>
<td>Ilisoa knysna</td>
<td>Tree sheetweb spider</td>
<td>No data</td>
<td>Arboreal webs found in vegetation between tree trunks</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyatholipidae</td>
<td>Isicabu zuluensis</td>
<td>Tree sheetweb spider</td>
<td>No data</td>
<td>Arboreal webs found in vegetation between tree trunks</td>
<td>VU</td>
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<td></td>
</tr>
<tr>
<td>Drymusidae</td>
<td>Izithunzi capense</td>
<td>False violin spider</td>
<td>No data</td>
<td>Under fallen logs or in caves, where they build space webs</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drymusidae</td>
<td>Izithunzi lina</td>
<td>False violin spider</td>
<td>No data</td>
<td>Under fallen logs or in caves, where they build space webs</td>
<td>Rare</td>
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</tr>
<tr>
<td>Drymusidae</td>
<td>Izithunzi productum</td>
<td>False violin spider</td>
<td>No data</td>
<td>Under fallen logs or in caves, where they build space webs</td>
<td>Rare</td>
<td></td>
<td></td>
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<tr>
<td>Drymusidae</td>
<td>Izithunzi silvicola</td>
<td>False violin spider</td>
<td>No data</td>
<td>Under fallen logs or in caves, where they build space webs</td>
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<td>Entypesidae</td>
<td>Hemacha bicolor</td>
<td>No data</td>
<td>Under rocks and logs</td>
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</table>

105 Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
### Species Environmental Assessment Guideline

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gallieniellidae</td>
<td>Austrachelas incertus</td>
<td>Long-jawed ground spider</td>
<td>No data</td>
<td>Fast moving; terrestrial hunters; ground dwellers; forests; wandering around tufts of grass</td>
<td>VU</td>
<td></td>
<td></td>
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<tr>
<td>Gallieniellidae</td>
<td>Austrachelas wassenaari</td>
<td>Long-jawed ground spider</td>
<td>No data</td>
<td>Fast moving; terrestrial hunters; ground dwellers; forests; wandering around tufts of grass</td>
<td>Rare</td>
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<tr>
<td>Gallieniellidae</td>
<td>Drassodella tenebrosa</td>
<td>Long-jawed ground spider</td>
<td>No data</td>
<td>Fast moving; terrestrial hunters often associated with ants, their likely prey; ground dwellers in forests or scrubland, often wandering on or in tufts of grass</td>
<td>EN</td>
<td></td>
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<tr>
<td>Hersiliidae</td>
<td>Tyrotama soutpansbergensis</td>
<td>Two-tailed spiders/whirligig spider</td>
<td>No data</td>
<td>Under stones on rocks in mountainous areas</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Idiopidae</td>
<td>Galeosoma hirsutum</td>
<td>Shield-bum trapdoor spider</td>
<td>No data</td>
<td>Trap door spider; constructs silk-lined burrow, often in clayey soil</td>
<td>EN</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Idiopidae</td>
<td>Galeosoma pallidum</td>
<td>Shield-bum trapdoor spider</td>
<td>No data</td>
<td>Trap door spider; constructs silk-lined burrow, often in clayey soil</td>
<td>EN</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Idiopidae</td>
<td>Galeosoma robertsi</td>
<td>Shield-bum trapdoor spider</td>
<td>No data</td>
<td>Trap door spider; constructs silk-lined burrow, often in clayey soil</td>
<td>VU</td>
<td>X</td>
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<tr>
<td>Idiopidae</td>
<td>Galeosoma scutatum</td>
<td>Shield-bum trapdoor spider</td>
<td>No data</td>
<td>Trap door spider; constructs silk-lined burrow, often in clayey soil</td>
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<td>X</td>
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<tr>
<td>Idiopidae</td>
<td>Idiops pretoriae</td>
<td>Spurred trapdoor spider</td>
<td>No data</td>
<td>Trap door spider; constructs silk-lined burrow, often in clayey soil</td>
<td>VU</td>
<td>X</td>
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<tr>
<td>Linyphiidae</td>
<td>Erigonops littoralis</td>
<td>Hammockweb spider/dwarf spider</td>
<td>No data</td>
<td>Sheet webs between branches of trees, shrubs or tall grass, often very small</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP(^{105})</th>
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<tbody>
<tr>
<td>Phylum:</td>
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<td>Arthropoda</td>
<td>Class: Arachnida, Order: Araneae</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>Linyphiidae Lepthyphantes rimicola</td>
<td>Cave sheet-web spider</td>
<td>No data</td>
<td>Cave-dwelling species</td>
<td>Critically Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lycosidae Pterarton cederbergensis</td>
<td>Wolf spider</td>
<td>No data</td>
<td>Free living; ground dwelling hunters</td>
<td>Critically Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Microstigmata amata Lepthyphantes</td>
<td>Micromygalomorph spider</td>
<td>No data</td>
<td>Found in undergrowth in humid forests</td>
<td>Rare</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lycosidae Pterarton cederbergensis</td>
<td>Wolf spider</td>
<td>No data</td>
<td>Free living; ground dwelling hunters</td>
<td>Critically Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Microstigmata amata Lepthyphantes</td>
<td>Micromygalomorph spider</td>
<td>No data</td>
<td>Found in undergrowth in humid forests</td>
<td>Rare</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Migidae Moggridgea intermedia Banded-legged trapdoor spider</td>
<td>No data</td>
<td>Arboreal and terrestrial trap door spiders</td>
<td>Rare</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Migidae Moggridgea loistata Banded-legged trapdoor spider</td>
<td>No data</td>
<td>Arboreal and terrestrial trap door spiders</td>
<td>EN</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Migidae Moggridgea quercina Banded-legged trapdoor spider</td>
<td>No data</td>
<td>Arboreal and terrestrial trap door spiders</td>
<td>EN</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Migidae Moggridgea teresa Banded-legged trapdoor spider</td>
<td>No data</td>
<td>Arboreal and terrestrial trap door spiders</td>
<td>Rare</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Migidae Moggridgea teresae Banded-legged trapdoor spider</td>
<td>No data</td>
<td>Arboreal and terrestrial trap door spiders</td>
<td>Rare</td>
<td>X</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Migidae Moggridgea terricola Banded-legged trapdoor spider</td>
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<td>Arboreal and terrestrial trap door spiders</td>
<td>VU</td>
<td>X</td>
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<tr>
<td></td>
<td>Penestomidae Penestomus egazini</td>
<td>--</td>
<td>No data</td>
<td>Soil surface or in silk-lined retreats; under bark or rocks</td>
<td>Rare</td>
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<tr>
<td></td>
<td>Penestomidae Penestomus montanus</td>
<td>--</td>
<td>No data</td>
<td>Soil surface or in silk-lined retreats; under bark or rocks</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pholcidae Quamtana ciliata Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
<td>Rare</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Pholcidae Quamtana embuleni Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
<td>Rare</td>
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<td>Pholcidae Quamtana entabeni Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
<td>Rare</td>
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<tr>
<td></td>
<td>Pholcidae Quamtana knysna Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
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<tr>
<td></td>
<td>Pholcidae Quamtana leptompholica Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
<td>Critically Rare</td>
<td></td>
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</tbody>
</table>

\(^{105}\) Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP\textsuperscript{105}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pholcidae</td>
<td>Quamtana mbaba</td>
<td>Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
<td>Critically Rare</td>
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<td></td>
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<tr>
<td>Pholcidae</td>
<td>Quamtana merwei</td>
<td>Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
<td>Critically Rare</td>
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<tr>
<td>Pholcidae</td>
<td>Quamtana meyeri</td>
<td>Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
<td>Critically Rare</td>
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<td></td>
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<td>Pholcidae</td>
<td>Quamtana nandi</td>
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<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
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</tr>
<tr>
<td>Pholcidae</td>
<td>Quamtana nylsvley</td>
<td>Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
<td>Critically Rare</td>
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<td>Pholcidae</td>
<td>Quamtana umzinto</td>
<td>Daddy-long-legs spider</td>
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<td>Dark habitats, caves, under rocks or fallen logs</td>
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<td>Pholcidae</td>
<td>Smeringopus blyde</td>
<td>Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
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<tr>
<td>Pholcidae</td>
<td>Smeringopus dehoop</td>
<td>Daddy-long-legs spider</td>
<td>No data</td>
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<tr>
<td>Pholcidae</td>
<td>Smeringopus hanglip</td>
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<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
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<tr>
<td>Pholcidae</td>
<td>Smeringopus lydenberg</td>
<td>Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
<td>Critically Rare</td>
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<tr>
<td>Pholcidae</td>
<td>Smeringopus mililwane</td>
<td>Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
<td>Rare</td>
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<td></td>
</tr>
<tr>
<td>Pholcidae</td>
<td>Smeringopus ndumo</td>
<td>Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
<td>Rare</td>
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<td></td>
</tr>
<tr>
<td>Pholcidae</td>
<td>Spermophora gordimerae</td>
<td>Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
<td>Rare</td>
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<tr>
<td>Pholcidae</td>
<td>Spermophora peninsulae</td>
<td>Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
<td>Rare</td>
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<tr>
<td>Pholcidae</td>
<td>Spermophora schoemaneae</td>
<td>Daddy-long-legs spider</td>
<td>No data</td>
<td>Dark habitats, caves, under rocks or fallen logs</td>
<td>Critically Rare</td>
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</tbody>
</table>

\textsuperscript{105} Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
**TABLE 12.4.—Terrestrial invertebrate SCC included in the screening tool, including adult activity periods, microhabitat and/or food preferences as applicable (continued).**

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP&lt;sup&gt;105&lt;/sup&gt;</th>
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</thead>
<tbody>
<tr>
<td>Phyxelididae</td>
<td><em>Malaika longipes</em></td>
<td>Cave hacklemesh spider</td>
<td>No data</td>
<td>Cave dwelling species</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phyxelididae</td>
<td><em>Themacys silvicola</em></td>
<td>—</td>
<td>No data</td>
<td>Low vegetation or ground dwelling, dark damp places beneath logs or in holes in trees</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phyxelididae</td>
<td><em>Vidole helicigyna</em></td>
<td>—</td>
<td>No data</td>
<td>Low vegetation or ground dwelling, dark damp places beneath logs or in holes in trees</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phyxelididae</td>
<td><em>Xevioso lichmadina</em></td>
<td>—</td>
<td>No data</td>
<td>Low vegetation or ground dwelling, dark damp places beneath logs or in holes in trees</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pycnothelidae</td>
<td><em>Pionothele straminea</em></td>
<td>—</td>
<td>No data</td>
<td>Under rocks, bark or in burrows</td>
<td>VU</td>
<td></td>
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<tr>
<td>Salticidae</td>
<td><em>Belippo attenuata</em></td>
<td>Jumping spider</td>
<td>No data</td>
<td>Variety of habitats, often use surface of leaves for nests</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salticidae</td>
<td><em>Chinophrys trifasciata</em></td>
<td>Jumping spider</td>
<td>No data</td>
<td>Variety of habitats, often use surface of leaves for nests</td>
<td>Rare</td>
<td></td>
<td></td>
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<tr>
<td>Salticidae</td>
<td><em>Euophrys bifida</em></td>
<td>Jumping spider</td>
<td>No data</td>
<td>Variety of habitats, often use surface of leaves for nests</td>
<td>VU</td>
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<td></td>
</tr>
<tr>
<td>Salticidae</td>
<td><em>Heliophanus africanus</em></td>
<td>Jumping spider</td>
<td>No data</td>
<td>Variety of habitats, often use surface of leaves for nests</td>
<td>EN</td>
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<tr>
<td>Salticidae</td>
<td><em>Homalattus punctatus</em></td>
<td>Jumping spider</td>
<td>No data</td>
<td>Variety of habitats, often use surface of leaves for nests</td>
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<tr>
<td>Salticidae</td>
<td><em>Ictus nigricaudus</em></td>
<td>Jumping spider</td>
<td>No data</td>
<td>Variety of habitats, often use surface of leaves for nests</td>
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<tr>
<td>Salticidae</td>
<td><em>Massagris natalensis</em></td>
<td>Jumping spider</td>
<td>No data</td>
<td>Variety of habitats, often use surface of leaves for nests</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salticidae</td>
<td><em>Rumburak lateripunctatus</em></td>
<td>Jumping spider</td>
<td>No data</td>
<td>Variety of habitats, often use surface of leaves for nests</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>105</sup>Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP&lt;sup&gt;105&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salticidae</td>
<td><em>Rumburak mirabilis</em></td>
<td>Jumping spider</td>
<td>No data</td>
<td>Variety of habitats, often use surface of leaves for nests</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salticidae</td>
<td><em>Tanzania striatus</em></td>
<td>Jumping spider</td>
<td>No data</td>
<td>Variety of habitats, often use surface of leaves for nests</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salticidae</td>
<td><em>Thyenula clarisognata</em></td>
<td>Jumping spider</td>
<td>No data</td>
<td>Variety of habitats, often use surface of leaves for nests</td>
<td>EN</td>
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<td></td>
</tr>
<tr>
<td>Salticidae</td>
<td><em>Thyenula rufa</em></td>
<td>Jumping spider</td>
<td>No data</td>
<td>Variety of habitats, often use surface of leaves for nests</td>
<td>EN</td>
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</tr>
<tr>
<td>Scytodidae</td>
<td><em>Scytodes gooldi</em></td>
<td>Spitting spider</td>
<td>No data</td>
<td>Wandering spiders found in diverse habitats</td>
<td>VU</td>
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<td></td>
</tr>
<tr>
<td>Scytodidae</td>
<td><em>Scytodes montana</em></td>
<td>Spitting spider</td>
<td>No data</td>
<td>Wandering spiders found in diverse habitats</td>
<td>Rare</td>
<td></td>
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</tr>
<tr>
<td>Selenopidae</td>
<td><em>Anyphops kraussi</em></td>
<td>Flattie/ wall spider</td>
<td>No data</td>
<td>Free living wandering spiders found under stones and rocks, or on tree trunks</td>
<td>Rare</td>
<td></td>
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<tr>
<td>Selenopidae</td>
<td><em>Loxaceles speluncarum</em></td>
<td>Violin spider</td>
<td>No data</td>
<td>Ground dwelling wandering spiders, in caves, under rocks or logs, or bark of trees</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sparassidae</td>
<td><em>Palystes kreuzmanni</em></td>
<td>Huntsman/ rain spider</td>
<td>No data</td>
<td>Wandering spiders, mainly found on plants in woodland or bushveld</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sparassidae</td>
<td><em>Palystes martinfilmeri</em></td>
<td>Huntsman/ rain spider</td>
<td>No data</td>
<td>Wandering spiders, mainly found on plants in woodland or bushveld</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stasimopidae</td>
<td><em>Stasimopus filmeri</em></td>
<td>African cork-lid trapdoor</td>
<td>No data</td>
<td>Live in terrestrial burrows, thick silken lid</td>
<td>EN</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Stasimopidae</td>
<td><em>Stasimopus griswoldi</em></td>
<td>African cork-lid trapdoor</td>
<td>No data</td>
<td>Live in terrestrial burrows, thick silken lid</td>
<td>EN</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Stasimopidae</td>
<td><em>Stasimopus hewitti</em></td>
<td>African cork-lid trapdoor</td>
<td>No data</td>
<td>Live in terrestrial burrows, thick silken lid</td>
<td>VU</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

<sup>105</sup> Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP&lt;sup&gt;105&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stasimopidae</td>
<td>Stasimopus mandelai</td>
<td>African cork-lid trapdoor</td>
<td>June</td>
<td>Open Karoo vegetation; live in terrestrial burrows, thick silken lid</td>
<td>Critically Rare</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Telemidae</td>
<td>Cangoderces lewisi</td>
<td>Long-legged cave spider</td>
<td>No data</td>
<td>Cave dwelling species</td>
<td>Critically Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tetragnathidae</td>
<td>Diphya tanikawai</td>
<td>Golden orbweb spider</td>
<td>No data</td>
<td>Constructs orbweb, variety of habitats, prefers long grass in moist shaded gorges</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theraphosidae</td>
<td>Ceratogyrus paulseni</td>
<td>Paulsen’s baboon spider</td>
<td>No data</td>
<td>Silk-lined burrow in soil</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theraphosidae</td>
<td>Idiothele mira</td>
<td>Blue-foot baboon spider</td>
<td>Males mature in January</td>
<td>Silk-lined burrows under rocks and logs in lightly wooded habitat</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theraphosidae</td>
<td>Pterinochilus lapalala</td>
<td>Lapalala baboon spider</td>
<td>No data</td>
<td>Occupy messy sheet webs under loose rocks in gentle to steep very rocky habitat</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thomisidae</td>
<td>Heriaeus muizenberg</td>
<td>Crab spider</td>
<td>No data</td>
<td>Wandering spiders, mainly on foliage, a few on ground</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thomisidae</td>
<td>Mystaria longicapsensis</td>
<td>Crab spider</td>
<td>No data</td>
<td>Wandering spiders, mainly on foliage, a few on ground</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trachelidae</td>
<td>Afroceto capensis</td>
<td>Dark sac spider</td>
<td>January, February, April</td>
<td>Leaf litter in fynbos</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trachelidae</td>
<td>Fuchibotulus bicornis</td>
<td>Dark sac spider</td>
<td>November, December, March, April, July</td>
<td>Under rocks or in leaf litter in fynbos</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trachelidae</td>
<td>Jocquestus incurvus</td>
<td>Dark sac spider</td>
<td>December</td>
<td>Afromontane forest</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trachelidae</td>
<td>Spinotrachelas montanus</td>
<td>Dark sac spider</td>
<td>December, January</td>
<td>Base of ferns or grass tussocks, may be associated with ants</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zodariidae</td>
<td>Australutica africana</td>
<td>Ant spider</td>
<td>No data</td>
<td>Free living, ground dwelling</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zodariidae</td>
<td>Diorees capensis</td>
<td>Ant spider</td>
<td>No data</td>
<td>Free living, ground dwelling</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zodariidae</td>
<td>Diorees dowsetti</td>
<td>Ant spider</td>
<td>No data</td>
<td>Free living, ground dwelling</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>105</sup> Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
### TABLE 12.4.—Terrestrial invertebrate SCC included in the screening tool, including adult activity periods, microhabitat and/or food preferences as applicable (continued).

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP&lt;sup&gt;105&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phylum:</strong> Arthropoda, <strong>Class:</strong> Arachnida, <strong>Order:</strong> Araneae (continued)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zodariidae</td>
<td>Diores leleupi</td>
<td>Ant spider</td>
<td>No data</td>
<td>Free living, ground dwelling</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zodariidae</td>
<td>Diores setosus</td>
<td>Ant spider</td>
<td>No data</td>
<td>Free living, ground dwelling</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zodariidae</td>
<td>Diores silvestris</td>
<td>Ant spider</td>
<td>No data</td>
<td>Free living, ground dwelling</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zodariidae</td>
<td>Procycla precursor</td>
<td>Ant spider</td>
<td>No data</td>
<td>Free living, ground dwelling</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zodariidae</td>
<td>Psammoduon arenicola</td>
<td>Back-flip spider</td>
<td>No data</td>
<td>Free living, ground dwelling</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zodariidae</td>
<td>Rotundrela arorbiculata</td>
<td>Ant spider</td>
<td>No data</td>
<td>Free living, ground dwelling</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zodariidae</td>
<td>Rotundrela rotunda</td>
<td>Ant spider</td>
<td>No data</td>
<td>Free living, ground dwelling</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zoropsidae</td>
<td>Griswoldia melana</td>
<td>False wolf spider</td>
<td>No data</td>
<td>Ground wanderers</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zoropsidae</td>
<td>Griswoldia zuluensis</td>
<td>False wolf spider</td>
<td>No data</td>
<td>Ground wanderers</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zoropsidae</td>
<td>Phanotea ceratogyna</td>
<td>False wolf spider</td>
<td>No data</td>
<td>Ground wanderers</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zoropsidae</td>
<td>Phanotea peringueyi</td>
<td>False wolf spider</td>
<td>No data</td>
<td>Ground wanderers</td>
<td>Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Phylum:</strong> Arthropoda, <strong>Class:</strong> Diplopoda, <strong>Order:</strong> Spirostreptida</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirostreptidae</td>
<td>Doratogonus avius</td>
<td>Solitary black millipede</td>
<td>No data</td>
<td>A forest species</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirostreptidae</td>
<td>Doratogonus furculifer</td>
<td>Badplaas black millipede</td>
<td>No data</td>
<td>No data</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirostreptidae</td>
<td>Doratogonus herberti</td>
<td>Herbert's black millipede</td>
<td>No data</td>
<td>Found in Afromontane forests</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirostreptidae</td>
<td>Doratogonus hoffmani</td>
<td>Hoffman's black millipede</td>
<td>No data</td>
<td>Found in Afromontane forest and bracken dominated grassland</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirostreptidae</td>
<td>Doratogonus infragilis</td>
<td>Strong black millipede</td>
<td>No data</td>
<td>No data</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirostreptidae</td>
<td>Doratogonus major</td>
<td>Major black millipede</td>
<td>No data</td>
<td>Forest</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirostreptidae</td>
<td>Doratogonus meridionalis</td>
<td>Southern black millipede</td>
<td>No data</td>
<td>Afromontane forest</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirostreptidae</td>
<td>Doratogonus minor</td>
<td>Minor black millipede</td>
<td>No data</td>
<td>No data</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>105</sup> Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
TABLE 12.4.—Terrestrial invertebrate SCC included in the screening tool, including adult activity periods, microhabitat and/or food preferences as applicable (continued).

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP$^{105}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylum: Arthropoda, Class: Diplopoda, Order: Spirostreptidae (continued)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirostreptidae</td>
<td>Doratogonus natalensis</td>
<td>Natal black millipede</td>
<td>No data</td>
<td>Forest habitat</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirostreptidae</td>
<td>Doratogonus rubipodus</td>
<td>Ruby-footed black millipede</td>
<td>No data</td>
<td>Limited data but likely forest</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirostreptidae</td>
<td>Doratogonus septentrionalis</td>
<td>Northern black millipede</td>
<td>No data</td>
<td>Afromontane forest</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirostreptidae</td>
<td>Doratogonus zuluensis</td>
<td>Zululand black millipede</td>
<td>No data</td>
<td>Coastal dune forest</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phylum: Arthropoda, Class: Insecta, Order: Coleoptera</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucanidae</td>
<td>Colophon barnardi</td>
<td>Cape stag beetle</td>
<td>Crepuscular, October–March</td>
<td>High mountain ranges. Under stones or low vegetation. Likely root-feeders, on low bushy Restionaceae</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucanidae</td>
<td>Colophon berrisfordi</td>
<td>Cape stag beetle</td>
<td>Crepuscular October–March</td>
<td>High mountain ranges. Under stones or low vegetation. Likely root-feeders, on low bushy Restionaceae</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucanidae</td>
<td>Colophon cameroni</td>
<td>Cape stag beetle</td>
<td>Crepuscular, October–March</td>
<td>High mountain ranges. Under stones or low vegetation. Likely root-feeders, on low bushy Restionaceae</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucanidae</td>
<td>Colophon cassoni</td>
<td>Cape stag beetle</td>
<td>Crepuscular, October–March</td>
<td>High mountain ranges. Under stones or low vegetation. Likely root-feeders, on low bushy Restionaceae</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucanidae</td>
<td>Colophon eastmani</td>
<td>Cape stag beetle</td>
<td>Crepuscular, October–March</td>
<td>High mountain ranges. Under stones or low vegetation. Likely root-feeders, on low bushy Restionaceae</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucanidae</td>
<td>Colophon haughtoni</td>
<td>Cape stag beetle</td>
<td>Crepuscular, October–March</td>
<td>High mountain ranges. Under stones or low vegetation. Likely root-feeders, on low bushy Restionaceae</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$LDP^{105}$ Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
TABLE 12.4.—Terrestrial invertebrate SCC included in the screening tool, including adult activity periods, microhabitat and/or food preferences as applicable (continued).

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP105</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylum: Arthropoda, Class: Insecta, Order: Coleoptera (continued)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucanidae</td>
<td><em>Colophon izardi</em></td>
<td>Cape stag beetle</td>
<td>Crepuscular, October–March</td>
<td>High mountain ranges. Under stones or low vegetation. Likely root-feeders, on low bushy Restionaceae</td>
<td>LR/NT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucanidae</td>
<td><em>Colophon montisatris</em></td>
<td>Cape stag beetle</td>
<td>Crepuscular, October–March</td>
<td>High mountain ranges. Under stones or low vegetation. Likely root-feeders, on low bushy Restionaceae</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucanidae</td>
<td><em>Colophon neli</em></td>
<td>Cape stag beetle</td>
<td>Crepuscular, October–March</td>
<td>Sloping flatlands. Under stones or low vegetation</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucanidae</td>
<td><em>Colophon primosi</em></td>
<td>Cape stag beetle</td>
<td>Crepuscular, October–March</td>
<td>High mountain ranges. Under stones or low vegetation. Likely root-feeders, on low bushy Restionaceae</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucanidae</td>
<td><em>Colophon stokoe</em></td>
<td>Cape stag beetle</td>
<td>Crepuscular, October–March</td>
<td>Sloping flatlands. Under stones or low vegetation</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucanidae</td>
<td><em>Colophon thunbergi</em></td>
<td>Cape stag beetle</td>
<td>Crepuscular, October–March</td>
<td>High mountain ranges. Under stones or low vegetation. Likely root-feeders, on low bushy Restionaceae</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucanidae</td>
<td><em>Colophon westwoodi</em></td>
<td>Cape stag beetle</td>
<td>Crepuscular, October–March</td>
<td>Marshy flatland, taller restioid vegetation. Under stones or low vegetation</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucanidae</td>
<td><em>Colophon whitei</em></td>
<td>Cape stag beetle</td>
<td>Crepuscular, October–March</td>
<td>High mountain ranges. Under stones or low vegetation. Likely root-feeders, on low bushy Restionaceae</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scarabaeidae</td>
<td><em>Anonychonitis freyi</em></td>
<td>–</td>
<td>Presumably October to March</td>
<td>Prefers moist savanna and finer-grained soils in grassland and open woodland</td>
<td>NT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scarabaeidae</td>
<td><em>Endroedyolus paradoxus</em></td>
<td>–</td>
<td>Summer rainy season (mainly December)</td>
<td>Natural forest patches within a montane grasslands, woodlands and forests</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

105 Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
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<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scarabaeidae</td>
<td><em>Frankenbergerius opacus</em></td>
<td>–</td>
<td>No data, although collection records suggest that it may be active in autumn (May)</td>
<td>Lowland Fynbos and Renosterveld ecoregion, where cover is shrubland</td>
<td>DD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scarabaeidae</td>
<td><em>Pachysoma aesculapius</em></td>
<td>Westcoast flightless dung beetles</td>
<td>Active in morning (07:00–19:00) and late afternoon (16:00–18:00). Most active in spring (August to October)</td>
<td>Found in deep sand of coastal hummocks, riverbanks and vegetated dunes. Lowland Fynbos and renosterveld</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scarabaeidae</td>
<td><em>Pachysoma endroedyi</em></td>
<td>Westcoast flightless dung beetles</td>
<td>Most active in spring (August to September)</td>
<td>Found on firm vegetated sand on low coastal hills and sand dunes</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scarabaeidae</td>
<td><em>Pachysoma glentoni</em></td>
<td>Westcoast flightless dung beetles</td>
<td>Most active in spring (July to September)</td>
<td>Firm vegetated sand on the banks of rivers and from coastal hummocks</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scarabaeidae</td>
<td><em>Sarophonus punctatus</em></td>
<td>–</td>
<td>Collected during mid-summer (December)</td>
<td>Possibly montane forest</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phylum: Arthropoda, Class: Insecta, Order: Coleoptera (continued)</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Hesperiidae</td>
<td><em>Kedestes barberae bunta</em></td>
<td>Barber’s Cape Flats ranger</td>
<td>September</td>
<td><em>Imperata cylindrica</em></td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hesperiidae</td>
<td><em>Kedestes lenis lenis</em></td>
<td>False Bay unique ranger</td>
<td>Mainly during spring</td>
<td><em>Imperata cylindrica</em></td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hesperiidae</td>
<td><em>Kedestes niveostriga schloszi</em></td>
<td>Greyton dark ranger</td>
<td>December–April</td>
<td><em>Pennisetum macrourum and P. clandestinum</em></td>
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<td>Hesperiidae</td>
<td><em>Kedestes sarahae</em></td>
<td>Cederberg ranger</td>
<td>late September</td>
<td>Probably <em>Merxmuellera</em> spp.</td>
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<tr>
<td>Hesperiidae</td>
<td><em>Metisella syrinx</em></td>
<td>Bamboo sylph</td>
<td>January–February</td>
<td><em>Thamnocalamus tessellatus</em></td>
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<tr>
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<td><em>Tsitana dicksoni</em></td>
<td>Dickson’s sylph</td>
<td>Mid October–early January</td>
<td>No data</td>
<td>Rare – Low density</td>
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*Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
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<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP&lt;sup&gt;105&lt;/sup&gt;</th>
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<td>Lycaeinidae</td>
<td>Alaena margaritacea</td>
<td>Wolkberg zulu</td>
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<td>Aloeides barbarae</td>
<td>Barbara’s copper</td>
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<td>Aloeides caledoni</td>
<td>Caledon copper</td>
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<td>Lycaeinidae</td>
<td>Aloeides carolynnae carolynnae</td>
<td>Carolyn’s copper</td>
<td>September–November &amp; January–March</td>
<td>Aspalathus spp.</td>
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<td>Aloeides clarki</td>
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<td>Aloeides dentatis dentatis</td>
<td>Roodepoort copper</td>
<td>August–November &amp; February–March</td>
<td>Hermannia depressa and Lotononis eriantha</td>
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<td>Aloeides nubilus</td>
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<sup>105</sup> Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
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<tr>
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<td>Trimen's copper</td>
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<td>Lycaenidae</td>
<td><em>Anthene crawshayi juanita</em></td>
<td>Juanita's hairtail</td>
<td>No data</td>
<td><em>Senegalia polyacantha</em></td>
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<td>Linda's hairtail</td>
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<td><em>Vachellia erioloba</em></td>
<td>VU</td>
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<td>Southern purple</td>
<td>Undetermined (spring–autumn based on collection records)</td>
<td>No data</td>
<td>Rare – Restricted range</td>
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<td>Lycaenidae</td>
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<td>Pennington’s protea</td>
<td>Mid-September–early November</td>
<td><em>Protea caffra</em> and <em>P. simplex</em></td>
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<tr>
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<td><em>Chrysoritis adonis adonis</em></td>
<td>Adonis opal</td>
<td>November &amp; January</td>
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<td>Adonis opal</td>
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<td>No data</td>
<td>Extremely Rare</td>
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<td><em>Chrysoritis aureus</em></td>
<td>Heidelberg copper</td>
<td>September–April</td>
<td><em>Clutia pulchella</em> and <em>Diospyros lycioides</em></td>
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<td>Lycaenidae</td>
<td><em>Chrysoritis beaufortia charlesi</em></td>
<td>Beaufort opal</td>
<td>Mid-September–mid-December &amp; early March</td>
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<td>Rare – Restricted range</td>
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<td>Waaihoek opal</td>
<td>Mid-December–early March</td>
<td>No Data</td>
<td>Rare – Restricted range, habitat specialist</td>
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<td>Lycaenidae</td>
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<td>Brook’s opal</td>
<td>October–November &amp; April</td>
<td><em>Roepera</em> spp. and <em>Zygophyllum</em> spp.</td>
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<td>Lycaenidae</td>
<td><em>Chrysoritis daphne</em></td>
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<td>November &amp; December</td>
<td>No Data</td>
<td>Rare – Restricted range, habitat specialist</td>
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*Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.*
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<th>LDP&lt;sup&gt;105&lt;/sup&gt;</th>
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<td>Chrysoritis dicksoni</td>
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<td>CR</td>
<td>X</td>
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<td>Chrysoritis endymion</td>
<td>Endymoin opal</td>
<td>Mid-October–end January &amp; mid-April</td>
<td>No Data</td>
<td>Rare - Habitat specialist</td>
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<td>Chrysoritis irene</td>
<td>Irene's opal</td>
<td>Mid-October–end December &amp; February–early April</td>
<td>No data</td>
<td>Rare – Restricted range, habitat specialist</td>
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<td>Chrysoritis lyncurium</td>
<td>Tsomo River opal</td>
<td>December &amp; January</td>
<td>Diospyros lycioides</td>
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<td>Lycaeinidae</td>
<td>Chrysoritis lyndseyae</td>
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<td>Drakensberg daisy copper</td>
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<td>Lycaeinidae</td>
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<td>Pyramus opal</td>
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<td>Thesium spp. and Aspalathus spp.</td>
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<td>No data</td>
<td>Rare – Restricted range, habitat specialist</td>
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<th>Status (IUCN)</th>
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<td>Algoa common opal</td>
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<td>Thesium spp., Roepera flexuosa, R. morgsana and Osteospermum oppositifolium</td>
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<td>Uranus opal</td>
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<td>Durbania amakosa flavida</td>
<td>Amakoza rocksitter</td>
<td>November–January</td>
<td>Cyanobacteria</td>
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<td>Durbaniella clarki belladonna</td>
<td>Clark’s rocksitter</td>
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<td>Waterberg copper</td>
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<td>Deinbollia oblongifolia</td>
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</table>

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<th>Status (IUCN)</th>
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<td>Ketsi blue</td>
<td>November &amp; January</td>
<td>No data</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Lepidochrysops littoralis</td>
<td>Coastal blue</td>
<td>Late August–December</td>
<td>No data</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Lepidochrysops lotana</td>
<td>Lotana blue</td>
<td>September–early November</td>
<td>Ocimum obovatum subsp. cordatum</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{105}\) Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP&lt;sup&gt;105&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phylum:</strong> Arthropoda, <strong>Class:</strong> Insecta, <strong>Order:</strong> Lepidoptera (continued)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Lepidochrysops mcgregori</em></td>
<td>Mcgregor's Blue</td>
<td>August–mid-October &amp; mid-January</td>
<td>No data</td>
<td>Rare – Habitat specialist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Lepidochrysops areaeareas</em></td>
<td>Peninsula blue</td>
<td>Late September–early February</td>
<td>No data</td>
<td>Rare – Restricted range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Lepidochrysops pephredo</em></td>
<td>Estcourt blue</td>
<td>October–November</td>
<td><em>Ocimum obovatum</em> subsp. <em>cordatum</em></td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Lepidochrysops praeterita</em></td>
<td>Highveld blue</td>
<td>Early September–November</td>
<td><em>Ocimum obovatum</em> subsp. <em>cordatum</em></td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Lepidochrysops proceras</em></td>
<td>Potchefstroom blue</td>
<td>Late August–November &amp; January</td>
<td>No data</td>
<td>Rare – Habitat specialist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Lepidochrysops quickelbergei</em></td>
<td>Quickelberge’s blue</td>
<td>October–January</td>
<td>No data</td>
<td>Extremely Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Lepidochrysops swanepoeli</em></td>
<td>Swanepoel’s blue</td>
<td>Mainly November</td>
<td><em>Ocimum obovatum</em> subsp. <em>cordatum</em></td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Lepidochrysops victori</em></td>
<td>Victor’s blue</td>
<td>Mid-February–late March</td>
<td><em>Selago corymbosa</em></td>
<td>VU</td>
<td></td>
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</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Orachrysops ariadne</em></td>
<td>Karkloof blue</td>
<td>March–April</td>
<td><em>Indigofera woodii</em></td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Orachrysops brinkmani</em></td>
<td>Brinkman’s blue</td>
<td>Late October–December</td>
<td>No data</td>
<td>Rare – Restricted range, habitat specialist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Orachrysops mijburghi</em></td>
<td>Mijburgh’s blue</td>
<td>October–December &amp; January–March</td>
<td><em>Indigofera evansiana</em> and <em>I. dimidiata</em></td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Orachrysops montanus</em></td>
<td>Golden Gate blue</td>
<td>December–January</td>
<td><em>Indigofera dimidiata</em></td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Orachrysops niobe</em></td>
<td>Brenton blue</td>
<td>October–November &amp; February–March</td>
<td><em>Indigofera erecta</em></td>
<td>CR</td>
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</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Orachrysops regalis</em></td>
<td>Royal blue</td>
<td>October–December</td>
<td><em>Indigofera spp.</em></td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Orachrysops violescens</em></td>
<td>Violescent blue</td>
<td>September–December</td>
<td><em>Indigofera spp.</em></td>
<td>EN</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>105</sup> Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
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<thead>
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<th>Status (IUCN)</th>
<th>LDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lycaeinidae</td>
<td>Orachrysops warreni</td>
<td>Warren’s blue</td>
<td>Late October–mid-January</td>
<td>No data</td>
<td>Extremely Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Teriomima zuluana</td>
<td>Zulu buff</td>
<td>October &amp; November</td>
<td>Cyanobacteria</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Thestor barbatus</td>
<td>Bearded skolly</td>
<td>December</td>
<td>No data</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Thestor brachycerus brachycerus</td>
<td>Seaside skolly</td>
<td>December–January</td>
<td>No data</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Thestor calviniae</td>
<td>Calvinia skolly</td>
<td>Mid-November–December–December &amp; late February</td>
<td>No data</td>
<td>Rare – Restricted range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Thestor candeboo</td>
<td>Camdeboo skolly</td>
<td>November–early January</td>
<td>No data</td>
<td>Rare – Restricted range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Thestor claassensi</td>
<td>Claassen’s skolly</td>
<td>November–early December</td>
<td>No data</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Thestor compassbergae</td>
<td>Compassberg skolly</td>
<td>December</td>
<td>No data</td>
<td>Rare – Restricted range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Thestor dicksoni malagas</td>
<td>Atlantic skolly</td>
<td>December–April</td>
<td>No data</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Thestor dicksoni warreni</td>
<td>Dickson’s skolly</td>
<td>December–April</td>
<td>No data</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Thestor kaplani</td>
<td>Kaplan’s skolly</td>
<td>December-January</td>
<td>No data</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Thestor petra tempe</td>
<td>Tempe skolly</td>
<td>November–early January</td>
<td>No data</td>
<td>Extremely Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Thestor pictus</td>
<td>Langeberg skolly</td>
<td>September–December</td>
<td>No data</td>
<td>Rare – Restricted range, habitat specialist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Thestor pratumnus terblanchei</td>
<td>Terblanche's skolly</td>
<td>January–March</td>
<td>No data</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Thestor rooibergensis</td>
<td>Rooiberg skolly</td>
<td>October–early November</td>
<td>No data</td>
<td>Rare – Restricted range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaeinidae</td>
<td>Thestor stratti</td>
<td>Strutt's skolly</td>
<td>Late July &amp; August–early September</td>
<td>No data</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TABLE 12.4.—Terrestrial invertebrate SCC included in the screening tool, including adult activity periods, microhabitat and/or food preferences as applicable (continued).

Phylum: Arthropoda, Class: Insecta, Order: Lepidoptera (continued)

LDP species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
### TABLE 12.4.—Terrestrial invertebrate SCC included in the screening tool, including adult activity periods, microhabitat and/or food preferences as applicable (continued).

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<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP&lt;sup&gt;105&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Phylum:</strong> Arthropoda, <strong>Class:</strong> Insecta, <strong>Order:</strong> Lepidoptera (continued)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Thestor yildizae</em></td>
<td>Peninsula skolly</td>
<td>Mid-November–February &amp; mid-April</td>
<td>No data</td>
<td>Rare – Restricted range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Trimenia malagrida malagrida</em></td>
<td>Scarcemountain copper</td>
<td>Late January–March</td>
<td>No data</td>
<td>CRPE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Trimenia malagrida maryae</em></td>
<td>Scarcemountain copper</td>
<td>Late January–March</td>
<td>No data</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Trimenia malagrida paarlensis</em></td>
<td>Scarcemountain copper</td>
<td>Late January–March</td>
<td>No data</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Trimenia wallengrenii gonnemoi</em></td>
<td>Wallengren’s silver-spotted copper</td>
<td>November–December</td>
<td>No data</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Trimenia wallengrenii wallengrenii</em></td>
<td>Wallengren’s silver-spotted copper</td>
<td>November–December</td>
<td>No data</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Cassionympha camdeboo</em></td>
<td>Cambedoo brown</td>
<td>No data</td>
<td>Poaceae, Cyperaceae, Restionaceae and Juncaceae</td>
<td>Rare – Restricted range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Charaxes druceanus solitarius</em></td>
<td>Blouberg silver-barred charaxes</td>
<td>No data</td>
<td>No data</td>
<td>Rare – Restricted range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Charaxes marieps</em></td>
<td>Marieps charaxes</td>
<td>No data</td>
<td>No data</td>
<td>Rare – Restricted range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Charaxes xiphares occidentalis</em></td>
<td>Western forest-king charaxes</td>
<td>No data</td>
<td>No data</td>
<td>Extremely Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Charaxes xiphares staudei</em></td>
<td>Blouberg forest-king charaxes</td>
<td>No data</td>
<td>No data</td>
<td>Rare – Restricted range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Dingana clara</em></td>
<td>Wolkberg widow</td>
<td>Mainly October</td>
<td>Possibly Poaceae</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Dingana dingana</em></td>
<td>Dingaan’s widow</td>
<td>Mainly October</td>
<td>Possibly Poaceae</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Dingana fratema</em></td>
<td>Stoffberg widow</td>
<td>Mid–late October</td>
<td>No data</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Dingana jeroniae</em></td>
<td>Jerine’s widow</td>
<td>November</td>
<td>Possibly Poaceae</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Dira swanepoeli isolata</em></td>
<td>Swanepoeli’s widow</td>
<td>Late February &amp; early March</td>
<td>Possibly Poaceae</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>105</sup>Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
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<tr>
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<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP&lt;sup&gt;105&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nymphalidae</td>
<td><em>Neta lotenia</em></td>
<td>Loteni brown</td>
<td>December–mid-February</td>
<td>No data</td>
<td>Rare – Low density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Pseudonympha paragaika</em></td>
<td>Golden Gate brown</td>
<td>December–January</td>
<td>Merxmuellera spp.</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Pseudonympha southeyi kamiesbergenensis</em></td>
<td>Southey's brown</td>
<td>September–October</td>
<td>No data</td>
<td>Rare – Restricted range, habitat specialist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Pseudonympha southeyi southeyi</em></td>
<td>Southey's brown</td>
<td>November–mid-December &amp; late January–mid-February</td>
<td>No data</td>
<td>Extremely Rare</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Pseudonympha swanepoeli</em></td>
<td>Swanepeol's brown</td>
<td>February &amp; March</td>
<td>Probably Poaceae or Cyperaceae</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Serradinga clarki amissivalis</em></td>
<td>Clark's widow</td>
<td>December–January</td>
<td>Probably Poaceae</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Serradinga kammanassiensis</em></td>
<td>Kammanassie widow</td>
<td>Mid-November–early January</td>
<td>No data</td>
<td>Rare – Restricted range, habitat specialist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Stygionympha dicksoni</em></td>
<td>Dickson's hillside brown</td>
<td>Mid-August–October &amp; mid-March &amp; mid-June</td>
<td>Tribolium echinatum</td>
<td>CR</td>
<td></td>
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</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Telchina induna salmontana</em></td>
<td>Soutpansberg acraea</td>
<td>March–May</td>
<td>Aeschynomene nodulosa</td>
<td>EN</td>
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<tr>
<td>Nymphalidae</td>
<td><em>Torynesis mintha piquetbergenensis</em></td>
<td>Piquetberg widow</td>
<td>April–May</td>
<td>Poaceae</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Torynesis orangica</em></td>
<td>Orange widow</td>
<td>Late December–February &amp; late March</td>
<td>No data</td>
<td>Rare – Restricted range, habitat specialist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Papilionidae</td>
<td><em>Papilio ophidicephalus zuluensis</em></td>
<td>Emperor swallowtail</td>
<td>Mid-August &amp; late September–early April &amp; mid-May</td>
<td>No data</td>
<td>Rare – Restricted range, habitat specialist</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>105</sup> Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
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<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP&lt;sup&gt;105&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylum: Arthropoda, Class: Insecta, Order: Orthoptera</td>
<td>Aneuryphymus montanus</td>
<td>Yellow-winged agile grasshopper</td>
<td>No data</td>
<td>Fynbos vegetation, collected amongst burnt stands of evergreen sclerophyll vegetation. It prefers south-facing cool slopes.</td>
<td></td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Acrididae</td>
<td>Phymeurus illepidus</td>
<td>Durban agile grasshopper</td>
<td>No data</td>
<td>Dry open grass vegetation. May be found at forest edges.</td>
<td></td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Lentulidae</td>
<td>Afratettix fursti</td>
<td>Bokkeveld earless grasshopper</td>
<td>No data</td>
<td>Occurs in the low foliage of low woody perennial shrublets growing on gently undulating plains.</td>
<td></td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Lentulidae</td>
<td>Betiscoides meridionalis</td>
<td>Slender restio grasshopper</td>
<td>No data</td>
<td>Occurs only in moist Restio vegetation</td>
<td></td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Lentulidae</td>
<td>Betiscoides parva</td>
<td>Small restio grasshopper</td>
<td>No data</td>
<td>Occurs only in Restio vegetation</td>
<td></td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Lentulidae</td>
<td>Betiscoides sjostedti</td>
<td>Robust restio grasshopper</td>
<td>No data</td>
<td>Occurs only in moist Restio vegetation</td>
<td></td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Pneumoridae</td>
<td>Bullacris obliqua</td>
<td>Bladder grasshopper</td>
<td>August–November</td>
<td>Fynbos biome. Eriocephalus africanus is currently the only confirmed host plant.</td>
<td></td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Pneumoridae</td>
<td>Peringueyacris namaqua</td>
<td>Bladder grasshopper</td>
<td>August–November</td>
<td>Succulent Karoo vegetation biome. Host plants include Pentzia incana and Eriocephalus aspalathoides.</td>
<td></td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Pneumoridae</td>
<td>Physemacris papillosa</td>
<td>Bladder grasshopper</td>
<td>No data</td>
<td>Fynbos vegetation biome</td>
<td></td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Pneumoridae</td>
<td>Physophorina livingstonii</td>
<td>Bladder grasshopper</td>
<td>No data</td>
<td>Forest dwelling species</td>
<td></td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Pneumoridae</td>
<td>Physophorina miranda</td>
<td>Bladder grasshopper</td>
<td>November–February</td>
<td>Forest dwelling spe-cies Berkheya amplexicaulis is its recorded host plant.</td>
<td></td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Pneumoridae</td>
<td>Prostalia granulata</td>
<td>Bladder grasshopper</td>
<td>No data</td>
<td>Prefers savanna type vegetation</td>
<td></td>
<td>EN</td>
<td></td>
</tr>
</tbody>
</table>

<sup>105</sup> Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP&lt;sup&gt;105&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tettigoniidae</td>
<td>Actilacris furcatus</td>
<td>Mt. Coke false shieldback</td>
<td>No data</td>
<td>Collected from humid, shady habitats on low vegetation within natural thicket.</td>
<td></td>
<td>CR</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Actilacris kristinae</td>
<td>Kristin's false shieldback</td>
<td>No data</td>
<td>Collected from humid, shady habitats on low vegetation close to the ground.</td>
<td></td>
<td>CR</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Africariola longicauda</td>
<td>Richtersveld katydid</td>
<td>No data</td>
<td>Found in semi-arid habitats of Nama and Succulent Karoo</td>
<td></td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Amytacta marakelensis</td>
<td>Marakele delicate katydid</td>
<td>No data</td>
<td>Found in Savanna and Grassland biome and feeds on seeds of grasses, eg. <em>Urochloa maxima</em>.</td>
<td></td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Aroegas dilatatus</td>
<td>Dilated false shieldback</td>
<td>No data</td>
<td>Occurs only within indigenous forest</td>
<td></td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Aroegas fuscus</td>
<td>Brown false shieldback</td>
<td>No data</td>
<td>Occurs at an elevation of above 1200 m in Mecis Highveld Grassland bioregion.</td>
<td></td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Aroegas nigroomatus</td>
<td>Black-spotted false shieldback</td>
<td>No data</td>
<td>No data</td>
<td></td>
<td>CR</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Arytropteris basalis</td>
<td>Flat-necked shieldback</td>
<td>No data</td>
<td>Occurs only within coastal forest and thicket mosaics.</td>
<td></td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Arytropteris pando</td>
<td>Pondi flat-necked shieldback</td>
<td>No data</td>
<td>Arboreal species found mostly in dense, shady forest vegetation, usually several meters above the ground.</td>
<td></td>
<td>CR</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Austrodontura castleoni</td>
<td>Castleton's flightless katydid</td>
<td>No data</td>
<td>Found to be abundant in indigenous coastal forests on herbaceous vegetation at shaded edges of the forest, on the invasive plant <em>Lantana camara</em>, and on lower branches of <em>Vachellia karoo</em>.</td>
<td></td>
<td>CR</td>
<td></td>
</tr>
</tbody>
</table>

<sup>105</sup>Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
### TABLE 12.4.—Terrestrial invertebrate SCC included in the screening tool, including adult activity periods, microhabitat and/or food preferences as applicable (continued).

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tettigoniidae</td>
<td><em>Brinckiella aptera</em></td>
<td>Mute winter katydid</td>
<td>August–October</td>
<td>Fynbos and Succulent Karoo biomes. Occurs primarily on low, herbaceous shrubs. This species feeds and stridulates at night and can be found basking from August until October.</td>
<td></td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td><em>Brinckiella arboricola</em></td>
<td>Tree winter katydid</td>
<td>August–October</td>
<td>Fynbos and Succulent Karoo biomes. Feeds on flowers and leaves of a very narrow range of host plants and occurs primarily on low, herbaceous shrubs. This species feeds and stridulates at night and can be found basking from August until October.</td>
<td></td>
<td>EN</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td><em>Brinckiella karooensis</em></td>
<td>Karoo winter katydid</td>
<td>No data</td>
<td>Inhabits Succulent Karoo biome and occurs on low shrubs and grasses.</td>
<td></td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td><em>Brinckiella mauerbergerorum</em></td>
<td>Mauerberger's winter katydid</td>
<td>June–August</td>
<td>Found in the Succulent Karoo biome, on succulent shrubs.</td>
<td></td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td><em>Cedarbergeniana imperfecta</em></td>
<td>Cave katydid</td>
<td>Year round</td>
<td>Cave-inhabiting katydid, adults and juveniles co-occur throughout the year. Found on cave ceilings, where rock hyrax is absent and conditions are of constant low temperature. Feeds on grasses outside the cave.</td>
<td></td>
<td>CR</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td><em>Clonia lalandei</em></td>
<td>Lalande's black-winged clonia</td>
<td>No data</td>
<td>Occurs in Grassland and Savanna biomes</td>
<td></td>
<td>VU</td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td><em>Clonia uvarovi</em></td>
<td>Uvarov's clonia</td>
<td>No data</td>
<td>Inhabits tall woodland savannah</td>
<td></td>
<td>VU</td>
<td></td>
</tr>
</tbody>
</table>

* Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
### TABLE 12.4.—Terrestrial invertebrate SCC included in the screening tool, including adult activity periods, microhabitat and/or food preferences as applicable (continued).

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP&lt;sup&gt;105&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tettigoniidae</td>
<td>Conocephalus peringueyi</td>
<td>Peringuey's meadow katydid</td>
<td>No data</td>
<td>Only known from mountains in the Fynbos biome, South Africa</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Conocephalus vaginalis</td>
<td>Striped restio katydid</td>
<td>No data</td>
<td>Associated exclusively with Restionaceae. Diet unknown but likely feed on seeds and flowers of restios.</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Conocephalus zlobini</td>
<td>Zlobin's meadow katydid</td>
<td>No data</td>
<td>Associated with grassy habitats. Feeds on grasses and grass seeds.</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Griffiniana duplessisa</td>
<td>Duplessis' agile katydid</td>
<td>No data</td>
<td>Associated with xeric, sparsely-vegetated habitats. Nocturnal and spend the day under rocks or deep within shrubs.</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Paracilacris lateralis</td>
<td>Drakensberg Grass false shieldback</td>
<td>No data</td>
<td>Associated primarily with open grasslands where it probably feeds on grass seeds and flowers.</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Paracilacris mordax</td>
<td>Golden Gate grass false shieldback</td>
<td>No data</td>
<td>Mid to high elevation grasslands. Likely feeds on flowers and seeds of grasses. Feeding and reproductive behaviours occur at night.</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Paracilacris periditus</td>
<td>Imperiled grass false shieldback</td>
<td>No data</td>
<td>Restricted to a small, residual strip of natural Podocarpus forest.</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Peringueyella rentzi</td>
<td>Rentz's ambush katydid</td>
<td>No data</td>
<td>Occurs in high elevation grassy habitats. It appears to be active during the day and is probably predatory.</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tettigoniidae</td>
<td>Peringueyella zulu</td>
<td>Zulu ambush katydid</td>
<td>No data</td>
<td>Occurs in grassy habitats and is active during the day. Morphology strongly indicates exclusively predatory habits.</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>105</sup>Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.


### Family: Tettigoniidae

<table>
<thead>
<tr>
<th>Species</th>
<th>Common Name</th>
<th>Adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP&lt;sup&gt;105&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pomatonota dregii</em></td>
<td>East coast katydid</td>
<td>No data</td>
<td>Found in Indian Ocean Coastal Belt forests. This species feeds on a variety of tree species, particularly native thorn trees (<em>Senegalia</em> and <em>Vachellia</em>).</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Thoracistus arbores</em></td>
<td>Arboreal seedpod shieldback</td>
<td>No data</td>
<td>Found in mountainous country on vegetation nearly 2 m from the ground.</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Thoracistus aureoportalis</em></td>
<td>Golden gate seedpod shieldback</td>
<td>No data</td>
<td>Collected in an open meadow habitat that had grasses and sparse shrubs. Observed feeding on floral parts of grasses.</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Thoracistus jambila</em></td>
<td>Jambila seedpod shieldback</td>
<td>No data</td>
<td>Associated with open, tall grassy habitats</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Thoracistus peringueyi</em></td>
<td>Peringuey's seedpod shieldback</td>
<td>No data</td>
<td>No data</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Thoracistus semeniphagus</em></td>
<td>Seedpod shieldback</td>
<td>No data</td>
<td>Found feeding on grass seed-heads on grassy hillsides in the late afternoon and early evening.</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Thoracistus thyraeus</em></td>
<td>Inflated seedpod shieldback</td>
<td>No data</td>
<td>'Collected at night in weedy growth along a roadside. Most of the specimens were feeding on seed-heads of grasses'.</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Thoracistus viridicus</em></td>
<td>Green-kneed seedpod shieldback</td>
<td>No data</td>
<td>Endemic to Savanna (bushveld) biome</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Transkeidectes multidentis</em></td>
<td>Transkei shieldback</td>
<td>No data</td>
<td>Humid, shady understory habitats of Indian Ocean Coastal Belt forests on herbaceous plants, very close to the ground. Partially diurnal, courtship activity occurs at night.</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>105</sup>Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
TABLE 12.5.—Terrestrial invertebrate SCC not specifically included in the screening tool, including adult activity periods, microhabitat and/or food preferences as applicable.

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Peak adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP (^{106})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylum: Mollusca, Class: Gastropoda, Order: Stylommatophora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charopidae</td>
<td><em>Chilocyists clifdeni</em></td>
<td>Dlinza forest pinwheel</td>
<td>No data</td>
<td>In leaf-litter/ground dwelling or arboreal, found in coastal scarp forest, Dlinza Forest in Eshowe.</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(synonym <em>Trachycystis clifdeni</em>)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charopidae</td>
<td><em>Trachycystis placenta</em></td>
<td>Discus pinwheel</td>
<td>No data</td>
<td>In leaf-litter/ground dwelling or arboreal, found in primarily mist-belt Podocarpus forest, but merging with scarp forest at lower altitudes. Known only from Nkandla Forest inland of Eshowe.</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charopidae</td>
<td><em>Trachycystis haygarthi</em></td>
<td>Haygarth’s pinwheel</td>
<td>No data</td>
<td>Arboreal found under leaves, in Mist-belt Podocarpus and scarp forest. Known only from Nkandla and Entumeni Forests inland of Eshowe.</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlamydephoridae</td>
<td><em>Chlamydephorus burnupi</em></td>
<td>Burnup’s hunter slug</td>
<td>No data</td>
<td>In leaf-litter/ground dwelling or arboreal, found in afromontane Podocarpus forest; in leaf litter, under logs and stones. Facultative predator.</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlamydephoridae</td>
<td><em>Chlamydephorus dimidius</em></td>
<td>Snake skin hunter slug</td>
<td>No data</td>
<td>In leaf-litter/ground dwelling or arboreal, in forested habitats, primarily coastal lowland and coastal scarp forests. Known only from the coastal region between Durban and the Mtamvuna River, with one inland record from Qudeni Forest in the Kranskop area. Facultative predator.</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urocyclidae</td>
<td><em>Kerkophorus puzeyi</em></td>
<td>Puzey’s tail-wagger</td>
<td>No data</td>
<td>Arboreal found under leaves, in coastal scarp forest and woodland. Known only from a small stretch of coast from just north of Mbotyi to just south of Port St. Johns.</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(synonym <em>Sheldonia puzeyi</em>)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhytididae</td>
<td><em>Natalina wesseliana</em></td>
<td>Tongaland cannibal snail</td>
<td>No data</td>
<td>In leaf-litter/ground dwelling or arboreal, occurs in coastal and coastal scarp forest. On the coastal plain of north Zululand and south Mozambique (St. Lucia–Maputo).</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhytididae</td>
<td><em>Natalina beyrichi</em></td>
<td>Pondoland cannibal snail</td>
<td>No data</td>
<td>In leaf-litter/ground dwelling or arboreal, occurs in coastal forest. Occurs in South Africa from Mkambati Nature Reserve to Xora.</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{106}\) Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Peak adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP&lt;sup&gt;106&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Streptaxidae</strong></td>
<td><em>Gulella aprosdoketa</em></td>
<td>Trident hunter snail</td>
<td>No data</td>
<td>In leaf-litter/ground dwelling or arboreal, in coastal scarp forest and woodland. A section of the Eastern Cape coast, from Port St Johns to Manubi inland of Mazeppa Bay. Preferred habitat is highly fragmented.</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Streptaxidae</strong></td>
<td><em>Gulella daustralis</em></td>
<td>Keyhole hunter snail</td>
<td>No data</td>
<td>In leaf-litter/ground dwelling or arboreal, in Mist-belt <em>Podocarpus</em> forest. Known only from three localities: Ngele Forest near Kokstad; Gomo Forest and Tabankulu Forest near Mt Ayliff (E. Cape).</td>
<td>EN</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Streptaxidae</strong></td>
<td><em>Gulella puzeyi</em></td>
<td>Puzey’s hunter snail</td>
<td>No data</td>
<td>In leaf-litter/ground dwelling or arboreal, in coastal scarp forest and woodland. Known from just north of Mbotyi to Manubi inland of Mazeppa Bay.</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Streptaxidae</strong></td>
<td><em>Gulella salpinx</em></td>
<td>Trumpet-mouthed hunter snail</td>
<td>No data</td>
<td>In leaf-litter/ground dwelling or arboreal, in limestone deposits (the Marble Delta) inland of Port Shepstone, in valley thicket and woodland on south facing slopes.</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Phylum: Onychophora, Class: Udeonychophora, Order: Euonychophora</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Peripatopsidae</strong></td>
<td><em>Peripatopsis clavigera</em></td>
<td>Knysna velvet worm</td>
<td>Seasonal activity unknown, adults present year-round</td>
<td>Afromontane forest, amongst moist leaf litter or under or in fallen and rotting logs. Predaceous.</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Peripatopsidae</strong></td>
<td><em>Peripatopsis alba</em></td>
<td>White cave velvet worm</td>
<td>Seasonal activity unknown, adults present year-round</td>
<td>Table Mountain, Wynberg and Bats Cave systems in Western Cape. In Wynberg Cave, specimens were collected about 30 m below the surface. The cave is dark, walls are constantly damp, and the only vegetation is small greyish lichen. Predaceous.</td>
<td>VU</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>106</sup>Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
**Phylum:** Onychophora, **Class:** Udeonychophora, **Order:** Euonychophora (continued)

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Common Name</th>
<th>Peak adult activity period</th>
<th>Microhabitat/food source</th>
<th>Status (South Africa)</th>
<th>Status (IUCN)</th>
<th>LDP&lt;sup&gt;106&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripatopsidae</td>
<td><em>Peripatopsis leonina</em></td>
<td>Lion's Hill velvet worm</td>
<td>Seasonal activity unknown, adults present year-round</td>
<td>Fynbos, in small ravines, under stones. Known only from Lion's Hill (Signal Hill), Cape Peninsula, Western Cape. Predaceous.</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peripatopsidae</td>
<td><em>Opisthopatus roseus</em></td>
<td>Pink velvet worm</td>
<td>Seasonal activity unknown, adults present year-round</td>
<td>Afromontane forest, amongst moist leaf litter or under or in fallen and rotting logs. Known only from Ngele Forest, KwaZulu-Natal. Predaceous.</td>
<td>CR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>106</sup> Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
12.6 **Appendix 6**

Target invertebrate species based on provincial biodiversity plans

<table>
<thead>
<tr>
<th>Family</th>
<th>Scientific name</th>
<th>Province</th>
<th>LDP¹⁰⁷</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lycaenidae</td>
<td><em>Aloeides dentatis dentatis</em></td>
<td>Gauteng (C-Plan 3.3)</td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Chrysoritis aureus</em></td>
<td>Gauteng (C-Plan 3.3)</td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Lepidochrysops praeterita</em></td>
<td>Gauteng (C-Plan 3.3)</td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Capys penningtoni</em></td>
<td>KwaZulu-Natal</td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Lepidochrysops pephredo</em></td>
<td>KwaZulu-Natal</td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Orachrysops ariadne</em></td>
<td>KwaZulu-Natal</td>
<td></td>
</tr>
<tr>
<td>Lycaenidae</td>
<td><em>Teriomima zuluana</em></td>
<td>KwaZulu-Natal</td>
<td></td>
</tr>
<tr>
<td>Nymphalidae</td>
<td><em>Dingana dingana</em></td>
<td>KwaZulu-Natal</td>
<td></td>
</tr>
<tr>
<td>Scarabaeidae</td>
<td><em>Ichnestoma stobbiai</em></td>
<td>Gauteng (C-Plan 3.3)</td>
<td>X</td>
</tr>
</tbody>
</table>

¹⁰⁷Low Detection Probability (LDP) species. Specialists must refer to 9.3.7 Expected SCC with very low detection probabilities.
### Appendix 7

List of important fauna SCC and their estimated geographic area of occurrence (km² and ha)

<table>
<thead>
<tr>
<th>Clade or Group</th>
<th>Scientific Name</th>
<th>Common name</th>
<th>IUCN Status</th>
<th>Occurrence area (km²)</th>
<th>Occurrence area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphibia</td>
<td>Afrixalus knysnae</td>
<td>Knysna leaf-folding frog</td>
<td>EN</td>
<td>7.29</td>
<td>729.45</td>
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<tr>
<td>Amphibia</td>
<td>Anhydrophyne ngongoniensis</td>
<td>Mistbelt chirping frog</td>
<td>EN</td>
<td>13.08</td>
<td>1308.38</td>
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<tr>
<td>Amphibia</td>
<td>Anhydrophyne rattrayi</td>
<td>Hogsback chirping frog</td>
<td>VU</td>
<td>4.41</td>
<td>441.10</td>
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<tr>
<td>Amphibia</td>
<td>Arthroleptella rugosa</td>
<td>Rough moss frog</td>
<td>CR</td>
<td>17.48</td>
<td>1747.99</td>
</tr>
<tr>
<td>Amphibia</td>
<td>Arthroleptella subvoce</td>
<td>Northern moss frog</td>
<td>CR</td>
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<td>4138.19</td>
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<td>Amphibia</td>
<td>Cacosternum thorini</td>
<td>Hogsback caco</td>
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<td>247.79</td>
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<tr>
<td>Amphibia</td>
<td>Capensibufa rosei</td>
<td>Rose's mountain toadlet</td>
<td>CR</td>
<td>1.15</td>
<td>114.70</td>
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<tr>
<td>Amphibia</td>
<td>Heleophryne hewitti</td>
<td>Hewitt’s ghost frog</td>
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<td>2.93</td>
<td>292.97</td>
</tr>
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<td>Amphibia</td>
<td>Heleophryne rosei</td>
<td>Table Mountain ghost frog</td>
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<td>11.85</td>
<td>1185.12</td>
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<td>Amphibia</td>
<td>Hyperolius pickersgilli</td>
<td>Pickersgill’s reed frog</td>
<td>EN</td>
<td>20.84</td>
<td>2084.08</td>
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<td>Amphibia</td>
<td>Leptopelis xenodactylus</td>
<td>Weza Forest tree frog</td>
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<td>7.78</td>
<td>778.26</td>
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<tr>
<td>Amphibia</td>
<td>Microbatrachella capensis</td>
<td>Cape Flats frog</td>
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<td>2.25</td>
<td>224.74</td>
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<td>Amphibia</td>
<td>Natalobatrachus bonebergi</td>
<td>Kloof frog</td>
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<td>15.40</td>
<td>1539.69</td>
</tr>
<tr>
<td>Amphibia</td>
<td>Sclerophrys pantherina</td>
<td>Western leopard toad</td>
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<td>4.09</td>
<td>409.00</td>
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<tr>
<td>Amphibia</td>
<td>Vandijkophrynus amatolicus</td>
<td>Amathole toad</td>
<td>CR</td>
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<td>325.98</td>
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<td>Amphibia</td>
<td>Xenopus gilli</td>
<td>Cape platanna</td>
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<td>335.01</td>
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<tr>
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<td>Anthus chloris</td>
<td>Yellow-breasted Pipit</td>
<td>VU</td>
<td>1494.97</td>
<td>149496.67</td>
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<tr>
<td>Aves</td>
<td>Aquila verreauxii</td>
<td>Verreaux’s Eagle</td>
<td>VU</td>
<td>24703.59</td>
<td>2470358.54</td>
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<tr>
<td>Aves</td>
<td>Bradypterus sylvaticus</td>
<td>Knysna Warbler</td>
<td>VU</td>
<td>2519.99</td>
<td>251999.04</td>
</tr>
<tr>
<td>Aves</td>
<td>Calendulauda burra</td>
<td>Red Lark</td>
<td>VU</td>
<td>5212.32</td>
<td>521231.76</td>
</tr>
<tr>
<td>Aves</td>
<td>Campethera notata</td>
<td>Knysna Woodpecker</td>
<td>EN</td>
<td>10279.02</td>
<td>1027901.89</td>
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<td>Aves</td>
<td>Certhilauda brevirostris</td>
<td>Agulhas Long-billed Lark</td>
<td>NT</td>
<td>7867.48</td>
<td>786747.94</td>
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<tr>
<td>Aves</td>
<td>Ciconia nigra</td>
<td>Black Stork</td>
<td>VU</td>
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<td>159783.40</td>
</tr>
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<td>Aves</td>
<td>Circaetus fasciolatus</td>
<td>Southern Banded Snake Eagle</td>
<td>CR</td>
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<td>179575.34</td>
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<td>Circus ranivorus</td>
<td>African Marsh Harrier</td>
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<td>Eastern Bronze-naped Pigeon</td>
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<td>7573.14</td>
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<td>Saddle-Billed Stork</td>
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<td>4673.39</td>
<td>467339.22</td>
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<td>Falco fascinucha</td>
<td>Taita Falcon</td>
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<td>Geokichla gymneri</td>
<td>Orange Ground Thrush</td>
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<td>51367.15</td>
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<td>Spotted Ground Thrush</td>
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<td>61150.52</td>
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<td>Southern Bald Ibis</td>
<td>VU</td>
<td>33362.67</td>
<td>3336267.45</td>
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<td>Grus carunculata</td>
<td>Wattled Crane</td>
<td>CR</td>
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<td>239252.50</td>
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<tr>
<td>Clade or Group</td>
<td>Scientific Name</td>
<td>Common name</td>
<td>IUCN Status</td>
<td>Occurrence area (km²)</td>
<td>Occurrence area (ha)</td>
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<tr>
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<td>---------------------</td>
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<tr>
<td>Aves</td>
<td>Gypaetus barbatus</td>
<td>Bearded Vulture</td>
<td>CR</td>
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<td>Halcyon senegaloides</td>
<td>Mangrove Kingfisher</td>
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<td>459.71</td>
<td>45970.72</td>
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<tr>
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<td>Heteromirafruddi</td>
<td>Rudd's Lark</td>
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<td>238.29</td>
<td>23829.23</td>
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<td>Hirundo atrocaerulea</td>
<td>Blue Swallow</td>
<td>CR</td>
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<td>35774.07</td>
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<td>CR</td>
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<td>2215.45</td>
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<td>Denham's Bustard</td>
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<td>1363315.87</td>
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<td>Cape Parrot</td>
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<td>69067.18</td>
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<td>Sagittarius serpentinus</td>
<td>Secretarybird</td>
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<td>27547.79</td>
<td>2754779.33</td>
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<tr>
<td>Aves</td>
<td>Sartophala capensis</td>
<td>Striped Flufftail</td>
<td>VU</td>
<td>749.97</td>
<td>74996.85</td>
</tr>
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<td>Sartophala ayresi</td>
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<td>African Grass Owl</td>
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<td>Wolkberg Zulu</td>
<td>CR</td>
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<td>202.85</td>
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<td>Aloceides barbarae</td>
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<td>Caledon russet</td>
<td>R-LD</td>
<td>0.43</td>
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<td>Coega russet</td>
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<td>Red Hill russet</td>
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<td>46.92</td>
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<td>119.10</td>
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<td>Cederberg russet</td>
<td>R-RR</td>
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<td>748.29</td>
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<td>Cloud russet</td>
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<td>74.12</td>
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<tr>
<td>Clade or Group</td>
<td>Scientific Name</td>
<td>Common name</td>
<td>IUCN Status</td>
<td>Occurrence area (km²)</td>
<td>Occurrence area (ha)</td>
</tr>
<tr>
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<td>----------------------------------</td>
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<td>-------------</td>
<td>-----------------------</td>
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<tr>
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<td>Aloeides pallida jonathani</td>
<td>Kammanassie giant russet</td>
<td>R-RR</td>
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<td>1027.77</td>
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<td>Tsitsikamma giant russet</td>
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<td>Rossouw’s russet</td>
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<td>173.35</td>
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<td>Invertebrate</td>
<td>Aloeides stevensoni</td>
<td>Wolkeberg russet</td>
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12.8 Appendix 8
List of plant SCC and their estimated geographic area of occurrence (km²)

For plants listed as having no recent data, any confirmed population represents the only recent known population for the taxon and must be included as highly significant. For plants listed as being under-sampled, the proportion of the population may still be calculated and represented in the report but specialists must flag that it is likely an overestimate as there is too little recent data to accurately calculate the total area of occurrence for the species. In such cases the specialist must represent the significance of the population through comparing field findings with the information included in the Red List assessment for the taxon.

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This Species Environmental Assessment Guideline was developed to support the Protocols for the Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal and Plant Species. The protocols prescribe the assessment and minimum reporting criteria for impacts on terrestrial animal and plant species for activities requiring environmental authorisation. They have the force of regulations made in terms of the National Environmental Management Act, and are therefore legally binding and must be complied with. The guideline, in turn, describes the manner in which species specialists, environmental assessment practitioners, and the proponents of the development project, can ensure compliance with these requirements. It provides background and context to the requirements set by the respective protocols, as well as guidance on sampling and data collection methodologies for the different taxonomic groups represented therein, and represents the most efficient and effective manner in which the Terrestrial Animal and Plant Species Protocols can be complied with.

The guideline was produced by the South African National Biodiversity Institute (SANBI) in collaboration with BirdLife South Africa, the Council for Scientific and Industrial Research (CSIR), and several commissioned species specialists. It will be updated periodically in response to updates to the species layers of the national web-based environmental screening tool. Environmental assessment practitioners and specialists are therefore advised to ensure that they utilise the most recent version of the guideline (available on the SANBI website).