

Mala *Lagorchestes hirsutus* (central Australia)

Key Findings

Following European settlement, the Central Australian subspecies of Mala suffered catastrophic declines throughout arid and semi-arid Australia, due to predation by foxes and feral cats and altered fire regimes. The last population was removed from the wild and translocated to a WA coastal island in 1991. All surviving Mala are now in managed areas where introduced predators are excluded. While overall numbers are still very low, the trajectory of Mala is improving due to sustained and intensive efforts to maintain rescued populations. Photo: Wayne Lawler, AWC



Significant trajectory change from 2005-15 to 2015-18?

Yes, rate of increase has improved.

Priority future actions

- Translocations to additional mainland sites, into fenced enclosures
- Maintenance of fenced enclosures to ensure they remain free of introduced predators, effective control of foxes and cats at low levels are at larger scales
- Genetic management, including strategic transfers of animals between populations

Full assessment information

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The primary purpose of this scorecard is to assess progress against achieving the year three targets outlined in the Australian Government's Threatened Species Strategy, including estimating the change in population trajectory of 20 mammal species. It has been prepared by experts from the **National Environmental Science Program's Threatened Species Recovery Hub**, with input from a number of taxon experts, a range of stakeholders and staff from the Office of the Threatened Species Commissioner, for the information of the Australian Government and is non-statutory. Statutory documents relating to this species, such as Recovery Plans and/or Conservation Advices, are listed at Section 11. The descriptive information in this scorecard is drawn from the Recovery Plan (Richards 2012), other published sources and advice contributed by experts.

The background information aims to provide context for estimation of progress in research and management (Section 7) and estimation of population size and trajectories (Section 8).

1. Conservation status and taxonomy

The Mala currently occurs in the wild only as an introduced population on one small island off the Pilbara (WA) coast that has no introduced predators, and in a few introduced predator-free exclosures on the mainland. This account focuses only on the (undescribed) central Australian subspecies rather than the Shark Bay islands Rufous Hare-wallaby subspecies.

Conservation status	2018
EPBC	Endangered
WA	Endangered
NT	Extinct in the Wild
SA	Not assessed*

Taxonomy:

The Mala is widely accepted as a distinct subspecies of *L. hirsutus* but has not been formally described. Courtenay (1993) found morphological differences between the then recognised four subspecies of *L. hirsutus*. Eldridge *et al.* (2004) and Eldridge *et al.* (2018) found that while the subspecies on Bernier and Dorre Islands were highly inbred and lacked genetic variability, the Mala, despite an apparent genetic bottleneck (when the captive colony was small), retained a large degree of genetic variability.

*Full species is Endangered

2. Conservation history and prospects

The Mala is one of three recognised subspecies of the Rufous Hare-wallaby. One subspecies, *Lagorchestes hirsutus hirsutus* (formerly from south-western Australia) is now extinct, and the other subspecies *L. h. bernieri* was restricted to Bernier and Dorre Islands in Shark Bay, Western Australia, but populations have recently been translocated from there to nearby Dirk Hartog Island. At the time of European settlement, the Mala had an extensive distribution in arid and semi-arid Australia (mostly inland central Western Australia, southern Northern Territory and north-western South Australia). However, it declined catastrophically across this range (Burbidge *et al.* 1988) and was extirpated from all known wild localities, persisting only as captive populations, by the 1990s (Gibson *et al.* 1994a; Johnson *et al.* 1996). In 1998, some of those captive individuals were introduced successfully to Trimouille Island (5.2 km²), off the Pilbara coast of Western Australia. Subsequently individuals from Trimouille Island and/or captive-breeding populations have been reintroduced to introduced predator-proof exclosures at Watarrka, Uluru, Scotia, Peron Peninsula and Matuwa (ex Lorna Glen). The population in an exclosure at Watarrka has subsequently been disbanded and the Peron Peninsula reintroduction failed. Mala are being re-introduced by Australian Wildlife Conservancy to newly established exclosures at Newhaven.

3. Past and current trends

The Mala has suffered a catastrophic decline across its entire range over the last ca. 100 years, with extirpation of the last wild mainland population occurring in 1991 (Gibson *et al.* 1994a; Johnson *et al.* 1996). However, from captive populations, a successful translocation occurred to Trimouille Island in 1998, and subsequently to mainland exclosures at Matuwa (ex Lorna Glen), Scotia, Uluru and Newhaven, although another re-introduction to an exclosure at Watarrka was subsequently discontinued.

Monitoring (existing programs):

Monitoring is undertaken by:

WA DBCA (Trimouille and Matuwa):

- Spotlight transects (distance analysis) undertaken on Trimouille Island (2015-2023)
- Spotlight transects and live trapping (2010-2018) in the Matuwa enclosure

Parks Australia (Uluru):

- Mark-recapture survey to determine population estimates undertaken from 2010 to 2016

AWC (Scotia and Newhaven sanctuaries):

- Annual census data collected

The table below summarises the overall trend and status of the Mala. Note that this table does not reflect the catastrophic historical decline, but rather trends over the last 10-20 years.

Population trends:

Tables 1 and 2 summarise the overall trend and status of the Mala. The information provided in these tables is derived from the recovery plan and conservation advices with some amendments made by contributing experts based on new information.

Table 1. Summary of the available information on Mala distribution and population size, and (where possible) trend estimates between 2015 and 2018 for each parameter.

Population parameters	Published baseline	2015 Estimate	2018 Estimate	Confidence in estimates
WILD* (Trimouille Island popn here considered 'wild')				
Extent of Occurrence	5.2 km ²	-	16.2 km ²	High
Area of Occupancy	5.2km ²	-	16.2 km ²	High
Dates of records and methods used	As per Mammal Action Plan			
No. mature individuals	<250	800	800	High (DBCA estimates, for 2013, with no change reported for 2013-18)
No. of subpopulations	1	1	1	High
No. of locations	1	1	1	High
Generation time	3.5	n/a	n/a	Medium (as per MAP)
EXCLOSURES				
No. mature individuals	n/a	200	410	High (Matuwa 50-80: (DBCA); Uluru 52 in 2010, 252 in 2016 (Parks Australia); Scotia & Newhaven 57 in 2017, 98 in 2018 (AWC))
No. locations	n/a	4	4	High. Newhaven added, Watarrka discontinued
CAPTIVE BREEDING				
No. mature individuals	n/a	?	?	
No. locations	n/a	?	?	

*Including translocations

Table 2. Estimated recent (2005-2015) and current (2015-2018) population trends for the Mala.

Sub-population	Est. % of total pop'n (pre 2015)	2005-2015 trend	Confidence in 2005-2015 trend	2015-2018 trend	Confidence in 2015-2018 trend	Details
Trimouille Island	70		High		Medium	Estimates given by Keith Morris and Colleen Sims (WA DBCA) suggest stable population
Matuwa (Lorna Glen)	10		High		High	Population estimates given by Keith Morris and Colleen Sims (WA DBCA) suggest stable population
Scotia	<1		High		High	
Newhaven	0	n/a	n/a		High	Translocations of total of 57 Mala from Watarrka and Scotia to Newhaven in 2017 and 2018. More individuals to be translocated in 2019.
Watarrka	1		High		High	Note that this colony was provided with supplementary feed and otherwise intensively managed. 27 individuals were relocated from the declining population to Newhaven in 2017.
Uluru	10		High		High	Capture-mark recapture surveys indicate increasing population
Whole population	100					

KEY:

Improving	Stable	Deteriorating	Unknown	Confidence	Description
			?	High	Trend documented
				Medium	Trend considered likely based on documentation
				Low	Trend suspected but evidence indirect or equivocal

4. Key threats

The threats listed here are derived from the Recovery Plan and advice from contributing experts based on new information. Note that this is not a list of all plausible threats, but a subset of the threats that are likely to have the largest impact on populations.

Introduced predators

Predation by introduced red foxes *Vulpes vulpes* and feral cats *Felis catus* was the most likely cause of the extensive historic decline of Mala (Gibson *et al.* 1994b) and continues to be the major threat. All surviving populations occur in areas from which these introduced predators have been excluded.

Inappropriate fire regimes

Mala are likely to benefit from fine-scale fire regimes that provide a local range of habitat types and resources (Lundie-Jenkins 1993). Given the small size of the locations in which Mala persist, and the small population size of Mala at each site, a high intensity and extensive fire could cause severe depletion or loss of sub-populations, or may cause significant damage to introduced predator-exclusion fences. Such a fire event caused the loss of most of the suitable habitat at the Watarrka enclosure in 2013. Historically, the impact of extensive fires was probably exacerbated by introduced predators with foxes and cats hunting most effectively in recently burnt areas.

Loss of genetic diversity

All existing Mala populations derive from a small population of individuals from the last naturally occurring population that existed in the Tanami Desert and sourced for captive breeding at Watarrka and Alice Springs in the 1980s. It is likely that the historic reduction of the population to low levels may have caused a significant depletion of genetic diversity, but this diversity is still greater than the Shark Bay island Rufous Hare-wallaby populations (Eldridge *et al.* 2018).

Invasive grasses

Introduced Buffel Grass (*Cenchrus ciliaris*) has spread or has the potential to spread across much of Mala past and potential future range, resulting in changes in habitat structure, floristic composition, resource availability and fire regimes.

Introduced herbivores

Across much of Mala past and potential future range, livestock and feral stock are widespread and abundant, and rabbits are present, particularly around salt lake systems. These introduced species may degrade Mala habitat, reduce food and shelter resource availability, and contribute to increased predator impacts (through reducing ground cover and – for rabbits – contributing to higher densities of predators). These species are absent on Trimouille Island, and mostly absent or controlled within the enclosures that now constitute the only mainland locations.

The impacts of the major threats are summarised in Table 3.

Table 3. Major threats facing the Mala and their associated impact scores.

CURRENT THREAT IMPACT			
Threat	Timing	Extent	Severity
1. Predation by feral cats	continuing/ongoing	50-90% of range (but intensively managed to be 0)	>90%
2. Predation by red foxes	continuing/ongoing	50-90% of range (but intensively managed to be 0)	>90%
3. Increase in fire frequency/intensity	continuing/ongoing	1-50% of range	50-100%
4. Reduction in genetic diversity	continuing/ongoing	>90% of range	Not negligible but <20%
5. Competition with introduced herbivores, habitat destruction	continuing/ongoing	<1% of range	Not negligible but <20%
6. Loss of food and shelter resources due to invasive grasses	continuing/ongoing	1-50% of range	Not negligible but <20%

Timing: continuing/ongoing; near future: any occurrence probable within one generation (includes former threat no longer causing impact but could readily recur); distant future: any occurrence likely to be further than one generation into the future (includes former threat no longer causing impact and unlikely to recur).

Extent: <1% of range; 1-50%; 50-90%; >90%.

Severity: (over three generations or 10 years, whichever is longer) Causing no decline; Negligible declines (<1%); Not negligible but <20%; 20-29%; 30-49%; 50-100%; Causing/could cause order of magnitude fluctuations.

5. Past and current management

Recent and current management actions directed specifically towards the conservation of the Mala are summarised below in Table 4. This compilation derives from the current Recovery Plan for the full species (Richards 2012) which guides recovery action, with modifications and additions from contributing experts.

The Mala has been subject to conservation management extending back for at least 50 years (Johnson *et al.* 1996), with particularly intensive management over the last 30 years. The table below refers to actions in the last ca. 10 years.

Table 4. Management actions that support the conservation of the Mala

Action	Location	Timing	Est. % pop'n	Contributors and partners
Establishment of a reintroduced population in introduced predator-proof enclosure with broadscale annual baiting surrounding the enclosure	Matuwa (ex Lorna Glen)	2010-2018, ongoing	10	WA DBCA
Establishment and maintenance of a reintroduced population in predator-proof enclosure (population maintained at c. 60 individuals)	Scotia	2001-2018, ongoing	1	AWC
Emergency translocation of Watarrka Mala population	Newhaven	2017	1	AWC, DENR, PWCNT (funded by the Australian Government)
Translocation of the last Mala from the Watarrka Enclosure to Alice Springs Desert Park, for reinforcement of small captive breeding population.	Alice Springs Desert Park	2018	<<1	PWCNT, DENR
30 Mala (1/2 of the Scotia population) translocated to Newhaven to help maintain genetics of Watarrka individuals; remainder to be translocated in 2019 when new predator proof fence is complete	Newhaven	2018 (in part)		AWC
Establishment of a reintroduced population in predator-proof enclosure (170 ha, founder population of 24 Mala)	Uluru-Kata Tjuta National Park	2005	20	Parks Australia
Captive management of Mala, including provision of supplementary feed and water, mosaic burning, fence inspection and maintenance (BAU). Successful management resulting in population increase from 25 in 2005 to 252 in 2016	Uluru-Kata Tjuta National Park	2005-ongoing	20	Parks Australia

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Rabbit eradication from predator-proof enclosure, involving baiting, fumigation, Calicivirus release and trained rabbit detection dogs	Uluru-Kata Tjuta National Park	2014-2016	20	Parks Australia, Department of the Environment, volunteers
Establishment of a reintroduced population in an enclosure that is without introduced predators or feral herbivores	Newhaven		3	AWC
Ongoing maintenance of captive-breeding populations			n/a	NT DENR
Reintroduction of Mala to mainland and island sites	Trimouille Island, Matuwa enclosure	1998 (Trimouille) 2010 (Matuwa)		WA DBCA (some funded with offsets)
Maintenance of island predator-free status	Trimouille Island	ongoing	70	WA DBCA
Repeat the [2015] Population Viability Analysis (PVA)				
Research taxonomic status and genetics	WA	2018		WA DBCA, AWC, Murdoch University, ANU, NT PWC, NHM, Australian Museum, IUCN CBSG

6. Actions undertaken or supported by the Australian Government resulting from inclusion in the Threatened Species Strategy

Two projects were undertaken with direct support arising from the Threatened Species Strategy:

- i. Assisting re-introduction of up to six threatened mammal species in WA – funding the Martu traditional owners at Matuwa Kurrara Kurrara (MKK) Indigenous Protected Area (IPA) for actions such as patch burns inside the fence to improve habitat quality for Mala (\$250,000).
- ii. Funding for Newhaven large feral-free area (\$750,000)

The Australian Government, through Parks Australia, has continued to support the active management of Mala at Uluru-Kata Tjuta National Park.

7. Measuring progress towards conservation

Table 5. Progress towards management understanding and management implementation for each of the major threats affecting Mala in 2015 (i.e. timing of TSS implementation) and 2018, using the progress framework developed by Garnett et al. (2018).

PROGRESS IN MANAGING THREATS			
Threat	Year	Understanding of how to manage threat	Extent to which threat being managed
1. Predation by feral cats	2015	5. Trial management is providing clear evidence that it can deliver objectives <i>[Note this categorisation reflects the demonstration of the effectiveness of exclosures and translocations to a predator-free island, but that sufficient control of predators in open landscapes remains elusive.]</i>	4. Solutions are enabling achievement but only with continued conservation intervention
	2018	5. Trial management is providing clear evidence that it can deliver objectives	4. Solutions are enabling achievement but only with continued conservation intervention
2. Predation by red foxes	2015	5. Trial management is providing clear evidence that it can deliver objectives	4. Solutions are enabling achievement but only with continued conservation intervention
	2018	5. Trial management is providing clear evidence that it can deliver objectives	4. Solutions are enabling achievement but only with continued conservation intervention
3. Increase in fire frequency /intensity	2015	5. Trial management is providing clear evidence that it can deliver objectives	4. Solutions are enabling achievement but only with continued conservation intervention
	2018	5. Trial management is providing clear evidence that it can deliver objectives	4. Solutions are enabling achievement but only with continued conservation intervention
4. Reduced genetic diversity	2015	2. Research has provided strong direction on how to manage threat	3. Solutions have been adopted but too early to demonstrate success
	2018	2. Research has provided strong direction on how to manage threat	3. Solutions have been adopted but too early to demonstrate success
5. Competition from introduced herbivores, habitat destruction	2015	1. Research being undertaken or completed but limited understanding on how to manage threat	0. No management
	2018	1. Research being undertaken or completed but limited understanding on how to manage threat	0. No management
6. Loss of food and shelter resources due to invasive grasses	2015	1. Research being undertaken or completed but limited understanding on how to manage threat	0. No management
	2018	1. Research being undertaken or completed but limited understanding on how to manage threat	0. No management

> Green shading indicates an improvement in our understanding or management of threats between years 2015 and 2018, while red shading indicates deterioration in our understanding or management of threats.

KEY (Table 5):

Score	Understanding of how to manage threat	Extent to which threat is being managed
0	No knowledge and no research	No management
1	Research being undertaken or completed but limited understanding on how to manage threat	Management limited to trials
2	Research has provided strong direction on how to manage threat	Work has been initiated to roll out solutions where threat applies across the taxon's range
3	Solutions being trialled but work only initiated recently	Solutions have been adopted but too early to demonstrate success
4	Trial management under way but not yet clear evidence that it can deliver objectives	Solutions are enabling achievement but only with continued conservation intervention
5	Trial management is providing clear evidence that it can deliver objectives	Good evidence available that solutions are enabling achievement with little or no conservation intervention
6	Research complete and being applied OR ongoing research associated with adaptive management of threat	The threat no longer needs management

8. Expert elicitation for population trends

An expert elicitation process was undertaken to assess population trends for the period 2005-2015 and post-2015 under the following management scenarios. Please note that differences between Management Scenarios 2 and 3 (Fig. 1) are difficult to attribute, as it can be difficult to determine whether actions undertaken after 2015 were influenced by the Threatened Species Strategy or were independent of it (see Summary Report for details of methods).

Management Scenario 1 (red line): *no conservation management undertaken since 2015, and no new actions implemented.*

- No further translocations undertaken; existing fenced populations likely to succumb over time through fence disrepair, fire and/or inbreeding. Eventually, the only remaining population is likely to be that on Trimouille Island, which is likely to be safe for decades from incursions by introduced predators, but may face ongoing declines through lack of genetic diversity.

Management Scenario 2 (blue line): *continuation of existing conservation management (i.e. actions undertaken before implementation of the Threatened Species Strategy or independent of the Threatened Species Strategy).*

- No further translocations undertaken; existing subpopulations maintained at Trimouille Island and Matuwa, Scotia and Uluru exclosures, with adequate fire management and genetic exchange. Ongoing research to enhance predator control in open landscapes possibly eventually leading to some Mala populations out of exclosures.

Management Scenario 3 (green line): *continuation of existing management, augmented by support from the Office of the Threatened Species Commissioner.*

- Existing subpopulations maintained at Trimouille Island and Matuwa, Scotia and Uluru exclosures, with adequate fire management and genetic exchange. New large subpopulations established at Newhaven. Ongoing research to enhance predator control in open landscapes possibly eventually leading to some Mala populations out of exclosures.

Overall estimated population trajectories subject to management scenarios considered

The Mala is currently being managed under Scenario 3 (green line).

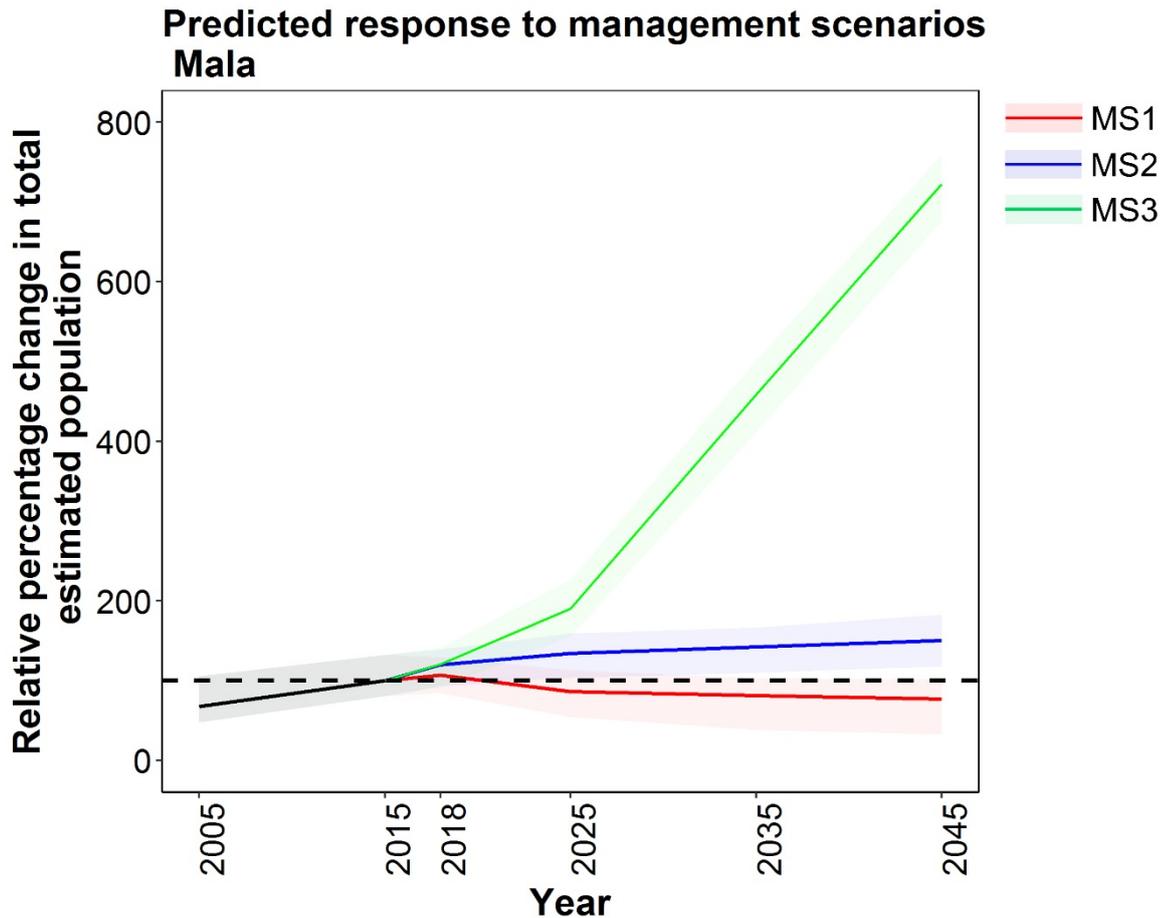


Figure 1. Estimated relative percentage change in population under each of the management scenarios described above. Data derived from 8 expert assessments of Mala expected response to management, using four-step elicitation and the IDEA protocol (Hemming et al. 2017), where experts are asked to provide best estimates, lowest and highest plausible estimates, and an associated level of confidence. The dashed line represents the baseline value (i.e. as at 2015, standardised to 100). Values above this line indicate a relative increase in population size, while values below this line indicate a relative decrease in population size. Shading indicates confidence bounds (i.e. the lowest and highest plausible estimates).

Population size projections based on expert elicitation are extended here to 2025, 2035 and 2045 (i.e. 10, 20 and 30 years after the establishment of the Threatened Species Strategy) on the grounds that some priority conservation management actions may take many years to achieve substantial conservation outcomes. However, we note also that there will be greater uncertainty around estimates of population size into the more distant future because, for example, novel threats may affect the species, managers may develop new and more efficient conservation options, and the impacts of climate change may be challenging to predict.

Improved trajectory (Threatened Species Strategy Year 3 target):

The primary purpose of this scorecard is to assess progress against achieving the year three targets outlined in the Australian Government’s Threatened Species Strategy, i.e. a demonstrated improved trajectory for at least half of the priority species (10 birds and 10 mammals). To assess this, we first use the expert-derived trend between 2005-15 (i.e. 10 years prior to implementation of the TSS) as a baseline for assessing whether there has been an improvement in trajectory in the time since implementation of the TSS (i.e. 2015-18). Table 6 below summarises this information, where negative values indicate a declining population, and positive values indicate an increasing population. We used Wilcoxon match-paired tests to compare trajectories for these two periods; a significant result (probability <0.05) indicates that there was a high concordance amongst experts that their trajectory estimates for 2005-15 were different to their estimates for 2015-18.

Table 6. A comparison of the relative annual percentage population change for the periods 2005-2015 and 2015-2018.

	Pre-TSS trend (2005-2015)	Post-TSS trend (2015-2018)	Year 3 target met?	Significant concordance among elicitors?
Annual percentage population change	3.25	6.90		Elicitors showed high degree of consistency in concluding that the rate of increase over the period 2015-18 was higher than that for the period 2015-18

The Mala suffered a severe historical decline, but conservation actions extending over the last 50 years have managed to secure it, and intensive management (through introductions to an island and enclosures free of introduced predators) has allowed for some recent recovery. Many agencies, non-government organisations and others have contributed to these conservation management efforts. Support from the Australian government has helped improve the population trajectory of the Mala, through active management of the reintroduced Mala population at Uluru Kata Tjuta and support for the establishment of a major new enclosure at Newhaven, to which Mala were recently reintroduced.

Additional actions that could improve trajectory

The potential impact of carrying out specific additional conservation measures on the population trajectory of the Mala was also evaluated through expert elicitation. Additional actions that could further improve the population trajectory of the Mala include:

- several more enclosures and/or island translocations; and
- eventually to effective predator management beyond fences allowing for broad-scale re-establishment of Mala populations.

9. Immediate priorities from 2019

The priorities listed here are derived from the Recovery Plan and advice from contributing experts. Identification of these priorities in this document is for information and is non-statutory. For statutory conservation planning documents, such as Recovery Plans or Conservation Advices, please see Section 11.

Data collection:

- Ongoing monitoring of trends in population size and genetic diversity at all sites;
- Ongoing monitoring of threats at all sites

Management actions:

- Translocations to additional mainland sites, most likely fenced enclosures (including planned Newhaven release)
- Maintenance of fenced enclosures to ensure they remain free of introduced predators, effective control of foxes and cats at low levels are at larger scales
- Genetic management, including strategic transfers of animals between populations

10. Contributors

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11. Legislative documents

SPRAT profile: http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=88019

Richards, J.D. (2012). *Rufous Hare-Wallaby (Lagorchestes hirsutus) National Recovery Plan. Wildlife Management Program No. 43.* Department of Environment and Conservation, Perth, WA. Available from: <http://www.environment.gov.au/resource/rufous-hare-wallaby-lagorchestes-hirsutus-national-recovery-plan>. In effect under the EPBC Act from 19-Sep-2012 as *Lagorchestes hirsutus* unnamed subsp..

Non-government documents:

[Diet of Mala \(Lagorchestes hirsutus\) at Uluru-Kata Tjuta National Park and comparison with that of historic free-ranging Mala in the Tanami Desert: implications for management and future reintroductions. *Australian Mammalogy*. 37:201-211.](#) (Clayton, J.A., C.R. Pavey, K. Vernes & E. Jefferys, 2015).

[Final Report: Mala Population Viability Analysis and Conservation Planning Workshop](#) (Lees, C.M., & K. Bennison (Eds), 2016).

[The action plan for threatened Australian macropods 2011-2021](#) (World Wildlife Fund for Nature - Australia (WWF), 2011).

12. References

- Burbidge A, Johnson K, Fuller P, Southgate R (1988) Aboriginal knowledge of the mammals of the central deserts of Australia. *Australian Wildlife Research* **15**, 9-39.
- Courtenay J (1993) The systematics of the hare-wallabies *Lagorchestes* Gould, 1841 and *Lagostrophus* Thomas, 1887. Australian National University.
- Eldridge MDB, Kinnear JE, Zengler KR, McKenzie LM, Spencer PBS (2004) Genetic diversity in remnant mainland and “pristine” island populations of three endemic Australian macropodids (Marsupialia): *Macropus eugenii*, *Lagorchestes hirsutus* and *Petrogale lateralis*. *Conservation Genetics* **5**, 325-338.
- Eldridge MDB, Neaves LE, Spencer PBS (2018) Genetic analysis of three remnant populations of the rufous hare-wallaby (*Lagorchestes hirsutus*) in arid Australia. *Australian Mammalogy*.
- Gibson DF, Johnson KA, Langford DG, Cole JR, Clarke DE, Community W (1994a) The Rufous Hare-wallaby *Lagorchestes hirsutus*: a history of experimental reintroduction in the Tanami Desert, Northern Territory. In 'Reintroduction biology of Australian and New Zealand fauna'. (Ed. M Serena) pp. 171-176. (Surrey Beatty & Sons: Chipping Norton)
- Gibson DF, Lundie-Jenkins G, Langford DG, Cole JR, Clarke DE, Johnson KA (1994b) Predation by feral cats, *Felis catus*, on the rufous hare-wallaby, *Lagorchestes hirsutus*, in the Tanami Desert. *Australian Mammalogy* **17**, 103-107.
- Johnson KA, Gibson DF, Langford DG, Cole JR (1996) Recovery of the mala *Lagorchestes hirsutus*: a 30-year unfinished journey. In 'Back from the brink: refining the threatened species recovery process'. (Eds S Stephens and S Maxwell) pp. 100-105. (Surrey Beatty & Sons: Chipping Norton)
- Lundie-Jenkins (1993) Ecology of the Rufous Hare-wallaby, *Lagorchestes hirsutus* Gould (Marsupialia : Macropodidae), in the Tanami Desert, Northern Territory. I. Patterns of Habitat Use. *Wildlife Research* **20**, 457-476.
- Richards JD (2012) 'Rufous Hare-Wallaby (*Lagorchestes hirsutus*) National Recovery Plan. Wildlife Management Program No. 43.' Department of Environment and Conservation, Perth.

13. Citation

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