Myosorex cafer – Dark-footed Forest Shrew


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Regional Red List status (2016)	**Vulnerable B2ab(i,ii,iii,iv)*†**
National Red List status (2004)	Data Deficient
Reasons for change	Non-genuine change: Taxonomy, newly split
Global Red List status (2016)	Least Concern
TOPS listing (NEMBA)	None
CITES listing	None
Endemic	Yes

*Watch-list Data †Watch-list Threat

Although once considered to occur in Limpopo Province, Zimbabwe and Mozambique, recent morphological and genetic evidence indicates that *M. cafer* is endemic to the KwaZulu-Natal and Eastern Cape provinces of South Africa (Willows-Munro 2008; Taylor et al. 2013).

Taxonomy

Myosorex cafer (Sundevall 1846)

ANIMALIA - CHORDATA - MAMMALIA - EULIPOTYPHLA - SORICIDAE - *Myosorex* - *cafer*

Common names: Dark-footed Forest Shrew (English), Donkerpoortbosskeerbek (Afrikaans)

Taxonomic status: Species

Taxonomic notes: Meester et al. (1986) recognised the subspecies *M. c. cafer* and *M. c. sclateri* but biochemical and morphological data suggested a rise to full species status for both (Maddalena & Bronner 1992; Kearney 1993). Isolated populations in the highlands of Zimbabwe and Mozambique; and north-eastern Limpopo have been previously assigned to *M. cafer* (Friedmann & Daly 2004). Within the *M. cafer* complex, Willows-Munro (2008) and Taylor et al. (2013), using a combination of molecular and morphological characters, demonstrated considerable lineage diversification. *Myosorex sclateri* and *M. cafer* were split in 2008 (Willows-Munro 2008). The Zimbabwe and Mozambique population are considered a new species (*M. meesteri*) and the Limpopo lineage was tentatively assigned to *M. tenius* based on small cranial size. A detailed molecular and morphological analysis of the latter assignment is underway.

Assessment Rationale

This newly recognised endemic species is a forest habitat specialist, occurring primarily in moist afromontane forest. The current estimated area of occupancy (AOO) of forest habitat, based on remaining natural habitat in 2014, is 1,263 km^2. Climate modelling work shows that forest habitat and thus AOO will be reduced by 37–48% by 2050 (since 1975). If we assume a linear rate of loss, 4.9–6.4% of suitable available habitat will be lost in the next 10 years. This model is corroborated by recent land cover analysis in KwaZulu-Natal which showed there was a 19.7% loss of natural habitat in from 1994 to 2011, with an average loss of 1.2% per year. Although the niche models predict a shift towards the coast as the climate changes, there are very few natural areas left as coastal development has proceeded rapidly (between 2000 and 2013, there has been a 5.6% and 1.1% rate of urban and rural expansion in KwaZulu-Natal Province respectively) and thus this represents an outright loss of AOO. Furthermore, remaining forest patches are fragmented and the species is suspected to have poor dispersal rates. Thus, we list this species as Vulnerable B2ab(i,ii,iii,iv) as it has a restricted and severely fragmented AOO, with an inferred and projected ongoing decline in both outright habitat, habitat quality (if moist conditions deteriorate) and forest patches (construed as subpopulations) from climate change, residential and industrial expansion and edge effects. Key interventions include protected area expansion of forest habitats, including the creation of corridors between patches and across elevational gradients to facilitate gene flow and allow adaptation to climate change, as well as the enforcement of regulations restricting disturbance to protected forests.

Distribution

Although previously thought to exist in South Africa, Mozambique and Zimbabwe, recent molecular work has confirmed it as endemic to the assessment region (Willows-Munro 2008; Taylor et al. 2013). It is now thought not to occur within Limpopo or Mpumalanga provinces, where these specimens may instead refer *Mysorex cf. tenuis* (Taylor et al. 2013). However, further molecular and taxonomic work of existing museum specimens is necessary to fully delineate the two species. Similarly, it is not certain whether Dark-footed Forest Shrews occur in Swaziland (Table 1). They occur in KwaZulu-Natal and Eastern Cape provinces (Figure 1), as far west as the Amathole Forest at Hogsback (Skinner & Chimimba 2005). They are sympatric in some areas with the more widespread *M. varius*. They are restricted to moist evergreen Afromontane (above 1,000 m asl) and temperate forests, which are highly fragmented within the assessment region. The estimated extent of occurrence is

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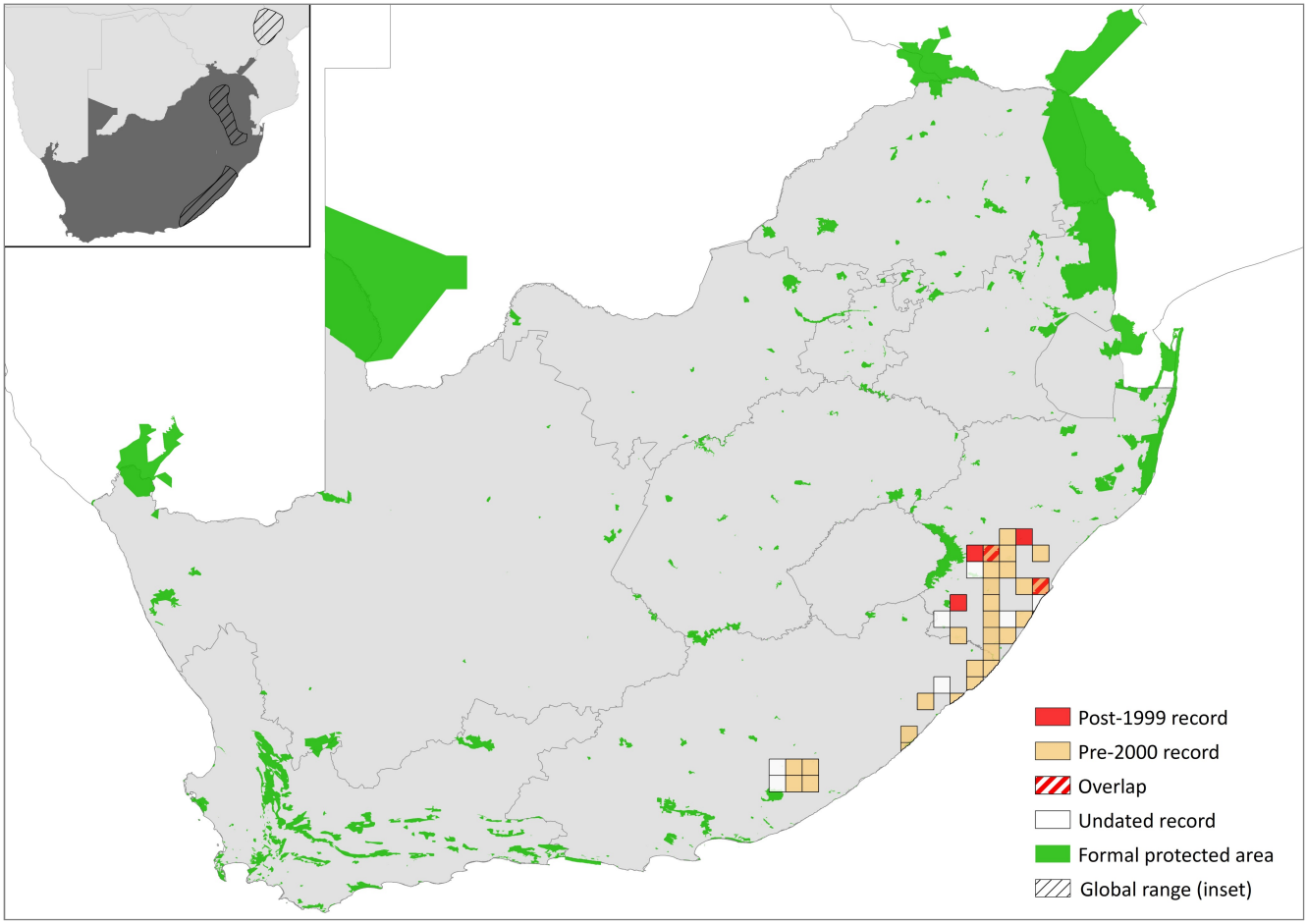

Figure 1. Distribution records for Dark-footed Forest Shrew (*Myosorex cafer*) within the assessment region

Table 1. Countries of occurrence within southern Africa

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

59,384 km^2. The current estimated area of occupancy (AOO) of forest habitat, based on remaining natural habitat in 2014, is 1,263 km^2.

Population

This species generally occurs at densities of around 10–30 individuals / 0.01 km^2 in suitable habitat (R. Baxter, unpubl. data). Extrapolating this density estimate across its estimated area of occupancy yields a population size of 1,263,000–3,789,000 individuals. It is more abundant in damp microhabitats and tends to be more common in forests while *M. varius* dominates in grasslands (Baxter & Dippenaar 2013a).

Current population trend: Declining. Inferred from ongoing forest habitat loss.

Continuing decline in mature individuals: Unknown

Number of mature individuals in population: 1,263,000

Number of mature individuals in largest subpopulation: Unknown

Number of subpopulations: Unknown, but may correspond to discrete forest patches.

Severely fragmented: Yes

Habitats and Ecology

Dark-footed Forest Shrews are restricted to moist, densely vegetated forests and grasslands. In KwaZulu-Natal Province, it occurs almost exclusively in Afromontane (mistbelt), scarp and coastal forests (Taylor 1998), while in the Eastern Cape Province they can be the dominant small mammal species in Afromontane forest (Baxter & Dippenaar 2013b). In captivity, they are predominantly nocturnal (Baxter et al. 1979), but, although almost entirely nocturnal in summer, are trapped during the day during winter (R. Baxter, unpubl. data). In the Amathole Forest, they have been observed to forage in the soil substrate, presumably searching for soil invertebrates (R. Baxter pers. obs.).

Ecosystem and cultural services: Candidate for flagship species in forest biodiversity stewardship schemes. Both the Barn Owl (*Tyto alba*) and the Grass Owl (*Tyto capensis*) are known to prey on this species (Skinner & Chimimba 2005).

Use and Trade

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

Table 2. Threats to the Dark-footed Forest Shrew (*Myosorex cafer*) 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	*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	65% of wetland ecosystem types threatened.
2	*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.
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	*11.1 Habitat Shifting & Alteration*: moist microhabitats lost from Afromontane forest cover reduction and aridification.	Taylor et al. 2016	Simulation	National	Increasing: a potential reduction in area of occupancy of 27–33% between 1975 and 2050.
5	*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 forest patches with limited dispersal between.	GeoTerraImage 2015	Indirect (land cover change from remote sensing)	Regional	Continuing. Area of urban expansion has increased by 5.6% and 6.3% for KwaZulu-Natal and Eastern Cape provinces, respectively, between 2000 and 2013.

Threats

The main threat to shrews is the loss or degradation of moist, productive areas such as wetlands and rank grasslands within suitable forest habitat. The two main drivers behind this are abstraction of surface water and draining of wetlands through industrial and residential expansion, and overgrazing of moist grasslands, which leads to the loss of ground cover and decreases small mammal diversity and abundance (Bowland & Perrin 1989). 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 suspected to be increasing with human settlement expansion. There are also clear overlaps and synergistic effects between these threats. Shrews have a high metabolic rate and thus rely on highly productive and complex environments, where small mammal diversity is highest (Bowland & Perrin 1993). Forests are protected by South African law but they are still being degraded as a result of human encroachment for livestock grazing and fuelwood extraction. The forest biome has one of the highest proportions of threatened ecosystem types (Driver et al. 2012). Similarly, 65% of wetland ecosystem types are threatened (48% Critically Endangered, 12% Endangered and 5% Vulnerable; Driver et al. 2012).

Climate change is considered to be the principal emerging threat to this species (Taylor et al. 2016), both due to loss of habitat and habitat degradation from drying out of wetlands and because shrews cannot tolerate extremes of temperature for long and thus their foraging time will be reduced. Because of their high metabolism, low dispersal capacity and short life spans, climate change will reduce the amount of suitable habitat available. The fragmented nature of forest patches is likely to exacerbate the effects of climate change. Habitat in neighbouring areas is arid and unsuitable for this species and thus it would not be able to disperse to other areas if the climate in its current range became unsuitable.

Current habitat trend: Overall, there was a 19.7% loss of natural habitat in KwaZulu-Natal Province from 1994 to 2008, with an average loss of 1.2% per year (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. Similarly, based on the results of Berliner and Desmet (2007), it can be deduced that 2% of the natural area of the Eastern Cape Province was lost during the period 2007 and 2015 at the rate of 0.24% per year. Additionally, between 2000 and 2013, there has been a 5.6% and 1.1% rate of urban and rural expansion in KwaZulu-Natal Province respectively; and a 6.3% and 0.8% rate of urban and rural expansion in Eastern Cape Province respectively (GeoTerraImage 2015), which indicates both a loss of habitat and possibly an increase in human encroachment on forest and wetland resources, which we infer as increasing habitat degradation. Finally, climate modelling has projected a 37–48% loss of available habitat from 1975 to 2050 (Taylor et al. 2016), where distribution may shift towards the coast with climate change. However, as there is increasing development along the coast, very few suitable areas would remain for dispersal.

Conservation

The main intervention for this species is the protection and restoration of wetlands and grasslands within and around forest patches. As habitat loss from climate change will be further compounded by loss from land transformation

(Driver et al. 2012), a critical intervention is to increase the extent of protected area networks that connect mountainous areas to lowland or coastal habitats, thus facilitating dispersal routes along elevational gradients. Biodiversity stewardship schemes should be promoted if landowners possess wetlands or grasslands close to core protected areas or remaining forest patches, and the effects on small mammal subpopulations should be monitored. Protecting such habitats may create dispersal corridors between forest patches that will enable adaptation to climate change.

All forests in South Africa are protected by law, although the degree to which this is enforced may vary. Legislation should be enforced to prevent development or human encroachment in key habitats, which includes increased enforcement of forest-related transgressions to minimise disturbance to existing forest patches, as well as stricter zonation on development to decrease fragmentation of remaining forests.

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 a buffer strip of natural vegetation around wetlands (Driver et al. 2012). Research will be needed to set the recommended length of the buffer strip in various habitats, but 500 m may provide a good indication of ecological integrity (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). Similarly, the specific fire regime thresholds should be calibrated by research. 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. This can be achieved through the Working for Water Programme (for example, Marais et al. 2004). However, the subsequent effects on shrew subpopulations must be monitored to demonstrate success (sensu Richardson & van Wilgen 2004). Education and awareness campaigns should be employed to teach landowners and local communities about the importance of conserving wetlands and moist grasslands.

Recommendations for land managers and practitioners:

- More accurate estimates of forest patch occupancy through extensive live-trapping and field surveys should be conducted through dedicated surveys by specialists and conservation authorities to more accurately establish geographical range and potential biodiversity stewardship sites, thus informing spatial conservation planning.
- Enforce regulations on developments that potentially impact on the habitat integrity of forests.
- Landowners should be incentivised to stock livestock or wildlife at ecological carrying capacity and to maintain a buffer of natural vegetation around wetlands.

Table 3. Conservation interventions for the Dark-footed Forest Shrew (*Myosorex cafer*) 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	*1.1 Site/Area Protection*: protected area expansion to connect high-altitude and coastal habitats thus allowing adaptation to climate change range shifts.	-	Anecdotal	-	-	-
2	*1.2 Resource & Habitat Protection*: stewardship agreements with private landowners to conserve wetlands and grasslands.	-	Anecdotal	-	-	-
3	*5.4 Compliance & Enforcement*: minimising disturbance to core forest patches by enforcing compliance with forest protection laws, and preventing illegal development.	-	Anecdotal	-	-	-
4	*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.	-
5	*2.1 Site/Area Management*: maintain/restore natural vegetation around wetlands.	-	Anecdotal	-	-	-
6	*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
7	*4.3 Awareness & Communications*: educating landowners in the importance of wetlands and grasslands.	-	Anecdotal	-	-	-

Research priorities:

- Further analysis of museum specimens is needed to correctly identify and delimit the distributions of *M. cafer*, *M. sclateri* and *M. tenuis*.
- Research should be conducted to determine disturbance thresholds in various habitats (for example, ecological stocking rates, amount of natural vegetation needed to sustain a viable subpopulation, and fire intensity and frequency needed to sustain habitat complexity) needed by managers to conserve shrew species.

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).

Data Sources and Quality

Table 4. Information and interpretation qualifiers for the Dark-footed Forest Shrew (*Myosorex cafer*) assessment

Data sources	Museum records, indirect information (literature, unpublished)
Data quality (max)	Estimated
Data quality (min)	Inferred
Uncertainty resolution	Best estimate
Risk tolerance	Evidentiary

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