Otomys auratus – Vlei Rat

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Regional Red List status (2016)	**Near Threatened A4c***
National Red List status (2004)	Not Evaluated
Reasons for change	Genuine change
Global Red List status	Not Evaluated
TOPS listing (NEMBA) (2007)	None
CITES listing	None
Endemic	Near

*Watch-list Threat

Over the past 90 years (1923 to 2015), *O. auratus* has been completely replaced by *O. angoniensis* at a contact zone in the Soutpansberg Mountains, Limpopo, due the habitat changing from grassland to thicket (Taylor et al. 2016).

Taxonomy

Otomys auratus Wroughton, 1906

ANIMALIA - CHORDATA - MAMMALIA - RODENTIA - MURIDAE - *Otomys* - *auratus*

Common names: Vlei Rat, Southern African Vlei Rat (English), Vleirot (Afrikaans), Leboli (Sesotho)

Taxonomic status: Species

Taxonomic notes: This species was until recently included in *Otomys irroratus* and the two cannot be distinguished on morphological grounds; however, *O. auratus* is closely associated with the Grassland Biome in South Africa and the Eastern Highlands of Zimbabwe, whilst *O. irroratus* is closely associated with the Fynbos and Thicket biomes of the Western Cape and Eastern Cape provinces of South Africa (Monadjem et al. 2015). *Otomys auratus* was shown to significantly differ from *O. irroratus* on molecular, chromosomal and ecological grounds (Taylor et al. 2009; Engelbrecht et al. 2011).

Assessment Rationale

This near-endemic grassland species is becoming increasingly threatened by grassland contraction and wetland loss, with niche modelling showing that it will undergo a 47–61% reduction in suitable habitat between 1975 and 2050 from climate change (6–8% per decade). Already one major subpopulation, that of the Soutpansberg Mountains, Limpopo Province, has been completely replaced at a key contact zone by the savannah species *O. angoniensis* over the past 90 years due to thicket habitats replacing grasslands. Ongoing grassland and wetland loss, primarily from agricultural and settlement expansion, may synergise with climate change to accelerate area of occupancy (AOO) reduction. Since this species is localised to montane grassland patches, it is more sensitive to habitat loss as it probably cannot utilise modified habitats. Nationally, there has been 32.8% decline in natural wetlands from 1990–2013/14, which is a combination of both genuine wetland loss through anthropogenic activities and the generally drier conditions currently than in 1990. Specifically, most distribution records (36%) are located in the Mesic Highveld Grassland Bioregion, where there has been a 19% loss of moist grasslands since 1990 (A. Skowno unpubl. data). In KwaZulu-Natal specifically, there was a loss of 7.6% of the natural habitat between 2005 and 2011 (1.3% per annum), which, when extrapolated, equates to a 13% loss of habitat over a ten year time period. Thus, multiple lines of evidence corroborate past, continuing and future habitat loss. Under a precautionary purview, we list as Near Threatened A4c as a 20–30% decline in AOO over ten years is possible due to the synergising effects of climate change and land-use change. We encourage more long-term surveys, such as that in the Soutpansberg, to identify other subpopulations that have been lost to landscape and climate changes.

Regional population effects: Rescue effect is not possible due to the disjunct distribution of populations within the assessment region and Zimbabwe.

Distribution

The species is widely distributed throughout the Highveld grasslands and Drakensberg Escarpment of South Africa, Lesotho and Swaziland, with isolated populations in the Soutpansberg Mountains of northern Limpopo and the Eastern Highlands of Zimbabwe (Monadjem et al. 2015). While indiscernible from *O. irroratus*, Engelbrecht et al. (2011) used mitochondrial data to delineate between the two cryptic species with the only known contact zone between the two species being Alice in the Eastern Cape. As this species has been split from *O. irroratus*, museum records will need vetting through molecular research to delimit distribution more accurately.

Worryingly, there has been a documented range contraction in the Soutpansberg Mountains of Limpopo Province due to habitat shifts from grassland to thicket. Comparison of occurrence data at a zone of sympatry between 1923 and 2013 revealed that while *O. auratus*

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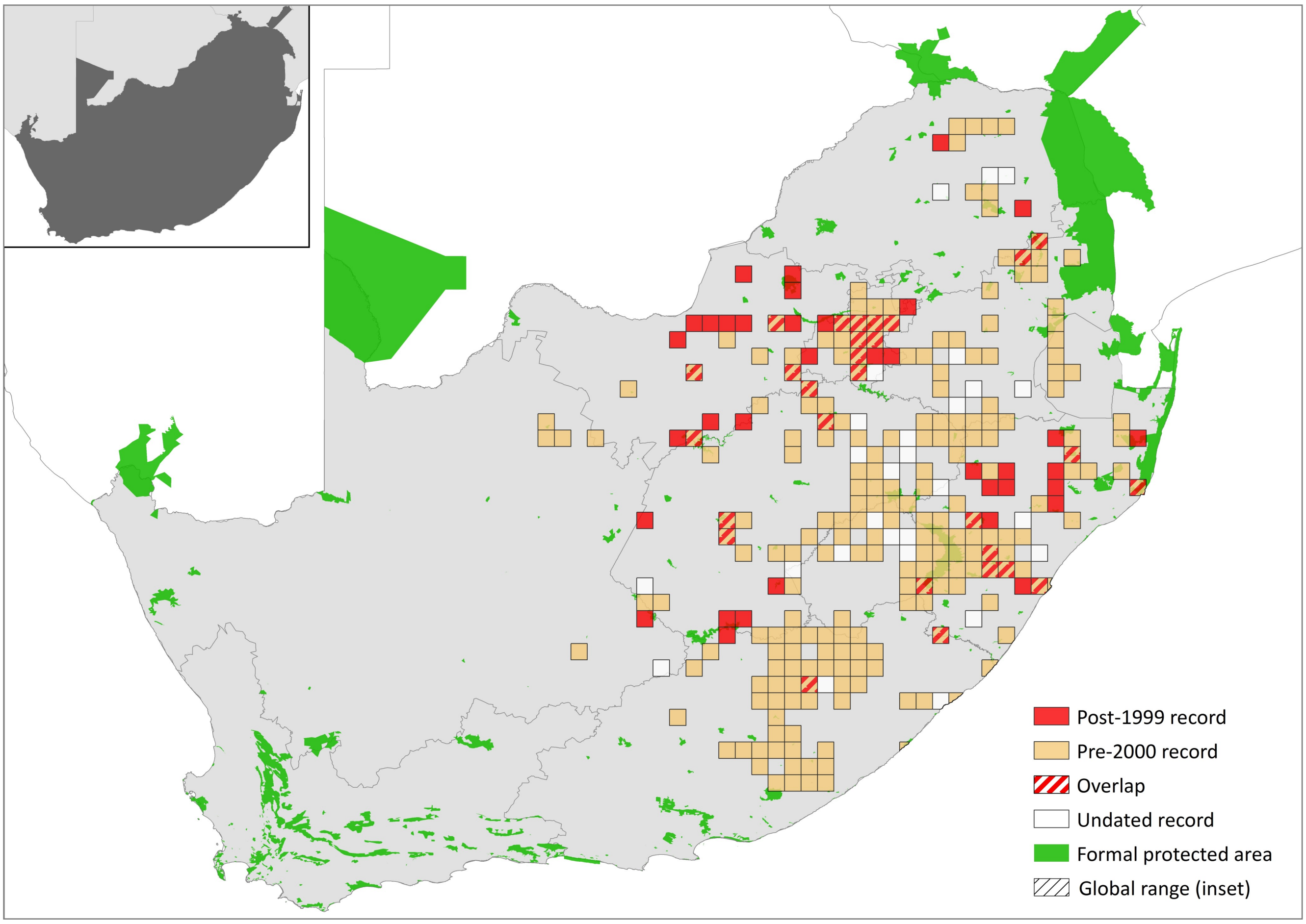

Figure 1. Distribution records for Vlei Rat (*Otomys auratus*) within the assessment region. This species was recently split from *O. irroratus* and has not yet been globally assessed by the IUCN, hence a global range map is not currently available.

Table 1. Countries of occurrence within southern Africa

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

was previously dominant, only *O. angoniensis* is currently found at the site (Taylor et al. 2016). This could indicate a savannah species displacing a grassland species as grasslands contract and are replaced by thicket woodlands due to climate change. Data from the wider Soutpansberg area support this trend: recent surveys in suitable grasslands habitats at > 1,300 m asl (typically *O. auratus* habitats) have revealed only *O. angoniensis*, while *O. auratus* was only sampled at one locality in the eastern Soutpansberg (Taylor et al. 2016).

Population

Although it is presently a common species in some areas, MaxEnt modelling based on continued grassland contraction from land-use and climate change is projected to lead to a 47–61% population reduction by 2050 (Taylor et al. 2016). This species is K-selected and thus has a relatively long generation length, estimated to be 1.8 years (Pacifici et al. 2013).

Current population trend: Declining

Continuing decline in mature individuals: No

Number of mature individuals in population: Unknown

Number of mature individuals in largest subpopulation: Unknown

Number of subpopulations: Unknown

Severely fragmented: Yes. Dispersal is dependent on continuous areas of riparian grassy vegetation around wetlands, dams and riparian corridors. Such patches may become too isolated for effective dispersal (Taylor et al. 2016).

Habitats and Ecology

This species is associated with mesic grasslands and wetlands within alpine, montane and sub-montane regions (Monadjem et al. 2015), typically occurring in dense vegetation in close proximity to water (for example, Wandrag et al. 2002; Watson 2006). In the Drakensberg range, *O. angoniensis* occurs on the lower slopes in savannah habitats, *O. auratus* and *O. laminatus* occur at mid-elevation in grasslands and *O. sloggetti* at the highest elevations in alpine heath habitats (Monadjem et al. 2015). Where *O. auratus* and *O. angoniensis* co-occur at the same site, the former is associated with sedges and grasses adapted to densely vegetated wetlands with wet soils, while the latter is associated with plant species that typically grow in the drier margins of wetlands (Davis 1973). Vlei Rats are exclusively herbivorous, with a diet mainly comprised of grasses. Cranial size of both *O. auratus* and *O. angoniensis* decreased significantly over the past 100 years, possibly in response to climate change (Nengovhela et al. 2016)

Ecosystem and cultural services: Vlei Rats are important food for a number of mammalian predators, as well as raptors such as Marsh Owls (*Asio capensis*) and Common Barn Owls (*Tyto alba*) (Skinner & Chimimba 2005; Monadjem et al. 2015). For example, Vlei Rats are favoured food by the Serval (*Leptailurus serval*) (Bowland 1990), so their range expansion could be interrelated (Power 2014).

Use and Trade

This species is not known to be traded or utilised in any form.

Threats

There are three main threats that may cause significant population decline in the near future:

1. Grassland and wetland habitat loss from agricultural expansion, human settlement sprawl and mining (see Current habitat trend). In Mpumalanga, for example, only 51% of the grasslands are still natural and not previously ploughed and 40% of the grassland vegetation types are listed as threatened (Lötter 2015). Water abstraction or filling in of wetlands from human settlement and industrial expansion also leads to habitat loss. Similarly, suppression of natural

Table 2. Threats to the Vlei Rat (*Otomys auratus*) 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	*2.1.3 Agro-industry Farming*: wetland and grassland habitat loss from agricultural expansion. Current stress *1.2 Ecosystem Degradation*.	Driver et al. 2012 Pence 2012 Lötter 2015 Jewitt et al. 2015 GeoTerraImage 2015	Indirect Indirect Indirect Indirect Indirect	National Regional Regional Regional National	Ongoing
2	*2.1.2 Small-holder Farming*: wetland and grassland habitat loss from agricultural expansion. Current stress *1.2 Ecosystem Degradation*.	Driver et al. 2012 Pence 2012 Lötter 2015 Jewitt et al. 2015 GeoTerraImage 2015	Indirect Indirect Indirect Indirect Indirect	National Regional Regional Regional National	Ongoing
3	*2.3.3 Agro-industry Grazing, Farming or Ranching*: wetland and grassland habitat loss from agricultural expansion. Current stress *1.2 Ecosystem Degradation*: from overgrazing.	Bowland & Perrin 1989 Bowland & Perrin 1993 Driver et al. 2012 Pence 2012 Lötter 2015 Jewitt et al. 2015 GeoTerraImage 2015	Empirical Empirical Indirect Indirect Indirect Indirect Indirect	Local Local National Regional Regional Regional National	Ongoing
4	*2.3.2: Small-holder Grazing, Ranching or Farming*: wetland and grassland habitat loss from agricultural expansion. Current stress *1.2 Ecosystem Degradation*: from overgrazing.	Bowland & Perrin 1989 Bowland & Perrin 1993 Driver et al. 2012 Pence 2012 Lötter 2015 Jewitt et al. 2015 GeoTerraImage 2015	Empirical Empirical Indirect Indirect Indirect Indirect Indirect	Local Local National Regional Regional Regional National	Ongoing
5	*1.1 Housing & Urban Areas*: wetland and grassland habitat loss from settlement expansion. Current stress *1.2 Ecosystem Degradation*: from water abstraction.	Driver et al. 2012 Pence 2012 Lötter 2015 Jewitt et al. 2015 GeoTerraImage 2015	Indirect Indirect Indirect Indirect Indirect	National Regional Regional Regional National	Ongoing
6	*3.2 Mining & Quarrying*: wetland and grassland habitat loss from mining expansion.	Driver et al. 2012 Pence 2012 Lötter 2015 Jewitt et al. 2015 GeoTerraImage 2015	Indirect Indirect Indirect Indirect Indirect	National Regional Regional Regional National	Ongoing
7	*2.2.2 Agro-industry Plantations*: wetland and grassland habitat loss from forestry plantations. Current stress *1.2 Ecosystem Degradation*.	Driver et al. 2012 Pence 2012 Lötter 2015 Jewitt et al. 2015 GeoTerraImage 2015	Indirect Indirect Indirect Indirect Indirect	National Regional Regional Regional National	Ongoing
8	*11.1 Habitat Shifting & Alteration*: loss of habitat from climate change.	Taylor et al. 2016	Projected	National	Increasing

ecosystem processes, such as fire, can also lead to habitat degradation through bush encroachment or loss of plant diversity through alien invasive species, and is suspected to be increasing with human settlement expansion. 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)

2. Overgrazing the vegetation around wetlands reduces ground cover and thus leads to decreased small mammal diversity and abundance (Bowland & Perrin 1989, 1993).The expansion of wildlife ranching will have to be monitored in this regard, as game overstocking may also affect wetland condition.

3. Climate change is projected to reduce area of occupancy significantly by reducing temperate grasslands and wetland habitats. Climate modelling show that a 47–61% loss in AOO is expected between 1975 and 2050 depending on the dispersal ability of the species (Taylor et al. 2016). While the model predicts a range shift along the Indian Ocean Coastal Belt, where it occurs narrowly at present, this area is highly developed (Driver et al. 2012) and thus may not provide suitable alternative habitat. Coastal habitat transformation in KwaZulu-Natal is due primarily to sugarcane monocultures, forestry plantations and residential developments. Thus, the future distribution of the species may be severely fragmented, resulting in local extinctions (Taylor et al. 2016).

Land-use change and climate change may synergise to cause non-linear and accelerating population decline. For example, trapping data suggest that *O. angoniensis* has already replaced *O. auratus* throughout most of the Soutpansberg Mountain range except in the Entabeni area (Taylor et al. 2016). More research is needed to validate these trends in other regions.

Current habitat trend: Declining. Wetlands are the most threatened ecosystem in South Africa (Driver et al. 2012). The South African National Land-Cover Change report found a 32.8% decline in natural wetlands nationally from 1990– 2013/14, which is a combination of both genuine wetland loss through anthropogenic activities and the generally drier conditions currently than in 1990 (GeoTerraImage 2015). Habitat loss due to land transformation in the surrounding matrix further isolates wetlands from one another and exacerbates the degradation of individual wetlands. For example, sugarcane and forestry plantations are often planted right up to wetland edges, not respecting the appropriate buffer. In KwaZulu-Natal alone, there was an average loss of natural habitat of 1.2% per annum between in 1994 and 2011 from agriculture, plantations, built environments and settlements, mines and dams (Jewitt et al. 2015). Although no specific rates of habitat loss are available, 61% of Mpumalanga's land surface between 2000 and 2014 have come under pressure from prospecting applications (Lötter 2015). Compounding habitat loss from land-use change is climate change. Projected range shifts under the A2 emission scenario of the Intergovernmental Panel on Climate Change showed increases (*O. angoniensis*) and decreases (*O. auratus*) that closely mirrored those expected for the Savannah and Grassland biomes, respectively (Taylor et al. 2016).

Conservation

They occur in many protected areas, such as Kruger National Park in Limpop/Mpumlanga, Pilanesberg National Park in the North West (Power 2014), Rietvlei Nature Reserve in Gauteng (Taylor et al. 2016), Tussen-die-Riviere and Seekoeivlei Nature Reserves in the Free State (Ferreira & Avenant 2003), and Asante Sana Nature Reserve and Mountain Zebra National Park in the Eastern Cape (Kok et al. 2012). Mitigating habitat loss outside of protected areas is urgently required. The following interventions should be implemented:

1. Using previously cultivated areas for development instead of remaining natural areas: In Mpumalanga, for example, old lands or previously ploughed areas now left fallow make up 8.9% of the Grassland Biome (Lötter 2015), and these areas should be prioritised for further development. Similarly, in KwaZulu-Natal, abandoned agricultural fields on marginal lands offer an opportunity for further development instead of transforming virgin land and at least 4% of the landscape is available for this (Jewitt et al. 2015).

2. Wetland conservation and restoration: land managers should maintain a vegetation buffer to reduce impacts of land-use practices (Driver et al. 2012). For example, the frequency of *O. auratus* and *O. angoniensis* has not changed between 1972 and 2013 as the wetland vlei areas have not changed significantly in structure

Table 3. Conservation interventions for the Vlei Rat (*Otomys auratus*) 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	*5.2 Policies & Regulations*: prioritising previously cultivated areas "old lands" for development.	-	Anecdotal	-	Unknown	-
2	*2.3 Habitat & Natural Process Restoration*: wetland conservation and restoration.	Taylor et al. 2016	Empirical	Local	Species still present at Rietvlei Nature Reserve where vlei restoration work has occurred.	-
3	*2.1 Site/Area Management*: holistic management of ranchlands to reduce impacts of overgrazing.	-	Anecdotal	-	Unknown	-

(Taylor et al. 2016). Restoration will also create corridors between suitable habitat patches to allow for dispersal in responses to climate change.

3. Holistic management of ranchlands: including de-stocking, rotational grazing and buffering wetland vegetation, are encouraged.

Recommendations for land managers and practitioners:

- Land managers should decrease stocking rates to conserve vegetation around wetlands.
- Long-term, systematic monitoring is needed to establish subpopulation trends and threat levels.
- Prioritise old fields for development in systematic conservation planning.

Research priorities:

- Long-term, systematic monitoring is needed to establish subpopulation trends and threat levels.
- Fine scale studies on habitat loss and inferred impact on the species across the range of the species.
- Effects of overgrazing on the density and viability of this species.
- Effects of habitat connectivity on dispersal rates.
- Further vetting of museum records to delimit distribution more accurately.

Encouraged citizen actions:

- Report Vlei Rat sightings on MammalMAP: The feeding signs of this species are easy to detect by short chopped lengths of grass and green moist faecal pellets (Skinner & Chimimba 2005).

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Data Sources and Quality

Table 4. Information and interpretation qualifiers for the Vlei Rat (*Otomys auratus*) assessment

Data sources	Field study (literature), museum records, indirect information (literature)
Data quality (max)	Estimated/projected
Data quality (min)	Inferred
Uncertainty resolution	Minimum/maximum values
Risk tolerance	Precautionary

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

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