Crocidura mariquensis – Swamp Musk Shrew

Regional Red List status (2016)	Near Threatened B2ab(ii,iii,iv)*
National Red List status (2004)	Data Deficient
Reasons for change	Non-genuine change: New information
Global Red List status (2016)	Least Concern
TOPS listing (NEMBA)	None
CITES listing	None
Endemic	No

*Watch-list Threat

Swamp Musk Shrews are habitat specialists, occurring only in moist, swampy habitats (Skinner & Chimimba 2005).

Taxonomy

Crocidura mariquensis (Smith 1844)

ANIMALIA - CHORDATA - MAMMALIA - EULIPOTYPHLA - SORICIDAE - *Crocidura* - *mariquensis*

Common names: Swamp Musk Shrew, Marico Musk Shrew (English), Vleiskeerbek (Afrikaans)

Taxonomic status: Species

Taxonomic notes: Meester et al. (1986) recognised two subspecies in southern Africa: *C. m. mariquensis* occurring in KwaZulu-Natal, northern Free State, North West, Limpopo, Gauteng and Mpumalanga provinces and Mozambique; and *C. m. shortridgei*, occurring from north-eastern Namibia to northwestern Zimbabwe. Additionally, morphometric data reveal the KwaZulu-Natal population to be distinct from all others (Dippenaar 1979; Taylor 1998). Thus, this species may represent a species complex, but until new research provides further evidence, we retain the species status.

Assessment Rationale

This species has a wide distribution across the assessment region and occurs in many protected areas, but is restricted to wetlands and waterlogged areas, thus leading to a patchy area of occupancy (AOO). We use wetlands as a proxy for suitable habitat and calculate the amount of natural habitat remaining within buffer strips around wetlands as the inferred area of occupancy (AOO), which yields 2,395–2,794 km^2 (using a 32 m buffer strip). We suspect that these habitat patches are severely fragmented, as shrews have a poor dispersal ability and continuing rates of urban and rural expansion may have increased overgrazing and water abstraction, which may reduce the suitability of patches and the corridors between them. Similarly, we infer a continuing population decline based on high rates of habitat loss in all provinces, especially KwaZulu-Natal and North West (1.2% per annum from 1994–2011 and 0.5% per annum from 2006–2010 respectively). Additionally, climate change may cause a range contraction in the future as arid areas expand towards the east, representing an emerging threat. Thus, we list this species, under a precautionary purview, as Near Threatened B2ab(ii,iii,iv) because, although the AOO estimate > 2,000 km^2, not all suitable habitat will be occupied.

Further field studies and research should assess the species' distribution more accurately and examine whether artificial wetlands can compensate for the loss of natural areas. Regardless, it is reliant on natural vegetation and wet, muddy substrates. Thus, managers and landowners should restore and maintain buffers of natural vegetation around wetlands and keep stocking densities at ecological carrying capacity to ensure the persistence of this species.

Regional population effects: No significant rescue effects are possible as habitats are presumably fragmented between regions and the species is too small to disperse over long distances.

Distribution

This widely but patchily distributed species occurs in south-eastern Democratic Republic of Congo, Zambia, Angola, northeast Namibia, northwest Botswana (the Okavango Delta), Zimbabwe, southern Mozambique, Swaziland and north-eastern South Africa. There is a disjunction between the subspecies occurring within the assessment region (*C. m. mariquensis*) and the more northern subspecies (*C. m. shortridgei*). If the latter is revealed to be a full species through molecular research, *C. m. mariquensis* will become endemic to the assessment region.

Within the assessment region, it occurs in wetlands and waterlogged grasslands predominantly (both post-1999 and pre-2000 records, Figure 1) in KwaZulu-Natal, Mpumalanga, Limpopo, Gauteng and eastern North West provinces, while marginally occurring in the northern reaches of Free State Province (Fuller & Perrin 2001;

Recommended citation: Taylor PJ, Baxter R, Power RJ, Monadjem A, Harvey J, Child MF. 2016. A conservation assessment of *Crocidura mariquensis*. In Child MF, Roxburgh L, Do Linh San E, Raimondo D, Davies-Mostert HT, editors. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

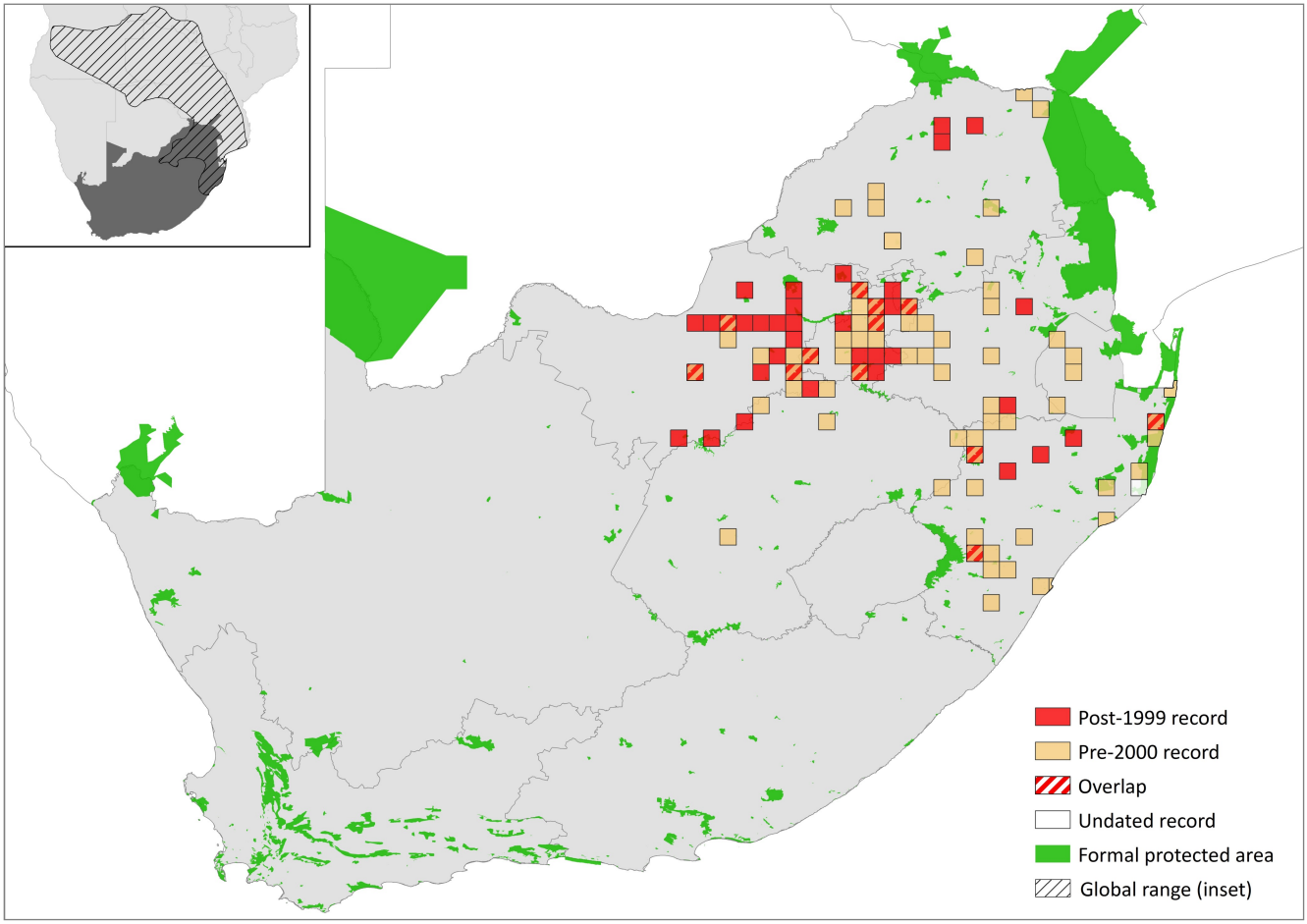

Figure 1. Distribution records for Swamp Musk Shrew (*Crocidura mariquesis*) within the assessment region

Table 1. Countries of occurrence within southern Africa

Country	Presence	Origin
Botswana	Extant	Native
Lesotho	Absent	-
Mozambique	Extant	Native
Namibia	Extant	Native
South Africa	Extant	Native
Swaziland	Extant	Native
Zimbabwe	Extant	Native

Wandrag et al. 2002) at Seekoeivlei and Tussen-die-Riviere nature reserves, with a single isolated record from the University of Free State, Bloemfontein (N. Avenant unpubl. data). Although no data for Kruger National Park are available, it presumably occurs there. In Swaziland, it occurs in the highveld and middleveld regions (Monadjem 1998). In the North West Province, new records were obtained from Mafikeng and Bloemhof (Power 2014), which extends the range westerly and confirms anecdotal suggestions of its presence in the area (Rautenbach 1982). Its distribution will track waterlogged environments and will thus most likely shift east, reflecting the east-west aridity gradient across the country, as climate change is predicted to make the western regions drier (Erasmus et al. 2002).

Based on the records available, we infer the extent of occurrence (EOO) to be 397,992 km^2. However, we suspect the species to be patchily distributed and fragmented within this wide area due to its reliance on moist habitats. Within the EOO, we calculated the amount of natural habitat remaining within buffer strips around wetlands as the inferred area of occupancy (AOO), which yields a range of 50,377–63,440 km^2 (using 500 m buffer strip) to 2,395–2,794 km^2 (using 32 m buffer strip). Although this is still a huge area, we suspect the lower estimates are more plausible as not all suitable patches will be occupied due to the natural patchiness of suitable habitats, its poor dispersal capacity and ongoing habitat degradation of patches and corridors between them. Given that this AOO estimate is uncertain, and applying a precautionary approach, it falls within the thresholds for Near Threatened (IUCN Standards and Petitions Subcommittee 2014).

Population

This can be a common and locally abundant species in suitable habitat. For example, it occurs in higher numbers than *Rhabdomys pumilio* at Lajuma in the Soutpansberg Mountains, Limpopo Province (R. Baxter and P. Taylor unpubl. data) and, at Seekoeivlei Nature Reserve in Free State Province, it was the most abundant small mammal sampled, constituting 41% of samples collected while *Rhabdomys pumilio* and *Myosorex varius* accounted for 28% and 22% respectively (Wandrag et al. 2002). However, due its patchy distribution, the total population size of the species is unlikely to compare to that of more widespread and generalist species. For example, Power (2014) reports that it is only locally common in wetlands in the mesic parts of North West Province, and it appears to be localised or patchily distributed in KwaZulu-Natal (J. Harvey unpubl. data).

Current population trend: Declining. Inferred from wetland habitat loss and degradation across its range.

Continuing decline in mature individuals: Unknown

Number of mature individuals in population: Unknown

Number of mature individuals in largest subpopulation: Unknown

Number of subpopulations: Unknown

Severely fragmented: Yes, considering the poor dispersal ability of the species and the fragmented nature of wetlands within its range.

Habitats and Ecology

This species has highly specific habitat requirements, occurring only close to open water with intact riverine and semi-aquatic vegetation such as reedbeds, wetlands and the thick grass along river banks (Monadjem 1999; Skinner & Chimimba 2005). They are found both in the wet substrates and drier grassland away from the water's edge (Taylor 1998). They are often sampled in waterlogged areas, such as inundated grasslands and vleis (Rautenbach 1982; Monadjem 1998; Taylor 1998; Fuller & Perrin 2001). Observations from Swaziland and Telperion Nature Reserve, Gauteng suggest it can occur within a variety of land covers (A. Monadjem pers. obs.)

They are active at night and during the day, but are primarily nocturnal (Baxter et al. 1979). They use the paths made by Vlei Rats (*Otomys* spp.) and Marsh Rats (*Dasymys* spp.) (Skinner & Chimimba 2005). Their hind feet are splayed, which may be an adaptation to marshy conditions. When they move, the tail is often curved slightly upwards (Baxter & Meester 1980). It apparently shows little agnostic behaviour to conspecifics (Baxter et al. 1979; Baxter & Meester 1980). Insects constituted 92% of its diet in Umvoti Vlei Conservancy, KwaZulu-Natal Province (Fuller & Perrin 2001).

Ecosystem and cultural services: Candidate for flagship species in wetland biodiversity stewardship schemes. It is an important prey species of African Grass-owls (*Tyto capensis*) (Vernon 1972).

Use and Trade

There is no known subsistence or commercial use of this species.

Threats

The main threat to shrews is the loss or degradation of moist, productive areas such as wetlands and rank grasslands within suitable habitat. The two main drivers behind this are abstraction of surface water and draining of wetlands through industrial, agricultural, afforestation and residential expansion, and overgrazing of moist grasslands, which leads to the loss of ground cover (reduces habitat structural complexity) and decreases small mammal diversity and abundance (Bowland & Perrin 1989, 1993). Overgrazing is particularly threatening for this species, as it relies on medium to tall grass cover. Suppression of natural ecosystem processes, such as fire, can also lead to habitat degradation through bush encroachment or loss of plant diversity through alien invasives, and is increasing with human settlement

Table 2. Threats to the Swamp Musk Shrew (*Crocidura mariquesis*) ranked in order of severity with corresponding evidence (based on IUCN threat categories, with regional context)

Rank	Threat description	Evidence in the scientific literature	Data quality	Scale of study	Current trend
1	*2.3.2 Small-holder Grazing, Ranching or Farming*: wetland and grassland degradation through overgrazing (removal of ground cover).	Bowland & Perrin 1989	Empirical	Local	Possibly increasing with human settlement expansion and intensification of wildlife farming.
		Driver et al. 2012	Indirect	National	45% of remaining wetland area exists in a heavily modified condition.
2	*7.2 Dams & Water Management/Use*: wetland loss through drainage / water abstraction during agricultural, industrial and urban expansion.	Driver et al. 2012	Indirect (land cover change from remote sensing)	National	Increasing with settlement expansion and 65% of wetland ecosystem types threatened already.
3	*7.1.2 Suppression in Fire Frequency/Intensity*: human expansion around forests has decreased natural fire frequency. Current stress *1.2 Ecosystem Degradation*: altered fire regime leading to bush encroachment (including alien vegetation invasion) and thus loss of moist grasslands.	-	Anecdotal	-	-
4	*1.1 Housing & Urban Areas*: forest habitat lost to residential and commercial development. Current stress *1.3 Indirect Ecosystem Effects*: fragmentation and isolation of remaining habitat patches with limited dispersal between.	GeoTerraImage 2015	Indirect (land cover change from remote sensing)	Regional	Continuing. Area of urban expansion has increased between 2000 and 2013.
5	*11.1 Habitat Shifting & Alteration*: moist microhabitats lost in westerly reaches of range.	Erasmus et al. 2002	Projected	National	Modelled range contraction and loss of habitat (41% of species) from west to east.

expansion. There are also clear overlaps and synergistic effects between these threats. We infer a continuing population decline based on loss of natural habitat.

Wetlands are the country's most threatened ecosystem, with 65% of wetland ecosystem types threatened (48% of all wetland types Critically Endangered, 12% Endangered and 5% Vulnerable) because they are highly productive and hence become transformed for agriculture (Driver et al. 2012). Overall, 45% of our remaining wetland area exists in a heavily modified condition, due primarily to onsite modification from crop cultivation, coal mining, urban development, dam construction, and overgrazing (and thus erosion) and off-site modifications from disruptions to flow regime and deterioration of water quality (Driver et al. 2012). Although this species may occur in artificial wetlands, it is reliant on natural vegetation and wet, muddy substrates.

Current habitat trend: Habitat loss and degradation across the range of the species is caused primarily by agricultural expansion (including overgrazing), urban and rural settlement expansion, aforestation and mining. Overall, there was a 19.7% loss of natural habitat in KwaZulu-Natal Province from 1994 to 2011, with an average loss of 1.2% per annum (Jewitt et al. 2015). If this rate of loss continues into the future, there will be an estimated 12% loss of habitat over 10 years. In Gauteng Province, 13% of natural habitat was lost between 1995 and 2009 (Driver et al. 2012). In North West Province, 2% of natural habitat was lost just between 2006 and 2010 (Desmet & Schaller 2015). Similarly, although not formally quantified, there is ongoing habitat loss in both Mpumalanga and Limpopo provinces, especially from settlement expansion and mining. New land cover data from 2000 and 2013 show that Gauteng, Limpopo, Mpumalanga and North West provinces experienced rural expansion of 39%, 9%, 7% and 6.5% respectively (GeoTerraImage 2015), while urban expansion proceeded at 8%, 15%, 11% and 14% for the same provinces (GeoTerraImage 2015). Such settlement expansion indicates both a loss of habitat and an increase in human encroachment on grassland and wetland resources, which we infer as increasing habitat degradation. Erasmus et al. (2002) modelled the effects of a 2°C increase in temperature and projected a range shift from west to east and an absolute reduction in total occupancy for most species. Presumably, this range shift and reduction, that tracks the east-west aridity gradient, would apply to this species too, and thus represents an emerging threat.

Conservation

This species occurs in several protected areas. Although the loss of wetlands may be in part compensated by its ability to exploit man-made waterbodies (for example, farm dams), natural vegetation is key to its survival. The main intervention for this species is thus the protection and restoration of rank vegetation around wetlands. Biodiversity stewardship schemes should be promoted if landowners possess wetlands close to core protected areas or remaining habitat patches, and the effects on small mammal subpopulations should be monitored. Protecting such habitats may create dispersal corridors between patches that will enable adaptation to climate change. At the local scale, landowners and managers should be educated, encouraged and incentivised to conserve the habitats on which shrews and small mammals depend. Retaining ground cover is the most important management tool to increase small mammal diversity and abundance. This can be achieved through lowering grazing pressure (Bowland & Perrin 1989), or by maintaining buffer strips of natural vegetation around wetlands (Driver et al. 2012). Small mammal diversity and abundance is also higher in more complex or heterogeneous landscapes, where periodic burning is an important tool to achieve this (Bowland & Perrin 1993). Removing alien vegetation from watersheds, watercourses and wetlands is also an important intervention to improve flow and water quality, and thus habitat quality, for shrews. Education and awareness campaigns should be

Table 3. Conservation interventions for the Swamp Musk Shrew (*Crocidura mariquesis*) ranked in order of effectiveness with corresponding evidence (based on IUCN action categories, with regional context)

Rank	Intervention description	Evidence in the scientific literature	Data quality	Scale of evidence	Demonstrated impact	Current conservation projects
1	*1.2 Resource & Habitat Protection*: stewardship agreements with private landowners to conserve wetlands and grasslands.	-	Anecdotal	-	-	Multiple organisations
2	*2.2 Invasive/Problematic Species Control*: maintain stocking rates of livestock and wildlife at ecological carrying capacity.	Bowland & Perrin 1989	Empirical	Local	Small mammal diversity and abundance significantly higher after decrease in grazing pressure.	-
3	*2.1 Site/Area Management*: maintain/ restore natural vegetation around wetlands.	-	Anecdotal	-	-	-
4	*2.2 Invasive/Problematic Species Control*: clear alien vegetation from watersheds and wetlands to restore habitat quality.	-	Anecdotal	-	-	Working for Water, Department of Environmental Affairs
5	*4.3 Awareness & Communications*: educating landowners in the importance of wetlands and grasslands.	-	Anecdotal	-	-	-

employed to teach landowners and local communities about the importance of conserving wetlands and moist grasslands.

Recommendations for land managers and practitioners:

- Landowners and communities should be incentivised to stock livestock or wildlife at ecological carrying capacity and to maintain buffers of natural vegetation around wetlands and riverine habitats.
- Enforce regulations on developments that potentially impact on the habitat integrity of grasslands and wetlands.

Research priorities:

- Additional field surveys are needed to clarify and confirm the distribution of this species, particularly around artificial waterbodies, agricultural landscapes and urban / rural gardens.
- The effects of climate change on its distribution and abundance should be specifically modelled.

Encouraged citizen actions:

- Citizens are requested to submit any shrews killed by cats or drowned in pools to a museum or a provincial conservation authority for identification, thereby enhancing our knowledge of shrew distribution (carcasses can be placed in a ziplock bag and frozen with the locality recorded).
- Practise indigenous gardening to sustain small mammals.

References

Baxter RM, Goulden EA, Meester J. 1979. The activity patterns of some southern African *Crocidura* in captivity. Acta Theriologica **24**:61–68.

Baxter RM, Meester J. 1980. Notes on the captive behaviour of five species of southern African shrews. Säugetierkundliche Mitteilungen **26**:55–62.

Bowland AE, Perrin MR. 1989. The effect of overgrazing on the small mammals in Umfolozi Game Reserve. Mammalian Biology **54**:251–260.

Bowland JM, Perrin MR. 1993. Wetlands as reservoirs of small-mammal populations in the Natal Drakensberg. South African Journal of Wildlife Research **23**:39–43.

Desmet PG, Schaller R. 2015. North West Biodiversity Sector Plan Technical Report. North West Department of Rural, Environment and Agricultural Development, Mahikeng, South Africa.

Dippenaar NJ. 1979. Variation in Crocidura mariquensis (A. Smith, 1844) in southern Africa, Part 2 (Mammalia: Soricidae). Annals of the Transvaal Museum **32**:1–34.

Driver A, Sink KJ, Nel JN, Holness S, van Niekerk L, Daniels F, Jonas Z, Majiedt PA, Harris L, Maze K. 2012. National Biodiversity Assessment 2011: An Assessment of South Africa's Biodiversity and Ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria, South Africa.

Erasmus BFN, van Jaarsveld AS, Chown SL, Kshatriya M, Wessels KJ. 2002. Vulnerability of South African animal taxa to climate change. Global Change Biology **8**:679–693.

Fuller JA, Perrin MR. 2001. Habitat assessment of small mammals in the Umvoti Vlei Conservancy, KwaZulu-Natal, South Africa. South African Journal of Wildlife Research **31**:1–12.

GeoTerraImage. 2015. Quantifying settlement and built-up land use change in South Africa.

IUCN Standards and Petitions Subcommittee. 2014. Guidelines for using the IUCN Red List categories and Criteria. Version 11. Prepared by the IUCN Standards and Petitions Subcommittee.

Jewitt D, Goodman PS, Erasmus BFN, O'Connor TG, Witkowski ETF. 2015. Systematic land-cover change in KwaZulu-Natal, South Africa: Implications for biodiversity. South African Journal of Science **111**:1–9.

Meester JA, Rautenbach IL, Dippenaar NJ, Baker CM. 1986. Classification of southern African mammals. Transvaal Museum Monographs **5**:1–359.

Monadjem A. 1998. The Mammals of Swaziland. Conservation Trust of Swaziland and Big Games Parks, Mbabane, Swaziland.

Monadjem A. 1999. Geographic distribution patterns of small mammals in Swaziland in relation to abiotic factors and human land-use activity. Biodiversity & Conservation **8**:223–237.

Power RJ. 2014. The Distribution and Status of Mammals in the North West Province. Department of Economic Development, Environment, Conservation & Tourism, North West Provincial Government, Mahikeng, South Africa.

Rautenbach IL. 1982. Mammals of the Transvaal. No. 1, Ecoplan Monograph. Pretoria, South Africa.

Skinner JD, Chimimba CT. 2005. The Mammals of the Southern African Subregion. Third edition. Cambridge University Press, Cambridge, UK.

Taylor PJ. 1998. The Smaller Mammals of KwaZulu-Natal. University of Natal Press, Pietermaritzburg, South Africa.

Data Sources and Quality

Table 4. Information and interpretation qualifiers for the Swamp Musk Shrew (*Crocidura mariquesis*) assessment

Data sources	Museum records, Field Study (literature, unpublished), Indirect information (literature, unpublished)
Data quality (max)	Estimated
Data quality (min)	Inferred
Uncertainty resolution	Maximum / minimum values
Risk tolerance	Precautionary

Assessors and Reviewers

Peter Taylor[1], Rod Baxter[1], R. John Power[2], Ara Monadjem[3], James Harvey[4], Matthew F.Child[5]

[1]University of Venda, [2]North West Provincial Government, [3]University of Swaziland, [4]Ecological Consultant, [5]Endangered Wildlife Trust

Contributors

Nico Avenant[1], Margaret Avery[2], Duncan MacFadyen[3], Guy Palmer[4], Beryl Wilson[5], Lizanne Roxburgh[6]

[1]National Museum, Bloemfontein, [2]Iziko South African Museums, [3]E Oppenheimer & Son, [4]Western Cape Nature Conservation Board, [5]McGregor Museum, [6]Endangered Wildlife Trust

Details of the methods used to make this assessment can be found in *Mammal Red List 2016: Introduction and Methodology.*

Vernon CJ. 1972. An analysis of owl pellets collected in southern Africa. Ostrich **43**:109–124.

Wandrag GF, Watson JP, Collins NB. 2002. Rodent and insectivore species diversity of Seekoeivlei Provincial Nature Reserve, Free State province, South Africa. South African Journal of Wildlife Research **32**:137–143.