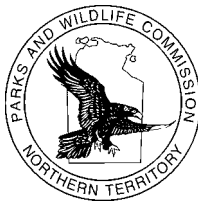


**REVISED RECOVERY PLAN
FOR THE
CARPENTARIAN ROCK-RAT**
Zyzomys palatalis

Helen Puckey, John Woinarski, Colin Trainor.

Parks and Wildlife Commission of the Northern Territory
PO Box 344
Katherine NT 0851



Natural Heritage Trust
Helping Communities Helping Australia

January 2003

TABLE OF CONTENTS

SUMMARY	II
CURRENT SPECIES STATUS.....	II
HABITAT CRITICAL TO SURVIVAL AND LIMITING FACTORS:.....	II
OVERALL OBJECTIVE.....	II
RECOVERY CRITERIA	II
SPECIFIC OBJECTIVES.....	II
RECOVERY ACTIONS.....	II
BIODIVERSITY BENEFITS.....	III
CONTRIBUTERS TO THE REVISED RECOVERY PLAN:.....	III
1.0 INTRODUCTION.....	1
1.1 DESCRIPTION OF THE SPECIES.....	1
1.2 DISTRIBUTION	1
1.3 POPULATION SIZE AND STRUCTURE	2
1.4 HABITAT CRITICAL TO SURVIVAL	2
1.5 LIFE HISTORY AND ECOLOGY.....	3
1.6 REASONS FOR LISTING	4
1.7 CURRENT THREATS	4
1.8 EXISTING CONSERVATION MEASURES.....	4
2.0 STRATEGY FOR RECOVERY.....	4
2.1 OVERALL OBJECTIVE.....	4
2.2 SPECIFIC OBJECTIVES DURING THE IMPLEMENTATION OF THE REVISED RECOVERY PLAN.....	4
2.3 RECOVERY CRITERIA.....	5
3.0 RECOVERY ACTIONS.....	6
IMPLEMENTATION SCHEDULE.....	11
ACKNOWLEDGEMENTS.....	12
BIBLIOGRAPHY	13

SUMMARY

CURRENT SPECIES STATUS:

Carpentarian Rock-rats qualify as Critically Endangered based on the IUCN criteria of B1 (extent of occurrence <100km²) *a* (severely fragmented or known to exist at only a single location) and *b* (continuing decline, observed, inferred or projected, in... (iii) area, extent and/or quality of habitat) and B2 (area of occupancy estimated to be less than 10km²) *a* (severely fragmented or known to exist at only a single location) and *b* (continuing decline, observed, inferred or projected, in... (iii) area, extent and/or quality of habitat). Their distribution is restricted to four sites on Wollogorang Station in the Gulf of Carpentaria hinterland near the Northern Territory/Queensland border. The total population size is thought to be low, its habitat requirements are specialised, and the preferred habitat is vulnerable to damage from current fire regimes. Historical distribution of the species is not known.

HABITAT CRITICAL TO SURVIVAL AND LIMITING FACTORS:

Carpentarian Rock-rats are closely associated with relatively large (>5ha) thickets of monsoon rainforests occurring on scree slopes in rocky gorges. It is unknown to what extent these monsoon rainforest thickets are being degraded by putative threatening processes of fire, cattle, feral cats and weeds. Thickets comprise only a small proportion of the vegetation in this region, and generally occur as small discrete patches. The extent and floristic richness of thickets decreases rapidly to the south and east of the area known to support Carpentarian Rock-rats (due to rapid decline in annual rainfall), and to the north and west (due to lack of sheltered gorges). Lack of data to define more specific habitat requirements and threatening processes will be addressed by the implementation of this revised Recovery Plan.

OVERALL OBJECTIVE:

To down-list the species to Vulnerable or Conservation Dependent within 10 years of revised Recovery Plan implementation.

RECOVERY CRITERIA

The species population remains stable or increases over the 10 years following implementation of the revised Recovery Plan.

SPECIFIC OBJECTIVES

1. Develop and implement appropriate management strategies to maintain known populations.
2. Continue research into ecology and population demography to fill current information gaps.
3. Continue to adapt established PVA models as new information becomes available.
4. Maintain a viable captive breeding population.
5. Investigate aspects of the biology of Carpentarian Rock-rats using captive animals.
6. Experimentally release captive bred individuals into potentially suitable areas not currently occupied.
7. Raise the profile of Carpentarian Rock-rats in the community.

RECOVERY ACTIONS:

- 1.1 Implement fire, cattle and feral predator management strategies that will maintain or increase habitat quality and extent at existing sites.
- 1.2 Establish a formal protected area for known populations.
- 2.1 Continue studies of diet and habitat requirements to define areas of habitat critical to the survival of the species.
- 2.2 Continue studies on population structure and demography.
- 3 Iteratively develop PVA models that will incorporate new biological information as it becomes available.
- 4 Maintain a self-supporting breeding colony containing at least 20 individuals at the TWP.
- 5 Investigate aspects of the biology of Carpentarian Rock-rats that can be carried out on captive animals.
- 6.1 Design and implement an experiment that introduces captive bred individuals into a suitable area currently unoccupied.
- 6.2 Monitor survival of experimental release population.
- 7.1 Operate the Recovery Team
- 7.2 Produce publications, reports, education and interpretive materials.

ESTIMATED COST OF RECOVERY (in \$000/year)

Actions	1.1	1.2	2.1	2.2	3	4	5	6.1	6.2	7.1	7.2	Total
Year 1	15.8	4	-	32.8	10	15.2	-	10.5	12.2	1	5.1	106.6
Year 2	7.9	2	-	27.9	2	15.2	-	5.7	10.1	1	12.6	84.4
Year 3	7.9	0	-	24.1	1	15.2	-	4.3	7.7	1	2.5	63.7
Year 4	15.3	0	-	22.6	1	15.2	-	4.3	7.3	1	2.5	69.2
Year 5	8.4	0	-	0	1	15.2	-	0	3.8	1	2.5	31.9
Total	55.3	6	0	107.4	15	76	0	24.8	41.1	5	25.2	355.8

BIODIVERSITY BENEFITS:

The Carpentarian Rock-rat is dependent upon the maintenance of floristically rich dry thickets of monsoon rainforest.

The protection of this species will require management to maintain the extent, integrity and floristic diversity of this vegetation type. Such management will conserve a substantial number of associated threatened and relict plant species, including *Tiliacora australiana*, *Paraceterach reynoldsi*, *Pteris tripartita*, *Alectryon tropicus*, Thelypteridaceae sp. nov., and Arecaceae sp. nov., as well as restricted plants in the adjacent woodlands such as *Cycas brunnea*. The maintenance of spring habitats will benefit the undescribed restricted turtle *Emydura* aff. *subglobosa*. The maintenance of thickets in rocky gorges will also help to conserve other vertebrates associated with this habitat, including Short-eared Rock-wallaby *Petrogale brachyotis*, Rock Ringtail Possum *Petropseudes dahli* and Sandstone Antechinus *Pseudantechinus bilarni*. Distribution of non-target species will be collected concurrently with that of the target species and a better understanding of the biophysical attributes of the Gulf region will be gained.

CONTRIBUTERS TO THE REVISED RECOVERY PLAN:

Parks and Wildlife Commission of the Northern Territory
 Key Centre for Tropical Wildlife Management, Northern Territory University
 Environment Australia, Endangered Species Program
 Territory Wildlife Park
 Threatened Species Network

1.0 Introduction

1.1 Description of the species

The Carpentarian Rock-rat is one of five species of rock-rat in the Australian endemic genus *Zyomys*. All species are similar in gross morphology and diet, though the Common Rock-rat *Z.argurus* is substantially smaller than the other four species. Four species are restricted to northern Australia (three of which have very limited ranges): the fifth species, Central Rock-rat *Z.pedunculatus*, occurs only in central Australia.

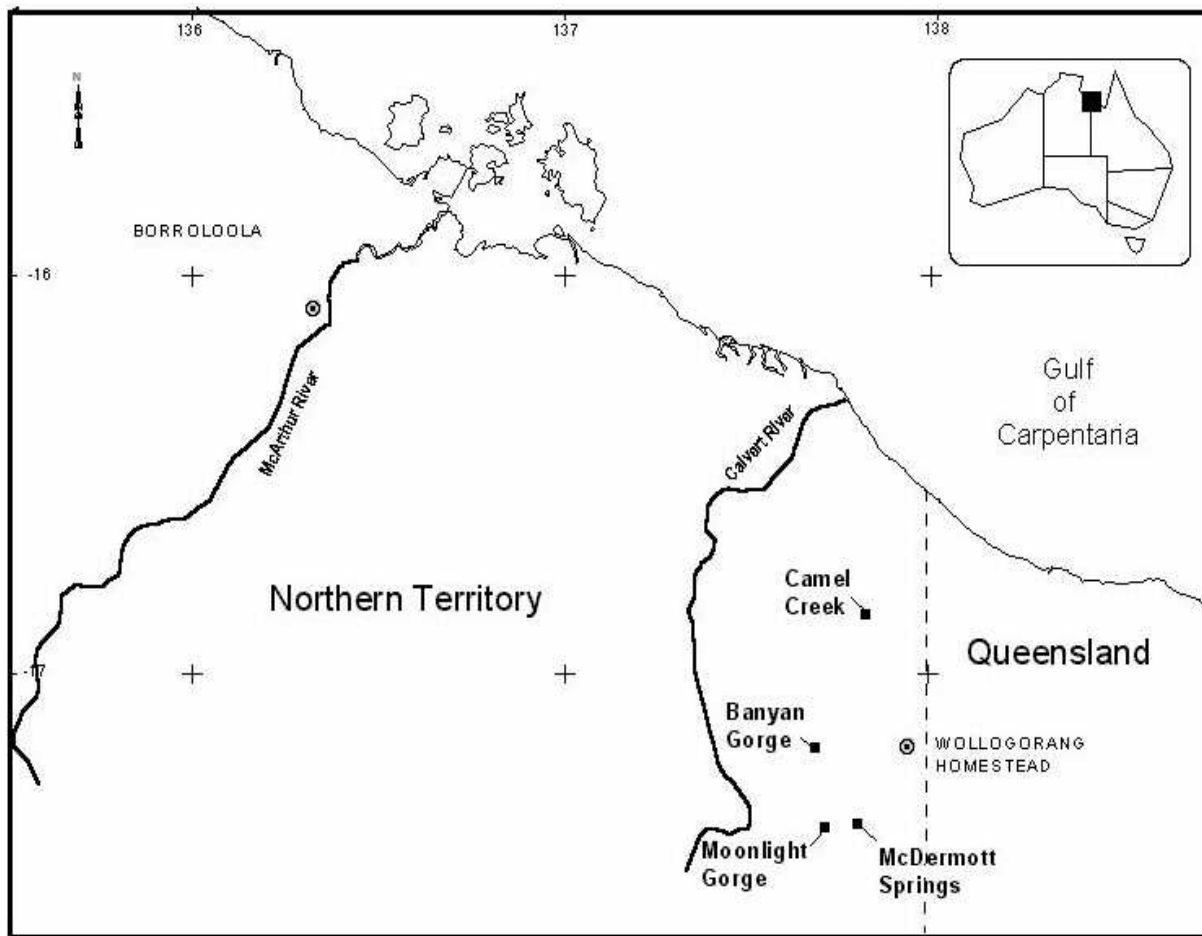
The rock-rats are characterised by “compact, harsh-furred bodies, pronounced roman-nosed appearance, rounded ears, and protruding eyes” (Watts and Aslin 1981), and especially by the fragile carrot-shaped tail, in which fat is deposited. They also have notably long whiskers. The Carpentarian Rock-rat is very similar in appearance to the Arnhem Land Rock-rat *Z.woodwardi* and the Kimberley Rock-rat *Z.maini*. It is grey-brown above and white below. The tail is relatively hairy, with especially long hairs towards the tip. Body weight averages about 120g. As with other Rock-rats, *Z.palatalis* is known to lose their tails, fur and skin very easily.

1.2 Distribution

The three large rock-rats in northern Australia occupy geographically disjunct distributions in rugged sandstone ranges: the Kimberley Rock-rat occurs only in the north Kimberley, the Arnhem Land Rock-rat is restricted to the escarpment and plateau of western Arnhem Land, and the Carpentarian Rock-rat occurs only in a very small area of the Gulf of Carpentaria hinterland. Morphological similarity between the three species suggests that the group may have had a more continuous distribution in the past, presumably when their major food-bearing plants were more widespread.

Currently, the Carpentarian Rock-rat is known from just four locations, all within a radius of 35km. All sites are within Wollogorang pastoral station, in the Northern Territory (adjacent to the Queensland border). Further occurrences beyond the known sites are possible, as the Gulf area has not been subject to comprehensive fauna survey however, specific searches for Carpentarian Rock-rats targeting apparently suitable habitat have been largely unsuccessful (Churchill 1996, Puckey 1999 unpublished data).

There are no fossil records. No known populations have become extinct, possibly because the species was only discovered as recently as 1986 (Kitchener 1989).



1.3 Population Size and Structure

The actual population size of Carpentarian Rock-rats is largely unknown. However, extrapolation of population size from density estimates indicate that the population was 696 at Moonlight Gorge and 450 at Banyon Gorge in 1996 (Trainor 1996). No such estimates are available at the other two sites. Carpentarian Rock-rats generally have a 1:1 sex ratio in the population and females give birth to 1-3 young per litter, those females living into their second year producing up to four litters (Trainor 1996).

1.4 Habitat critical to survival

The Carpentarian Rock-rat is strongly associated with monsoon thickets (dry rainforest) occurring on rocky slopes within large gorge systems. Plant species characteristic of this habitat include *Pouteria sericea*, *Terminalia subacroptera*, *T. volucris*, *Celtis phillipensis*, *Ficus leucotricha*, *F. virens*, *Cissus reniformis*, *Caesalpinia bonduc* and *Gyrocarpus americanus*. As the entire distribution of Carpentarian Rock-rats is restricted to only four of these rainforest patches they clearly represent habitats critical to the survival of the species as defined under section 201A of

the *Environment Protection and Biodiversity Act 1999*. However, it is possible that other rainforest patches may also be critical to the survival of the species.

The floristics, distribution and conservation of monsoon rainforests in the Northern Territory have been considered in detail. Russell-Smith (1991) mapped and classified rainforest patches, recording seven floristic groups (from 16 defined for the Northern Territory) from the Gulf area. Several of these groups are not associated with rocks, and are unlikely to support Carpentarian Rock-rats. However, three groups are rock-associated and comprise many plant species whose fruits are known to be eaten by rock-rats. The habitat provided by these groups may therefore be necessary to ensure the long-term future of the species, for example through re-introduction or re-colonisation. Further studies are necessary to identify any additional areas of habitat critical to the survival of the species and to define the boundaries of these areas.

Liddle *et al.* (1994) mapped the distribution of individual monsoon rainforest plant species. These maps show that many rare monsoon rainforest plants occur as relict populations in gorges of the Gulf area. Russell-Smith and Bowman (1992) described the conservation status of monsoon rainforests in the Top End of the Northern Territory, and noted that monsoon rainforest patches in general, and groups occurring in the Gulf region in particular, had a high frequency of disturbance from fire, feral animals and weeds.

1.5 Life history and ecology

The Carpentarian Rock-rat is a nocturnal rodent, sheltering during the day in cracks between boulders, caves and crevices. Much of its diet comprises fruits and seeds of fleshy-fruited plants, including *Terminalia subacroptera*, *T. carpentariae*, *Ficus spp* and *Pandanus aquaticus*. Its large incisors allow it to chew through the woody nuts of many of these species to access the kernel, and distinctively chewed nuts are a characteristic sign of its presence. This diet is common to all the rock-rats, and information from the more intensively-studied Arnhem Land Rock-rat (Begg and Dunlop 1980, 1985) is probably generally applicable to the Carpentarian Rock-rat.

As with all rock-rats, reproductive output is characteristically low, with females bearing only four nipples. However, growth of young is unusually rapid (Watts and Aslin 1981), perhaps allowing more frequent breeding events. Reproduction in the Arnhem Land Rock-rat has been said to be seasonal (mostly from March to May: Begg 1981) or aseasonal (Calaby and Taylor 1983). Breeding in the Carpentarian Rock-rat has been reported in most months.

There are only very limited data on longevity, sex ratios, territoriality and age structure of Carpentarian Rock-rats. There appears to be a substantial seasonal fluctuation in the abundance of Carpentarian Rock-rats, with relatively low numbers reported from January to June. It is unclear whether this is due to movements away from the habitats sampled in studies based on permanent grids, seasonal changes in trapability or real changes in population numbers.

1.6 Reasons for listing

The Carpentarian Rock-rat is listed as endangered due to its extremely limited total range; small number of fragmented populations within that range; presumed small total population size; specific habitat (and dietary) requirements; and demonstrated deterioration in the condition of that habitat generally (Russell-Smith and Bowman 1992) and specifically for at least one of its four known sites (Banyan Gorge).

1.7 Current threats

Current putative threats common to all known sites are frequent and hot fires and possibly grazing by cattle, both of which can damage the integrity of remnant rainforest patches. Studies demonstrated that the Arnhem Land Rock-rat *Zyomys woodwardi* declined substantially following wildfire (Begg *et al.* 1981). Feral predators (cats) are known to inhabit the area and could have a negative effect on the small and isolated populations of Carpentarian Rock-rats. The actual effects of these putative threatening processes remain a significant gap in our knowledge of Carpentarian Rock-rats.

1.8 Existing conservation measures

There are currently 17 Carpentarian Rock-rats being maintained in a captive breeding colony at the Territory Wildlife Park. PWCNT is currently in the process of establishing a fire management program for each of the known sites under a cooperative management agreement with the land holder. All areas surrounding the four known habitats are currently de-stocked and intended to remain that way for the immediate future.

2.0 Strategy for recovery

2.1 Overall objective

Down-list the Carpentarian Rock-rat to Vulnerable or Conservation Dependent within 10 years of revised Recovery Plan implementation.

2.2 Specific objectives during the implementation of the revised Recovery Plan

1. Develop and implement appropriate management strategies to maintain known populations.
2. Continue research into ecology and population demography to fill current information gaps.
3. Continue to adapt established PVA models as new information becomes available.
4. Maintain a viable captive breeding population.
5. Investigate aspects of the biology of Carpentarian Rock-rats that can be carried out on captive animals.
6. Experimentally release captive bred individuals into a potentially suitable area not currently occupied.
7. Raise the profile of the Carpentarian Rock-rat in the community.

2.3 Recovery criteria.

The criteria for achieving these objectives will be:

1. Maintenance of (or increase in) habitat quality and extent at existing known sites through appropriate fire management, stock exclusion and feral cat management.

This criterion will be satisfied when key habitat parameters and threatening processes are defined, the extent of these is known, fire management and where necessary stock/feral predator exclusion practices are established which maintain (or increase) habitat extent. This criterion will be ongoing.

2. Continue research into ecology and population demography to fill current information gaps. *Significant information gaps have been highlighted by the modelling process (see Brook et al. 2002). This criterion will be satisfied when these knowledge deficiencies have been prioritised and addressed through appropriate research projects and when such information can be incorporated into the conservation management of the species. This will include the collection of adequate spatial data on the available habitat at each site and the identification of habitat critical to the survival of the species. This criterion will be ongoing.*

3. Continue to adapt established PVA models as new information becomes available. *This criterion will be satisfied as iterative models can be generated that include new data collected during the above mentioned research process. It is expected that this criterion will be initially met within one year of implementation and further developed and adapted in an ongoing process.*

4. Maintain a viable captive breeding population. *A strategy for the maintenance of such a breeding colony should be established, and should consider the desirable number taken from the wild (a balance between as large as possible to maintain genetic heterogeneity, and as small as possible to minimise impacts of removal from wild populations); the sources from which the population is derived; optimum sex ratios and age composition; and the number of sites in which the population is housed. The criteria will be satisfied when there is an assurance that the breeding colony would be capable of supplying 20 individuals (or other number determined more precisely with adaptive PVA) to found a new wild colony or restore a colony destroyed by catastrophe. This criterion will be ongoing.*

5. Investigate aspects of the biology of Carpentarian Rock-rats that can be carried out on captive animals. *This criterion will be met when biological data are generated from the captive colony. Longevity, mortality, dietary and breeding biology are all aspects which can be studied in the captive population. This criterion will be ongoing.*

6. Experimentally release captive bred individuals into a potentially suitable area not currently occupied. *Initial modelling suggests that a successful translocation would not significantly reduce*

the species risk of extinction (Brook et al. 2002). However if captive bred individuals are released into a new site as part of a well designed experiment, important information can be gained through monitoring their survival and progress (or extinction). This criterion will be satisfied when an experimental release of individuals results in the collection of useful information relevant to the conservation management of the species. This criterion should be met within three years of Recovery Plan initiation, and monitoring will be ongoing through mark-recapture and radio-tracking methods.

7. Raise the profile of Carpentarian Rock-rats in the community.

This criterion will be satisfied when interpretive materials are available to the general public and there is increased community awareness and involvement in the project. Also when progress and final reports are successfully submitted and publications are accepted in refereed scientific journals. This criterion will be met within four years of Recovery Plan implementation.

3.0 Recovery actions

Action 1.1 Implement fire, cattle and feral predator management strategies that will maintain or increase habitat quality and extent at existing sites

Carpentarian Rock-rats show a clear association with monsoon thickets growing on rocky slopes. Such thickets are vulnerable to hot fires. Management strategies to protect thickets from fires will be developed. These will include annual assessment of fuel loads at thicket margins, fuel reduction burning around thicket edges in the early dry season, and/or fire suppression. Fencing for the exclusion of cattle and trapping for control of feral predators (cats) will be considered for some sites where further research and monitoring highlights the need.

Responsibility: PWCNT, BFC and existing landowner of Wollogorang.

Costs:

Year	1	2	3	4	5	Total
Total	15.8	7.9	7.9	15.3	8.4	55.3

Action 1.2 Establish a formal protected area for known populations

Formal protection measures should be established for at least two known sites. This may include a management agreement with the existing landowner (under Section 74 of the Territory Parks and Wildlife Conservation Act 2000). Any such management agreement should be accompanied by clear guidelines which define management actions and responsibilities aimed at the conservation of Carpentarian Rock-rat. Formal protection measures may also include the declaration of known sites as areas of essential habitat (under section 37 of the Territory Parks and Wildlife Conservation Act 2000).

Responsibility: PWCNT, in association with the existing landowner.

Costs:

Year	1	2	3	4	5	Total
Total	4	2	0	0	0	6

Action 2.1 Continue studies of diet and habitat requirements that will assist in the conservation management of the species

Current and previous studies have described broad patterns of diet for the Carpentarian Rock-rat and closely related species. However, there is little information on within- and between-year variation in food availability, whether Carpentarian Rock-rats depend on surrounding woodland vegetation for food resources, and what factors may be involved in food limitation. This action would investigate diet and food availability, to provide information for habitat management (Action 1) and modelling (Action 3). This should involve consideration of dependency at different times of the year on surrounding vegetation types with changes in diet and food availability; and the identification of further areas of habitat critical to the survival of the species. It may also include consideration of the effects of fire on food availability.

Responsibility: PWCNT.

Costs: included in action 2.2

Action 2.2 Continue studies on population structure and demography

Estimates of total population at known sites are not yet precise, and additional intensive trapping (and mark/recapture) is necessary to determine total population size, and to prioritise actions between known sites. Adequate spatial data are to be collected for the available habitat at each site. The age and sex composition of all known populations should be carefully determined and compared, to examine for signs of declining populations and to provide parameters required for determining age and sex composition of any potential reintroduced population (from captive-bred sources) if necessary in the future.

Responsibility: PWCNT

Costs:

Year	1	2	3	4	5	Total
Total	32.8	27.9	24.1	22.6	0	107.4

Action 3 Establish iterative PVA models that will incorporate new biological information as it becomes available

The long-term persistence of Z. palatalis is threatened by altered fire regimes, grazing by feral animals and stock, weed intrusion, and the stochastic hazards associated with small, fragmented

populations. To assess the relative importance of these threats and develop practical management options, a population and habitat simulation model (PVA) has been developed. This will be used to predict the future fate of the species if current conditions perpetuate, determine the relative sensitivity of various demographic and environmental factors for population viability, and help determine the most effective management strategy. As new information becomes available through monitoring, field experiments and laboratory trials, the PVA model will be iteratively updated, leading to a refinement of management strategies and improved precision of its risk estimates.

Responsibility: Key Centre for Tropical Wildlife Management, PWCNT

Costs:

Year	1	2	3	4	5	Total
Total	10	2	1	1	1	15

Action 4 Maintain a viable captive breeding population

A captive-breeding population has been established at the Territory Wildlife Park, consistent with the stated role of this facility in contributing to the conservation of the NT's threatened fauna (A strategy for the conservation of threatened species and ecological communities in the Northern Territory of Australia). This population will be monitored, maintained and studied. A formal management strategy for this captive population will be established (covering pedigrees, optimum population size, research needs and opportunities, and housing requirements as well as systems in place for rapid reproduction and release where necessary).

Responsibility: TWP

Costs:

Year	1	2	3	4	5	Total
Total	15	15	15	15	15	75

Action 5 Investigate aspects of the biology of Carpentarian Rock-rats that can be carried out on captive animals

Biological data obtained from individuals in the captive populations can be useful in the further development of PVA models as well as the management of the species in the wild. Such information may include, breeding biology, longevity, genetics, dietary preferences, some behavioural information and animal husbandry.

Responsibility: TWP

Costs: Included in action 4

Action 6.1 Experimentally release captive bred individuals into a potentially suitable area currently unpopulated by Carpentarian Rock-rats

According to the outcome of the modelling process (action 3), individuals translocated to an area not currently occupied would not significantly reduce the risk of extinction, given the presumed nature of the processes involved in the habitat degradation. For this reason translocations are no longer being considered as a primary management tool. However, the experimental release of captive bred individuals into a new area would be very useful as a research tool, allowing us to experimentally gauge the suitability of presumably suitable patches located in close proximity to currently occupied patches, measure the maximum intrinsic population growth rate at low densities, and assess the effectiveness/feasibility of low-cost methods of population re-establishment and recovery. ,

Responsibility: PWCNT, TWP.

Costs:

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Total	10.5	5.7	4.3	4.3	0	24.8

Action 6.2 Monitor survival of experimental release individuals

The released individuals should be monitored as part of an experiment for at least three years from the time of release. This will involve immediate radio-tracking of some individuals and PIT tagging (for mark-recapture analysis) of all individuals released. Successive trapping efforts will then be used to determine the survivorship, changes in weight or condition, and reproductive effort of the population.

Responsibility: PWCNT, TWP.

Costs:

Year	1	2	3	4	5	Total
Total	12.2	10.1	7.7	7.3	3.8	41.1

Action 7.1 Operate the Recovery Team

The establishment of a Recovery Team, comprising representatives of the diversity of interested parties, charged with prioritising and scrutinising research and management actions is considered the most acceptable means of implementing recovery plans. The case of the Carpentarian Rock-rat is unusual. Its occurrence is remote from the base of most agencies or NGOs. Its entire known range lies within one pastoral property. PWCNT has been largely responsible for the conservation of this species to date. A small Recovery Team has now been established from a core group of stakeholders who have been consulted throughout the duration

of the project thus far. Active consultation with the land holder will continue and expert advice will be sought from Recovery Team representatives from Territory Wildlife Park, Bushfires council of the Northern Territory and the Key Centre for Tropical Wildlife Management. Recovery Team meetings will be held once a year. The operation of the Recovery Team will be administered by PWCNT as the lead agency and team members will meet their own costs to attend meetings.

Responsibility: Recovery Team members, PWCNT

Costs:

Year	1	2	3	4	5	Total
Total	1	1	1	1	1	5

Action 7.2 Produce publications, reports, education and interpretive materials

Interpretive materials on the species and the recovery project should be produced for public utilisation. These might be displayed at Wollogorang Station Homestead and at the Territory Wildlife Park as well as distribution through media releases and educational materials for the PWCNT community education unit. Information and results gained from the actions of the recovery plan should be used to publish reports in a range of media including popular science magazines, refereed journals, internal reports and progress and annual reports to funding agencies

Responsibility: PWCNT, TWP.

Costs:

	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Total	5.1	12.6	2.5	2.5	2.5	25.2

Implementation schedule

action	description	priority	Feasibility	Responsibility	Cost estimate (\$000)					
					Year 1 (2002)	Year 2 (2003)	Year 3 (2004)	Year 4 (2005)	Year 5 (2006)	total
1.1	Habitat management	1	90%	PWCNT & Landowner	15.8	7.9	7.9	15.3	8.4	55.3
1.2	Protected area	1	90%	PWCNT & landowner	4	2	0	0	0	6
2.1	Diet and habitat requirements	2	90%	PWCNT	*	*	*	*	*	*
2.2	Population structure and demography	2	90%	PWCNT	32.8	27.9	24.1	22.6	0	107.4
3	Modelling	3	100%	KCTWM & PWCNT	10	2	1	1	1	1
4	Captive breeding colony	1	80%	TWP	15	15	15	15	15	75
5	Captive colony research	3	90%	TWP	0	0	0	0	0	0
6.1	Experimental release	3	90%	PWCNT & TWP	10.5	5.7	4.3	4.3	0	24.8
6.2	Monitor experimental release	3	100%	PWCNT	12.2	10.1	7.7	7.3	3.8	41.1
7.1	Recovery Team	1	100%	Recovery Team	1	1	1	1	1	5
7.2	Education and interpretation	3	100%	PWCNT & TWP	5.1	12.6	2.5	2.5	2.5	25.2

*Costing of 2.1 included in 2.2

4.0 International Obligations

As Carpentarian Rock-rats are not listed under any international agreement, the implementation of Australia's international environmental responsibilities are not affected by this plan.

5.0 Role and interests of indigenous people

There are no indigenous communities directly involved in the small area affected by this plan. Therefore no role has been identified for indigenous communities in the recovery of this species.

6.0 Social and economic impacts

The implementation of this recovery plan is unlikely to cause any significant adverse social and economic impacts.

Acknowledgements

We thank Barry Brooke and Colleen O'Malley for comments on the drafts of this revised Recovery Plan. Our work to date on this species has benefited from the contributions of Sue Churchill, and Jeremy Russell-Smith and the financial support of Environment Australia, Endangered Species Program (a program of the Natural Heritage Trust). Thanks to the staff at Territory Wildlife Park for caring for the captive population.

Bibliography

- Baillie, J. and Groombridge, B. (compilers and editors) (1996). *IUCN Red List of Threatened Animals*. IUCN, Gland, Switzerland.
- Begg, R.J. (1981). The small mammals of Little Nourlangie Rock, N.T. IV. Ecology of *Zyomys woodwardi*, the Large Rock-rat, and *Zyomys argurus*, the Common Rock-rat (Rodentia: Muridae). *Australian Wildlife Research* **8**, 307-320.
- Begg, R.J., and Dunlop, C.R. (1980). Security eating, and diet in the Large Rock-rat, *Zyomys woodwardi* (Rodentia: Muridae). *Australian Wildlife Research* **7**, 63-70.
- Begg, R.J., and Dunlop, C.R. (1985). The diets of the Large Rock-rat *Zyomys woodwardi* and the Common Rock-rat *Zyomys argurus* (Rodentia: Muridae). *Australian Wildlife Research* **12**, 19-24.
- Begg, R.J., Martin, K.C., and Price, N.F. (1981). The small mammals of Little Nourlangie Rock, N.T. V. The effects of fire. *Australian Wildlife Research* **8**, 515-527.
- Brook, B.W., Griffiths, A.D., and Puckey, H.L. (2002). Modelling strategies for the management and recovery of the critically endangered Carpentarian Rock-Rat (*Zyomys palatalis*) in northern Australia. *Journal of Environmental Management* **65**:335-368..
- Burbidge, A.A., and McKenzie, N.L. (1989). Patterns in the modern decline of Western Australia's vertebrate fauna: causes and conservation implications. *Biological Conservation* **50**, 143-198.
- Calaby, J.H., and Taylor, J.M. (1983). Breeding in wild populations of Australian Rock-rats, *Zyomys argurus* and *Z. woodwardi*. *Journal of Mammalogy* **64**, 610-616.
- Churchill, S.K. (1996). Distribution, habitat and status of the Carpentarian Rock-rat, *Zyomys palatalis*. *Wildlife Research* **23**, 77-91.
- Kitchener, D.J. (1989). Taxonomic appraisal of *Zyomys* (Rodentia, Muridae) with descriptions of two new species from the Northern Territory, Australia. *Records of the Western Australian Museum* **14**, 331-373.
- Lee, A.K. (1995). *The Action Plan for Australian rodents*. (ANCA: Canberra).
- Liddle, D.T., Russell-Smith, J., Brock, J., Leach, G.J., and Connors, G.T. (1994). *Atlas of the vascular rainforest plants of the Northern Territory*. Flora of Australia Supplementary Series no. 3. (Australian Biological Resources Study: Canberra).
- Menkhorst, K.A., and Woinarski, J.C.Z. (1992). Further records of the Carpentarian Rock-rat, *Zyomys palatalis*, from the Gulf region of the Northern Territory. *Northern Territory Naturalist* **13**, 40-41.
- Puckey, H.L. (1999) *Carpentarian rock-rat (Zyomys palatalis): Final report to Environment Australia, Endangered Species Program*. Parks and Wildlife Commission of the Northern Territory, Katherine.
- Russell-Smith, J. (1991). Classification, species richness and environmental relations of monsoon rain forest in northern Australia. *Journal of Vegetation Science* **2**, 259-278.
- Russell-Smith, J., and Bowman, D.M.J.S. (1992). Conservation of monsoon rainforest isolates in the Northern Territory, Australia. *Biological Conservation* **59**, 51-63.
- Trainer, C. (1996). Carpentarian Rock-rat (*Zyomys palatalis*): survey to clarify species status. Report to ANCA. (CCNT: Darwin). Watts, C.H.S., and Aslin, H.J. (1981). *The rodents of Australia*. (Angus & Robertson: Sydney).
- Wurst, D. (1990). Survey for the Central Rock-rat, *Zyomys pedunculatus*, in the Alice Springs region. Report to ANCA. (CCNT: Alice Springs).